City of Richmond

Community Energy and Emissions Plan

January 2014

4042672

Summary

Introduction

A Community Energy and Emissions Plan (CEEP) is a strategic plan that furthers Richmond's efforts to manage energy use and reduce community carbon emissions. It defines the municipality's role—working in partnership with others—in facilitating energy efficiency in the community, developing local energy sources, and reducing the greenhouse gas (GHG) emissions that form our "carbon footprint". An energy strategy will assist Richmond in achieving the sustainable community vision defined in its 2041 Official Community Plan (OCP).

The CEEP objectives are to:

- Define actions that support the 2041 OCP reduction targets and related energy-efficiency initiatives
- Identify opportunities to reduce energy in areas not addressed by the 2041 OCP
- Quantify the impact of these actions and determine the energy consumption and GHG emissions for the duration of the 2041 OCP

Context

Scientific evidence increasingly indicates that GHG emissions are contributing to global climate change and that the level of these emissions must be reduced in order to forestall dramatic changes to our climate systems. The Province of British Columbia requires all local governments to include a GHG reduction targets in their OCPs and to define policies and actions to achieve these targets. The City of Richmond previously completed CEEP Phase 1 in 2010. This report presented the potential community energy and GHG emissions reductions and informed Richmond's OCP reduction targets.

Where are we now?

While Richmond's 2013 population is estimated to be 205,000[1], this plan is based on 2010 estimates. 2010 is the date of the most recent Community Energy and Emissions Inventory (CEEI) data to be released by the Province as well as the year Richmond adopted community-wide reduction targets.

Richmond's population was approximately 195,000[2] in 2010, and the total amount of non-residential floor space was approximately 66 million square feet in 2009[3]. In 2010 the residents and businesses in the community consumed about 20 million GJ of energy. The estimated cost of this energy was $440 million—roughly $2,250 per resident—and the "carbon footprint" of the community was equivalent to 900,000 tonnes CO_2, or 4.5 tonnes per person annually (Figures S-1 and S-2).

[1] City of Richmond Projection with Urban Futures Inc., March 2013.

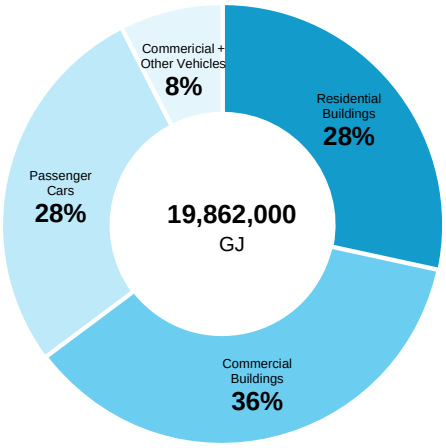
[2] BC Stats Population Estimates, September 2012.

[3] City of Richmond 2041 OCP Update – Employment Lands Strategy, 2011.

Where are we headed?

Between now and the 2041 OCP horizon date, the population of Richmond is forecasted to grow by 80,000 residents, reaching a total population of almost 280,0004. The non-residential floor space is also projected to increase, reaching approximately 88 million square feet by 20415. There are a number of initiatives already underway that have slowed the increase of energy and emissions. These efforts, including Federal vehicle fuel efficiency standards, Provincial building requirements of the BC Building Code, and Richmond's land use planning defined in the 2041 OCP, contribute to increased efficiency in the community and help stabilize GHG emissions near the 2010 level. However, further actions are required to achieve substantive overall reductions beyond the current policy trend.

Figure S-1. Richmond 2010 Energy Consumption



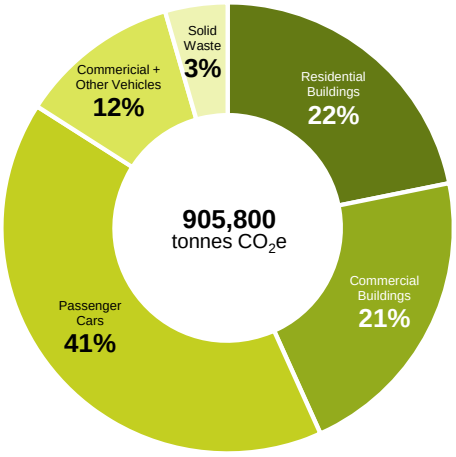
Where do we want to be?

CEEP Phase 1 defined an energy vision for Richmond to be "*an energy-wise and low-carbon community that supports a robust local economy, a healthy environment, and a safe, equitable, diverse, and resilient community.*"

The City also adopted the following community-wide energy and emissions targets:

- GHG emissions reduction targets of 33% below 2007 levels by 2020, and 80% below 2007 levels by 2050
- Energy use reduction target of 10% below 2007 levels by 2020

Figure S-2. Richmond 2010 GHG Emissions



How do we get there?

CEEP Phase 2 defines 14 strategies and 34 implementation actions developed to align with the 2041 OCP policies and objectives. The identified actions achieve significant reductions in energy use and GHG emissions (Table S-1). While this plan does not identify sufficient actions to reach the long-term targets, the per capita reductions demonstrate the scale of the change (Table S-2) and the "carbon wedge" diagram illustrates the CEEP's impact (Figure S-3).

[4] City of Richmond 2041 OCP Update: Demographics, Housing and Employment Projections Study, 2010.

[5] City of Richmond 2041 OCP Update: Employment Lands Strategy, 2011.

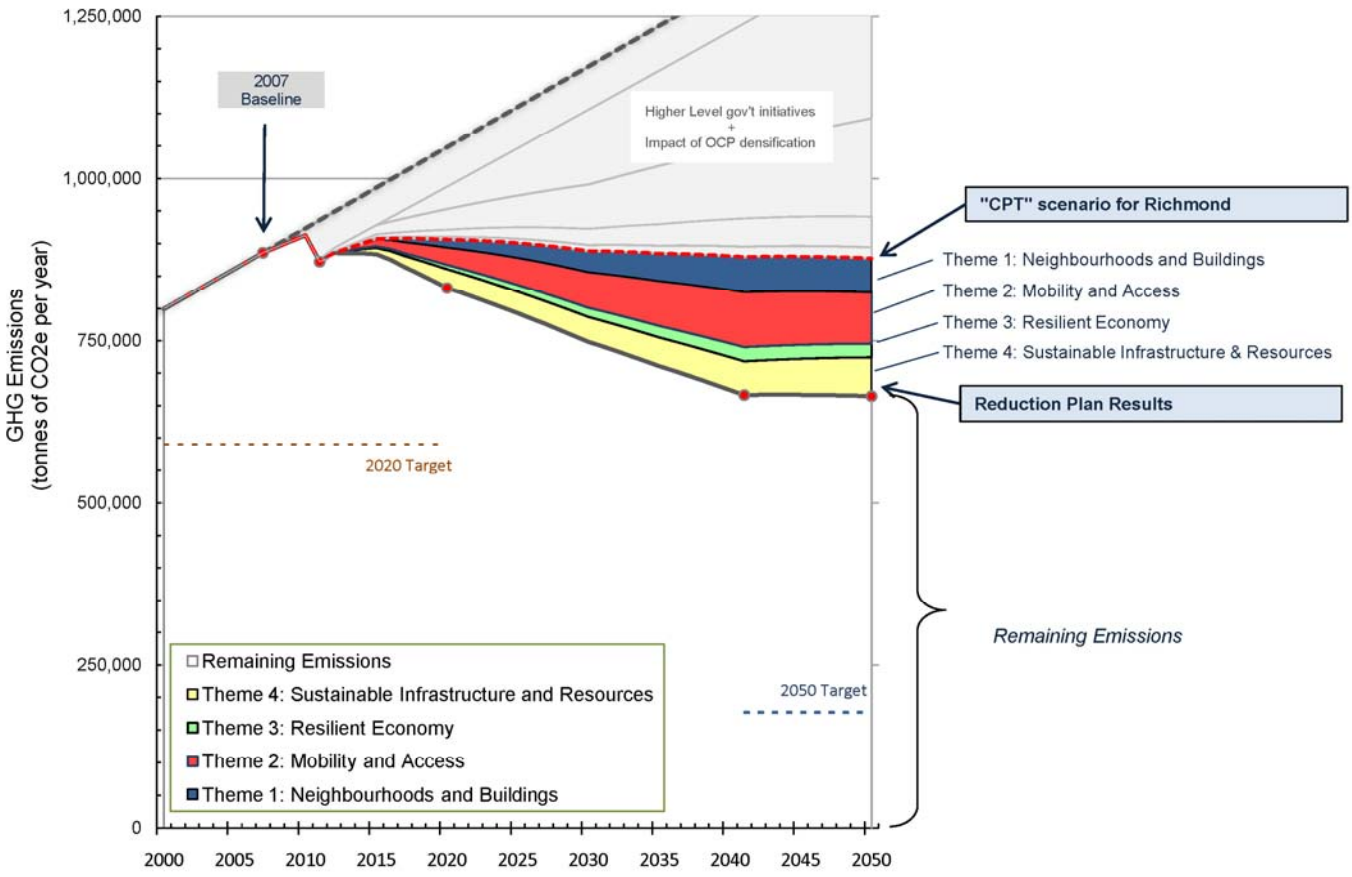
Table S-1: Current Policy Trend (CPT) and Energy Plan Reduction Scenario: Total Community Impact

Item (% compared to 2007 baseline)	**CPT**	**Reduction Scenario**	**OCP Target**
2020 GHG Emissions	+ 2 %	- 6 %	- 33 %
2050 GHG Emissions	- 1 %	- 25 %	- 80 %
2020 Energy Consumption	+ 2 %	- 3 %	- 10 %

Table S-2: Current Policy Trend (CPT) and Energy Plan Reduction Scenario: Per Capita Impact

Item (% compared to 2007 baseline)	**CPT**	**Reduction Scenario**
2020 GHG Emissions	- 14 %	- 21 %
2050 GHG Emissions	- 38 %	- 53 %
2020 Energy Consumption	-14 %	-18 %

Figure S-3: Carbon Reduction Wedge for the Reduction Scenario



"Breakthrough" Opportunities

The actions identified in this plan are not projected to reach the reduction targets. In order to explore opportunities that extend beyond the plan, estimated impacts of "breakthrough opportunities" are identified. The opportunities considered are the complete conversion of passenger vehicles to electric, carbon zero new buildings, and the massive renovation of the existing building stock.

These reductions are not achievable without larger shifts including additional Federal and Provincial regulatory change, aggressive industry development or global pricing changes for energy or carbon. However, they do highlight that there are opportunities today that could yield additional dramatic reductions towards the City's community-wide targets. Given the target dates, widespread application of these opportunities may be plausible during the timeframe for the plan.

Implementation

Plan implementation will require both existing and new resources. The 2041 OCP establishes the foundation for this plan and many of the actions are closely aligned with existing planning resources. Other actions may require additional resources for development and/or implementation. These needs could be identified through a plan review 5 to 7 years following adoption.

Richmond Community Energy & Emissions Plan Summary At A Glance

2050 FORECAST

Population

2007 195,000 → 2050 300,000

GHG Emission Target from 2007 levels

2020 -33% 2050 -80%

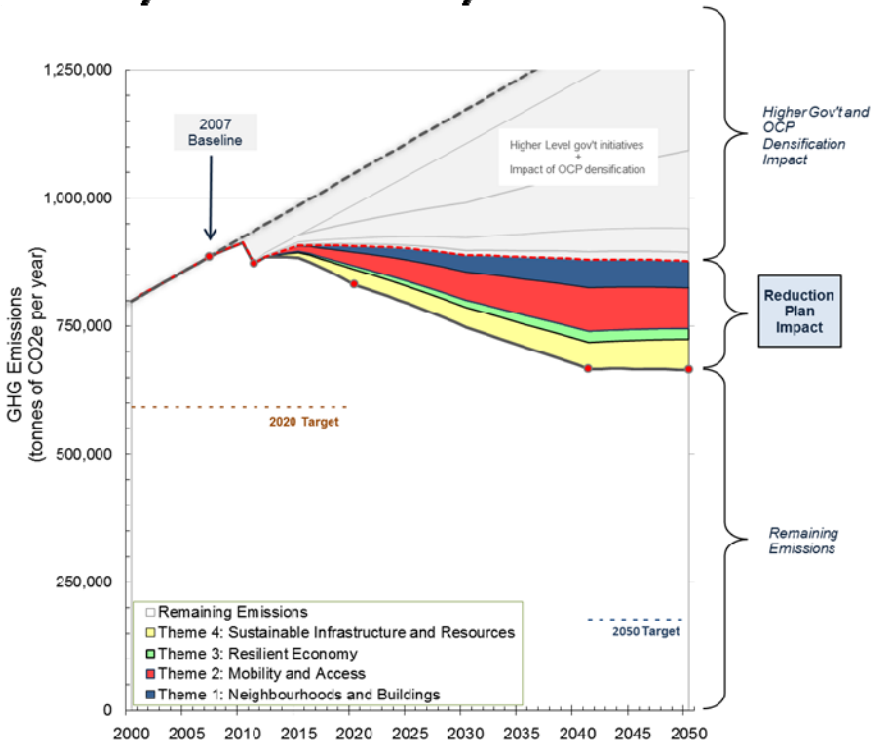
Total GHG Emissions (CO_2e)

2010 906,000 → 2050 665,000

Per Capita GHGs (CO_2e)

2010 4.6 → 2050 2.2

Summary of GHG Reductions by Plan Theme



Key Strategies in Richmond's Reduction Plan:

- Integrating Neighbourhood Centre planning with transit planning
- Promoting and incenting energy efficiency and alternative energy in new and existing buildings
- Prioritizing and funding walking, rolling and cycling infrastructure and connectivity
- Continuing advancement of District Energy systems
- Maximizing waste diversion

Summary List of Actions

Theme 1: Neighbourhoods and Buildings

Strategy 1: Integrate Future Neighbourhood Centre Planning with Transit Planning

Action 1# Review Neighbourhood Centre development sequencing for flexibility
Action 2# Collaborate with TransLink to update the Area Transit Plan (ATP)

Strategy 2: Increase Energy Efficiency in New Developments

Action 3# Include energy efficiency in Neighbourhood Centre planning
Action 4# Promote energy efficiency in all rezoning
Action 5# Develop incentives for new development to exceed the building code energy requirements
Action 6# Ensure that existing building code requirements are attained

Strategy 3: Improve the Performance of Existing Building Stock

Action 7# Promote building efficiency through outreach and education
Action 8# Provide incentives for building retrofit action
Action 9# Develop a residential energy conservation program to support housing affordability

Theme 2: Mobility and Access

Strategy 4: Prioritize and Fund Walking, Rolling and Cycling

Action 10#Prioritize walking, rolling and cycling infrastructure
Action 11#Continue a “Complete Streets” approach in all new street construction and rehabilitation projects

Strategy 5: Enhance Alternative Transportation Connectivity

Action 12#Improve pedestrian links throughout the city as the top transportation priority
Action 13#Focus on providing safe school routes

Strategy 6: Facilitate Changes in Transportation Behaviour and Mode Choice

Action 14#Implement Transportation Demand Management projects that incentivize non-vehicle mode choice and disincentivize vehicle use
Action 15#Reduce supply of unrestricted City-owned parking spaces
Action 16#Provide infrastructure improvements to support increased transit service
Action 17#Improve bike facilities and consider implementing a bike share system

Strategy 7: Promote Low Carbon Personal Vehicles

Action 18#Set minimum requirements for EV infrastructure in new developments
Action 19#Continue expanding the City-owned network of EV charging stations

Theme 3: Resilient Economy

Strategy 8: Encourage Energy Efficient Businesses

Action 20#Promote energy efficient business operations

Theme 4: Sustainable Infrastructure and Resources

Strategy 9: Continue Advancement of Neighbourhood District Energy Systems

Action 21#Reserve district energy rights of ways in new developments and road reconstruction
Action 22#Develop a City Centre DE Right of Way Master Plan
Action 23#Explore opportunities to connect existing buildings to DE system
Action 24#Explore options for electricity generation from utility scale renewable sources
Action 25#Integrate energy infrastructure into community planning

Strategy 10: Utilize Local Energy Sources

Action 26#Promote building scale renewable energy

Strategy 11: Maximize Use of Waste

Action 27#Continue to implement the Integrated Solid Waste and Resource Management Plan
Action 28#Continue to implement the Integrated Liquid Waste and Resource Management Plan

Theme 5: Climate Change Leadership

Strategy 12: Encourage Sustained Action by Senior Levels of Government

Action 29#Continue to advocate for support from senior levels of government

Strategy 13: "Lead by example" with City Operations Energy Management

Action 30#Develop long-term funding for climate activities in the city
Action 31#Integrate climate change into other municipal activities
Action 32#Provide incentives to encourage alternative transportation use by staff
Action 33#Define a climate change portfolio / staff person

Strategy 14: Engage the Community on Climate Action

Action 34#Develop an outreach program to residents and businesses on climate action

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Acronyms and Abbreviations

ADEU	Alexandra District Energy Utility
CPT	Current policy trend
Bill 27	Local Government (Green Communities) Statutes Amendment Act (Bill 27, 2008)
CARIP	Climate Action Revenue Incentive Program (CARIP) is a Province of BC grant program to reimburse the carbon tax paid by municipalities that have signed the Climate Action Charter
CAS	Climate Action Secretariat (of the BC Ministry of Environment)
Charter	Climate Action Charter
CEEI	Community Energy and Emissions Inventory
CEEP	Community Energy and Emissions Plan
CO_2	Carbon dioxide
CO_2e	Equivalent carbon dioxide is the measure of CO_2 that has the same global warming effect as a measured greenhouse gas (e.g. 1 tonne of methane has the equivalent impact as 25 tonne of CO_2)
DA	Dissemination area is a Statistics Canada subdivision of a community (i.e. Richmond is divided into about 250 dissemination areas)
FCM	Federation of Canadian Municipalities
GHG	Greenhouse gases are gases that trap heat in the earth's atmosphere; the dominant greenhouse gas resulting from human activity is carbon dioxide (from fossil fuel combustion), followed by methane (from solid waste and agriculture)
GJ	A unit of energy roughly equivalent to the energy of an average tank of gasoline
LGA	Local Government Act
OCP	Official Community Plans are developed by municipalities in BC—typically with significant public consultation—to articulate a longer-term vision for the community; they guide decisions about land use, planning, and the general purposes of local government
PCP	Partners for Climate Protection (PCP) is an Federation of Canadian Municipalities initiative
RGS	Metro Vancouver Regional Growth Strategy
t	Metric tonne is equal to 1,000 kilograms
vkt	Vehicle kilometres travelled

1 Introduction

1.1 What is a Community Energy and Emissions Plan?

A Community Energy and Emissions Plan (CEEP) is a strategy to manage community-wide energy use and GHG emissions. It identifies objectives, policies and actions. It also defines the City's role—working in partnership with others—in facilitating energy efficiency in the community, developing local energy sources, and reducing GHG emissions.[6]

1.2 Why have an Energy Plan?

Although it is not a legislated requirement for BC local governments to complete a CEEP, a plan supports the municipality in addressing the legislated requirements to reduce community-wide GHG emissions. An energy strategy supports the sustainable community vision defined in the 2041 OCP and delivers strategic benefits:

- Energy cost reduction to residents and businesses through more efficient energy use
- GHG emissions reduction to diminish the community's contribution to global climate change
- Improved air quality by reducing the air pollutants released from the combustion of fossil fuels especially from transportation
- Increased security from energy price and supply variability through more diversified and localized energy sources
- Job creation and business opportunities through green economy promotion
- Increased sustainability by aligning energy conservation with other OCP objectives such as a more efficient infrastructure, walkable neighbourhoods, protected farmland and natural areas, and compact, complete communities.

[6] A number of terms are commonly used to describe the emissions that create climate change including: greenhouse gases–abbreviated as GHGs, carbon emissions, and the carbon 'footprint' of our energy use. For the purposes here, these all refer to the greenhouse gas emissions of the community and can be used interchangeably. While the term GHG is more technically accurate, carbon emissions and carbon footprint are more commonly used in popular communication.

1.3 Plan Objectives

For the past several years, Richmond has taken action to develop a more sustainable urban environment. Initiatives include more compact and complete neighbourhoods, incorporation of rapid transit, development of low carbon district energy systems, and implementation of alternative transportation infrastructure. Recent planning and policy initiatives include the development of a sustainability framework, the City Centre Area Plan (CCAP), and an updated 2041 OCP defining a direction for a more sustainable community.

The CEEP builds on this foundation with objectives to:

- Define actions that support the 2041 OCP reduction targets and related energy-efficiency initiatives
- Identify opportunities to reduce energy in areas not addressed by the 2041 OCP
- Quantify the impact of these actions and determine the energy consumption and GHG emissions for the duration of the 2041 OCP

2 Context for Action

2.1 Global Climate Change

There is increasing evidence that raised levels of carbon dioxide and other greenhouse gases is impacting the climate globally. The *Fourth Assessment Report* (2007) of the Intergovernmental Panel on Climate Change (IPCC) states that the consensus of scientific opinion is that:

- Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level
- Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in human-caused GHG concentrations

In addition, climate change is expected to have serious negative effects on global economic growth and development. The British government commissioned the independent economic *Stern Review* in 2005 which concluded that "the benefits of strong and early action far outweigh the economic costs of not acting."[7] Using results from economic models, the *Stern Review* estimated that, without action, the overall costs and risks of climate change will be equivalent to losing at least 5% and potentially as much as 20% of global Gross Domestic Product (GDP) annually. In contrast, the costs of implementing actions to reduce GHG emissions and mitigate the impacts of climate change may be limited to 1% of global GDP annually.

2.2 Action by Senior Levels of Government

2.2.1 Global Action

The United Nations General Assembly endorsed action on climate change by establishing the IPCC in 1988. Since the panel's founding, there have been a number of international protocols and accords, including the Kyoto Protocol, that articulate each country's commitment to reduce GHG emissions. Subsequent policy commitments have followed as part of standing IPCC meetings.

[7] Nicholas Stern. *The Economics of Climate Change: The Stern Review*. Cambridge University Press, January 2007. http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

2.2.2 Federal Initiatives

The Canadian government has made commitments to reduce GHG emissions and has developed related policies, programs and initiatives. Legislation, targets and actions that affect Richmond's community-wide emissions include:

- **National Reduction Target** to reduce GHG emissions by 17 percent, relative to 2005 levels, by 2020 (2010)
- **Passenger Vehicle and Light Truck Greenhouse Gas Emission Regulations** under the *Canadian Environmental Protection Act* (CEPA) creating national vehicle fuel efficiency standards harmonized with the U.S. (2010); new vehicles sold in 2017 are projected to be an average of 25% more efficient relative to 2008, and further consultation is underway to reduce GHG emissions from cars and light trucks by 50% relative to 2008 by 2025[8]
- **Heavy-Duty Vehicle and Engine Greenhouse Gas Emissions Regulations** under CEPA creating national vehicle fuel efficiency standards harmonized with the U.S. (2013); new vehicles sold in 2018 will be up to 23% more efficient relative to 2008[9]

2.2.3 Provincial Initiatives

Since 2007, the Province has proceeded with a number of initiatives to reduce GHG emissions, including:

- **Greenhouse Gas Reduction Targets Act (Bill 44)** to reduce GHG emissions by 33 percent by 2020 and 80 percent by 2050, relative to 2007 levels (2007)
- **BC Climate Action Plan** supporting Bill 27 and estimated to achieve 73% of the reductions required to meet the target; the Plan and subsequent legislation included the BC carbon tax ($30 per tonne as of 2012)
- L**ocal Government (Green Communities) Statutes Amendment Act (Bill 27)** requiring local governments to includes targets, policies and actions to reduce GHG emissions in their OCPs (2008)
- **BC Climate Action Charter** encouraging local governments to be carbon neutral in their corporate operations beginning in 2012 (2007)[10]
- **Clean Energy Act** defines energy objectives including electricity self-sufficiency, GHG emissions reductions, clean and renewable energy investment, and meeting two-thirds of new demand through conservation and demand management (2010)

[8] Government of Canada Gazette "Regulations Amending the Passenger Automobile and Light Truck Greenhouse Gas Emissions Regulations", accessed March 2013 at http://www.gazette.gc.ca/rp-pr/p1/2012/2012-12-08/html/reg1-eng.html

[9] Environment Canada New Release "Canada Continues to Align Greenhouse Gas Emissions Measures with the United States", accessed March 2013 at http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=3FC39747-ABF2-470A-A99E-48CA2B881E97

[10] Carbon neutrality means that efforts are made to reduce emissions, and that carbon offsets are purchased to offset any emissions that cannot be reduced

2.2.4 Regional Context

Richmond is an island municipality situated at the west end of the Fraser River delta. Approximate 50 of the 130 square kilometre land area—generally the eastern half of the island—is within the Agricultural Land Reserve.

Richmond is the fourth most populated city in Metro Vancouver[11] after Vancouver, Surrey and Burnaby. The regional guidance for land use policies and development is the *2040 Regional Growth Strategy* (RGS). The RGS delineates urban growth boundaries to preserve agricultural, industrial and natural areas and to focus residential and commercial growth to specific areas. Following the adoption of the RGS the City developed a Regional Context Statement demonstrating that the 2041 OCP supports the RGS vision, goals and strategies. Richmond's City Centre is designated in the RGS as a "Regional City Centre" where significant urban growth is appropriate.

Metro Vancouver is also a key facilitator of regional waste management, completing the *Integrated Solid Waste and Resource Management Plan* (ISWRMP) and *Integrated Liquid Waste and Resource Management Plan* (ILWRMP) in 2010. The primary goal of the ISWRMP is to reduce waste through diversion and energy recovery, with a goal of diverting 80% of waste by 2020. The ILWRMP seeks to protect the environment and public health and to develop opportunities to use sewerage as an energy and materials resource. These targets and goals are only achievable through the commitments and actions by Richmond and other member municipalities in cooperation with Metro Vancouver.

The regional transportation authority, TransLink, plans and manages the transportation system including major roads, transit and pathways. Among TransLink's *Transport 2040* goals are reduced transportation GHG emissions, increased mode split with non-auto trips as the primary modes of transportation, alignment of new housing and jobs with the frequent transit network and the efficient movement of goods. TransLink completed the Canada Line rapid transit system in 2010, linking Richmond City Centre to the airport and Vancouver. Transit routes within Richmond are defined through the Area Transit Plan (2000) with the next revision planned in 2014. The 2041 OCP articulated a long-term concept for the transit network in 2041 that links future neighbourhood centres with frequent transit routes, reducing both GHG emissions and passenger car reliance.

2.3 Previous Action by Richmond

The City plays a significant role in reducing community-wide energy use and GHG emissions. Recent initiatives include:

- **City Centre Area Plan**

  Planning for significant levels of growth in the City Centre area, the 2009 City Centre Area Plan provides opportunities for residents to live, work, play and learn in a sustainable, high-amenity environment. By concentrating much of the City's growth, the area plan reduces sprawl and protects industrial areas, farmland and established single-family neighbourhoods (City Centre Area Plan section 1.1). Supportive policies include transit-oriented development, reduced parking, and improved pedestrian and cycling links. Policy 2.5.2(a) requires LEED Silver equivalent for private developments.

[11] Metro Vancouver is a Regional District (RD) under the Local Government Act. RDs provide services to municipalities and unincorporated areas within the geographic boundary. RDs are not specifically "higher levels of government", however, they do perform functions that span across several municipalities – thus operating with a perspective beyond the city's boundaries.

- **Official Community Plan Update**

  The 2041 OCP "Moving Towards Sustainability", adopted in 2012, guides the City's land use planning and policies based on a long-term vision of a sustainable community. The OCP provides clear direction that the majority of growth will be focused in the City Centre and that the remaining development will be accommodated along designated arterial roads and in proximity to Neighbourhood Centres. Policies include shifting transportation priorities to pedestrian, cyclists and transit users. The OCP includes targets for reducing energy and GHG emissions, with the emissions targets aligned with the Provincial target.

- **CEEP Phase 1**

  In response to the Province's Bill 27 requirement that local governments establish GHG reduction targets in their respective OCPs, Richmond completed a high-level analysis of the potential for community-wide energy conservation and GHG reductions. The analysis estimated energy reductions of 7-12% by 2020 and 15-21% by 2050 from 2007 levels were potentially achievable. The associated GHG emissions were calculated to be 20-26% by 2020 and 33-41% by 2050.

- **Corporate Energy Management**

  The City signed the BC Climate Action Charter in 2008 and made a voluntary commitment to the Province to become carbon neutral in its corporate operations. Richmond annually reports its progress towards this goal. The City has undertaken significant efforts to reduce energy consumption in its facilities, fleets and operations.

- **District Energy (DE)**

  Richmond is actively developing district energy systems and has incorporated the municipally owned Lulu Island Energy Company (LIEC). Several feasibility studies have been completed and Alexandra District Energy Utility (ADEU) began operating in 2012 (

  Figure 1). ADEU provides heating, cooling and domestic hot water to the developing West Cambie neighbourhood through a geoexchange system. At full buildout the system will serve over 3,000 residents and a total of 3.9 million square feet of residential, commercial, office and institutional space. Other study areas and policies related to district energy include:

  - Emerging City Centre subareas River Green (2.7 million square feet), North City Centre (6 million square feet potential), and City Centre main (6.3 million square feet potential)
  - City Centre district energy ready practice requiring new developments to utilize compatible hydronic heating systems
  - City Centre heat demand mapping to quantify total, projected thermal load
  - Heat recovery from the Metro Vancouver Lulu Island Wastewater Treatment Plant providing on-site and/or Steveston area building conditioning

- **Electric Vehicle Charging Stations**

  Richmond, with grant funding from the Province, installed ten EV charging stations in five civic locations in 2013 for public and fleet use

- **Active Transportation Dedicated Budget**

  Council consolidated existing funding programs in 2013 to create a dedicated budget for active transportation improvements

- **Transportation Demand Management (TDM) Measures**

  TDM measures are required in new developments to relax parking requirements. Measures include EV charging outlets, bicycle parking and storage, end-of-trip facilities and dedicated parking spaces for car-share vehicles

- **Solid Waste Strategic Program**

  Richmond has identified strategies and actions to reach its targets of 70% solid waste diversion by 2015 and 80% by 2020. These targets are aligned with Metro Vancouver's regional goals. City actions include a Green Cart program to increase diversion of compostable material in single-family areas and an expansion of the food scraps program to townhouse developments

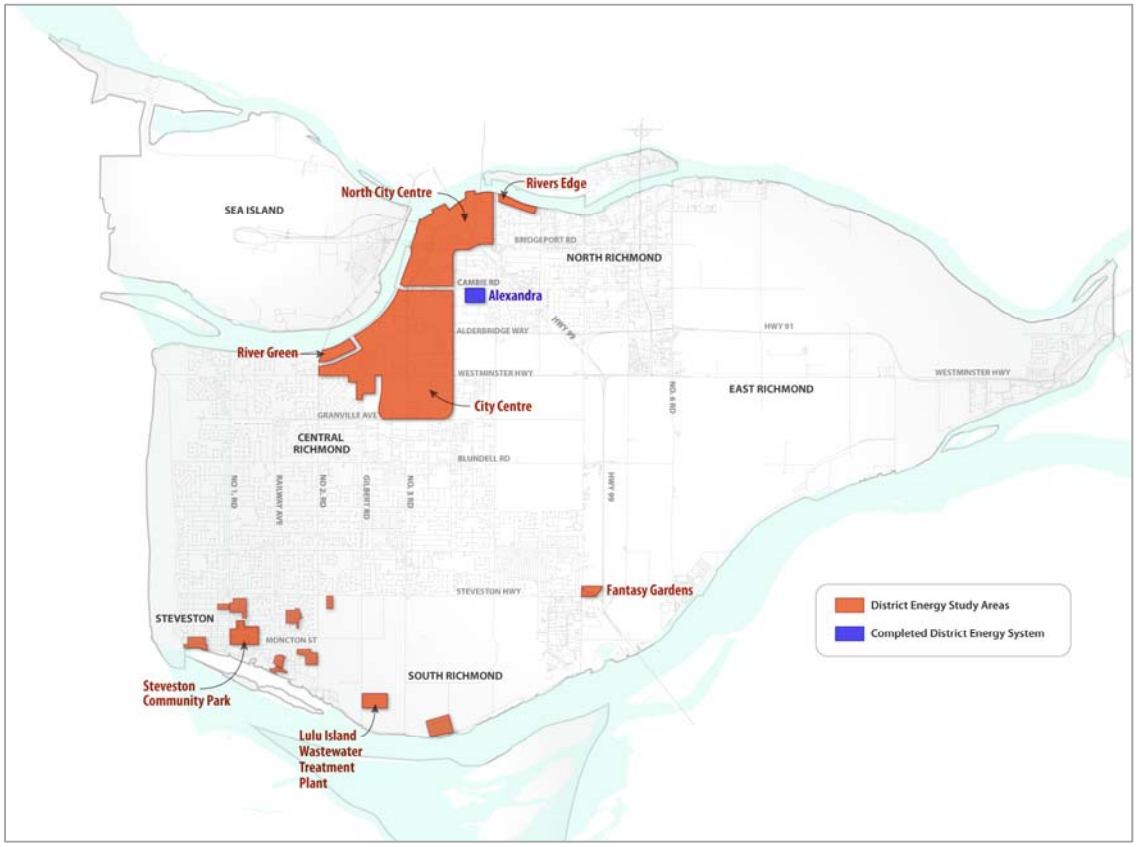
- **Climate Change and Energy Efficiency Awareness Programs**

  The City supports energy awareness initiatives such as the Climate Action Showdown in schools, Climate Smart Initiative for businesses undertaking GHG emissions inventories and business case analysis, and BC Hydro and FortisBC incentive program promotion

- **Sustainability Framework**

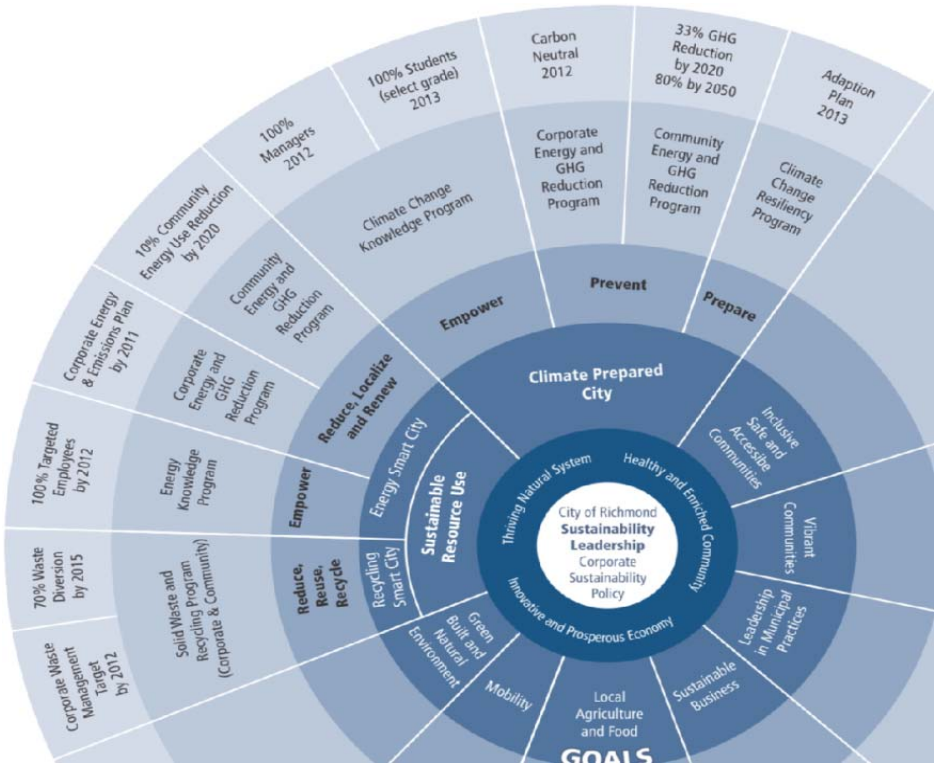
  This framework guides City policy decisions to consider opportunities and impacts in each of nine theme areas (Figure 2). Currently under development, additional actions, strategies and targets will be identified for the remaining community goals

Figure 1. District Energy Study Areas in Richmond



Note: Not all study areas have been determined to be feasible through analysis

Figure 2. Richmond Sustainability Framework Schematic (2010)



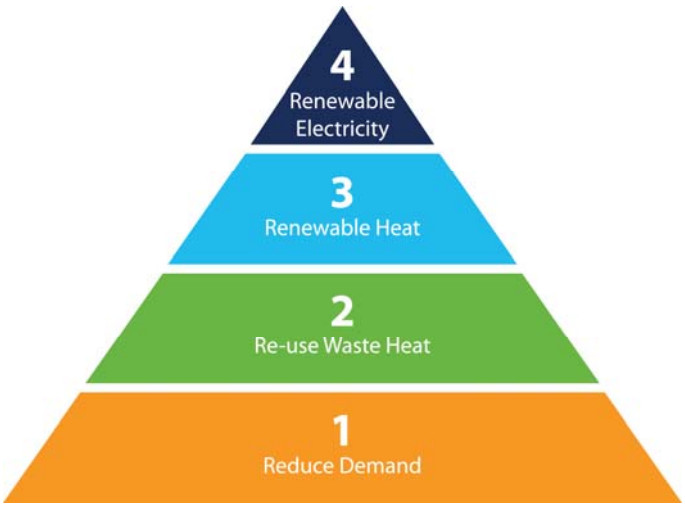
2.4 BC Hydro Promotion of Energy Planning

BC Hydro's Sustainable Communities Program supports the development and implementation of energy efficiency and renewable energy initiatives in BC communities. The program recognizes the primacy of identifying opportunities for conservation (i.e. reduce demand) prior to determining renewable energy alternatives (Figure 3). This hierarchy, developed by BC Hydro, presents the relative priorities of energy conservation strategies:

1. **Reduce Demand**
   Identify opportunities to reduce energy inputs needed including more efficient technologies (e.g. better insulation in building walls) and behaviours (e.g. using power bars to decrease standing loads)

2. **Re-use Waste Heat**
   Recover released heat through building-scale technologies (e.g. heating recovery ventilator) and plan communities to encourage waste heat recovery (pairing swimming pools and ice rinks with heat exchangers)

Figure 3. BC Hydro Hierarchy for Community Energy Planning



3. **Renewable Heat**
   Replace fossil fuels with renewable sources of heat (e.g. solar hot water, geoexchange, etc.)

4. **Renewable Electricity**
   Supplement or replace electricity with local renewable sources (e.g. photovoltaic solar panels, micro-turbines, etc.)

2.5 Richmond 2011: Context and Implications

The following section outlines recent context and its implications to Richmond's energy and GHG management efforts.

2.5.1 Population

Richmond's 2011 Census population was approximately 190,000, a 10% increase from 2006.[12] Richmond grew faster than Metro Vancouver (9%) and the Province of BC (7%) during the Census period. Energy consumption and GHG emissions are strongly linked to population growth. Without action, energy use and GHG emissions can be expected to increase with the City's population.

2.5.2 Demographics

The proportion of residents under the age of 15 is declining and the proportion between the ages 55 to 64 is growing. Improving infrastructure for walking and rolling, one strategy to reduce GHG emissions, also increase accessibility for an aging population. Providing housing options—such as apartments and ground-oriented townhouses—located near transit and amenities similarly supports energy and climate objectives as well as this demographic shift.

2.5.3 Dwellings

With the construction of high-rise apartments in City Centre and the increase in the stock of low-rise apartments and townhouses overall, Richmond's housing stock is becoming more diversified. Since 1996, the number of detached dwellings has remained roughly the same, but the proportion of all dwellings that are detached has decreased (

Figure 4). Apartments and townhouses are generally more energy efficient than detached dwellings. This is due to their smaller average size and their shared walls; attached units have a lower ratio of external wall (where heat is lost) to conditioned floor area. Apartments and townhouses are on average 50-80% more efficient than detached dwellings. Smaller dwellings have the potential to increase the supply of relatively affordable housing.

Approximate 58% of all housing is over 20 years old and a large share of these were constructed 40 years ago during the 1970s (Figure 5). Retrofitting exiting dwellings can reduce the operational costs of homes as well as decrease energy use and GHG emissions.

[12] Statistics Canada Census 2011 Profile, accessed March 2013.

Figure 4. Comparison of Dwelling Types in Richmond 1996 - 2011

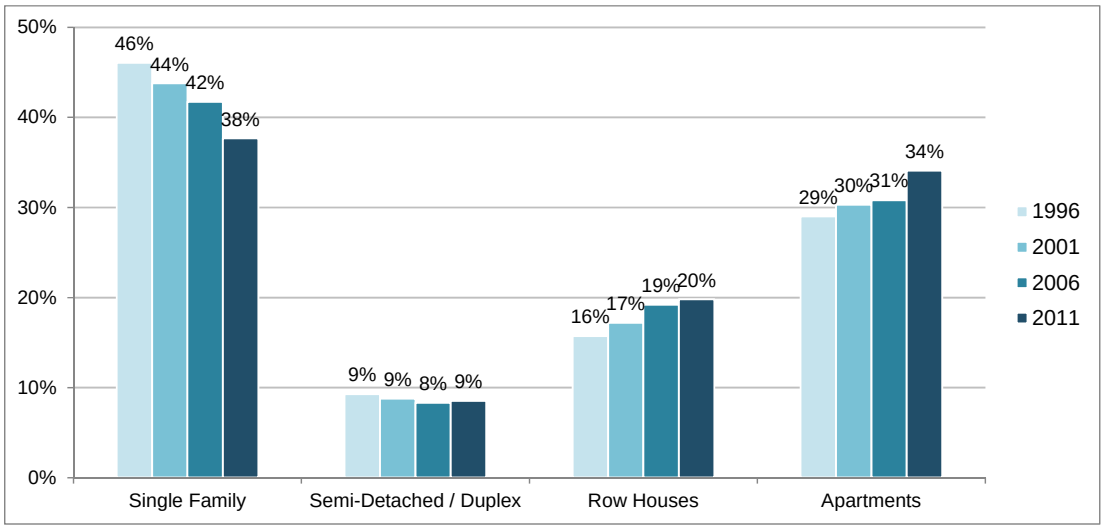
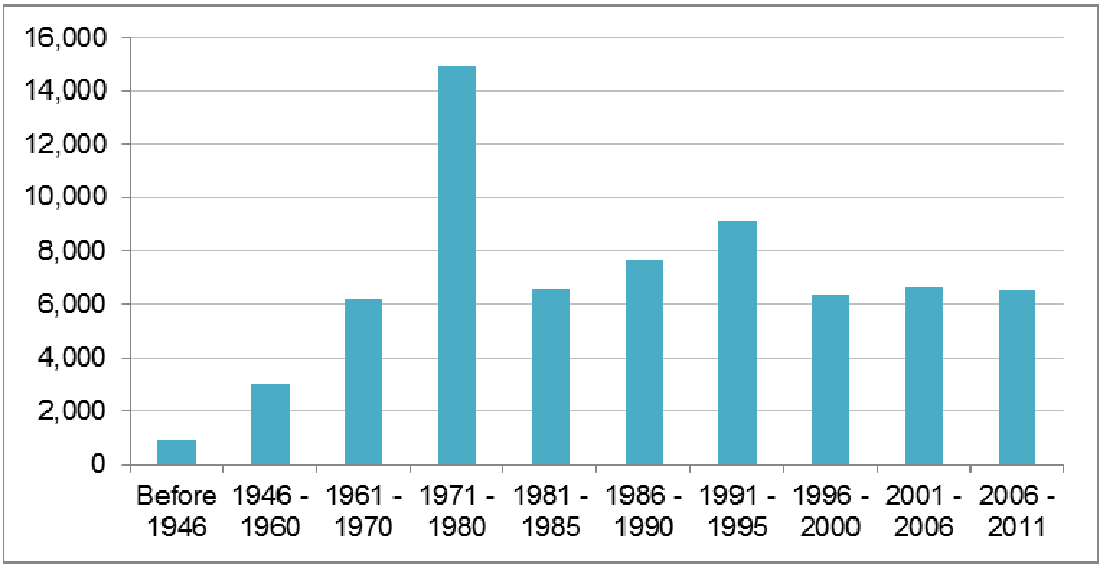


Figure 5. Period of Construction for Dwellings in Richmond, 2011



2.5.4 Mobility

Almost 80% of trips in Richmond are by taken by automobile (Figure 6). However, automobile trips have decreased 3% and transit use increased 4% since the 2010 opening of the Canada Line.[13] Walking (8%) and cycling (1%) trips have remained roughly the same between 2008 and 2011 (Figure 7). Richmond's topography and trip profile is generally supportive of walking and cycling: most trips originating in Richmond stay within the City (67%) and one-half of all trips are 4 km in length or less. Over half of grade school children already walk, cycle or take transit to school, and the average length of all school trips of 2.8 km.

[13] 2011 Metro Vancouver Regional Trip Diary Survey Analysis Report, TransLink, 2013.

Integrating land use and transportation planning locates housing in areas with access to transit and amenities. This proximity facilitates walking, cycling and transit use. Safe and accessible pathways with direct and connected links further support Richmond's mode shift targets. Additionally targeted infrastructure and program outreach in schools encourages healthy, active choices for Richmond's students.

Figure 6. Trips by Mode for Richmond, 2008 and 2011

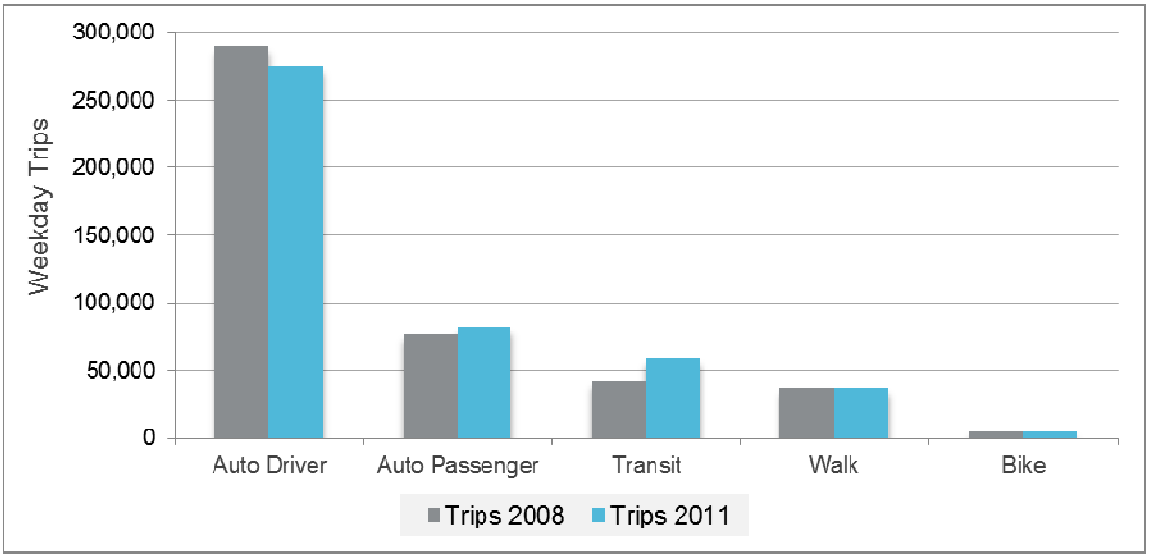
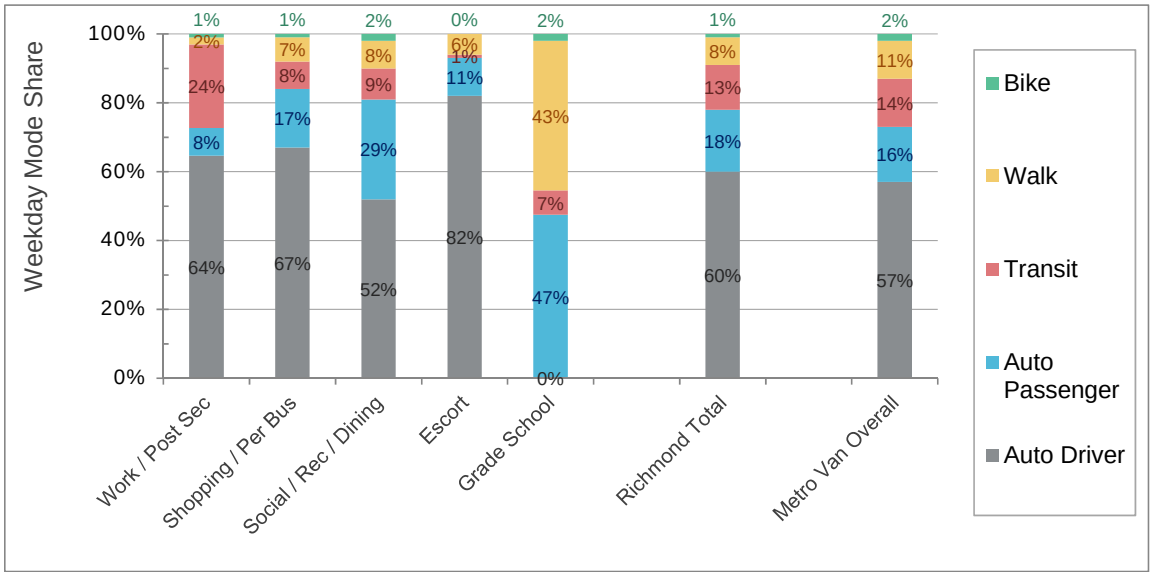


Figure 7. Weekday mode share (Richmond), 2011



Note: A trip when a driver assists someone else in their travel needs is considered an "escort". A common scenario is when a parent (escort) transports a child (passenger) to school.

2.5.5 Job Location

Richmond is a net provider of employment opportunities in the region with the highest jobs-to-labour force ratio in Metro Vancouver. In 2006, the jobs-to-labour force ratio was 1.24 (or 124 jobs per 100 residents).[14] Richmond's top employment industries include retail trade (12%), food services & accommodation (9%), professional, scientific & technical services (9%), and health care (8%).

City Centre retail and office space located near transit, cycling and pedestrian infrastructure is appropriate for many Richmond businesses. Commercial office space located near rapid transit stations has lower vacancy rates and attracts higher rents than office space located further from transit.[15] Office and retail located outside of City Centre contend with other transportation opportunities and challenges.

2.5.6 Industry

Additional important industries in Richmond include transportation & warehousing, manufacturing and wholesale trade. Industries responsible for a significant quantity of GHG emissions report directly to Provincial agencies and are not counted in the City's community-wide inventory.

Industries may have different input and output materials and there may be opportunities to share resources and/or energy. Eco-industrial networking takes advantage of co-located industries to achieve greater efficiency. Opportunities for reducing emissions from goods movement include buying new fuel-efficient vehicles, right-sizing fleets, ensuring trucks are optimally loaded, and advanced route planning.

2.5.7 Local Energy Sources

Richmond established the Lulu Island Energy Company and the City's first district energy system, Alexandra District Energy Utility (ADEU), provided energy to customers beginning in 2012. ADEU utilizes geoexchange to provide space heating, cooling and domestic hot water to residential and commercial buildings within the related West Cambie service area. New buildings within this service area are required to connect. District energy systems can achieve greater efficiencies—particularly when energy demand is diversified—and often provide great opportunities to develop local sources of renewable energy. Renewables reduce GHG emissions, insulate customers from global energy price fluctuations, and contribute to a more resilient community. Other opportunities include capturing waste heat from the sanitary sewer system and community buildings such as ice rinks and hospitals, as well as site-scale opportunities such as solar hot water systems.

[14] Statistics Canada Census 2006 Profile, accessed March 2013 at http://www.richmond.ca/discover/about/demographics/Census2006.htm. 2011 statistics not available for Plan development.

[15] "Rapid Transit Office Index for Metro Vancouver", Jones Lang LaSalle, 2011.

2.6 Richmond 2041: OCP Population, Housing and Employment Projections

In preparation of the 2041 OCP update, the City undertook substantial analysis and consultation to refine its population and employment projections and to identify areas where growth would be appropriate. This neighbourhood level analysis was generalized to seven city subareas for the CEEP (Figure 8). The population, dwelling and employment projections follow (Table 1, Figure 9 and Figure 10)

Figure 8. City of Richmond Subareas

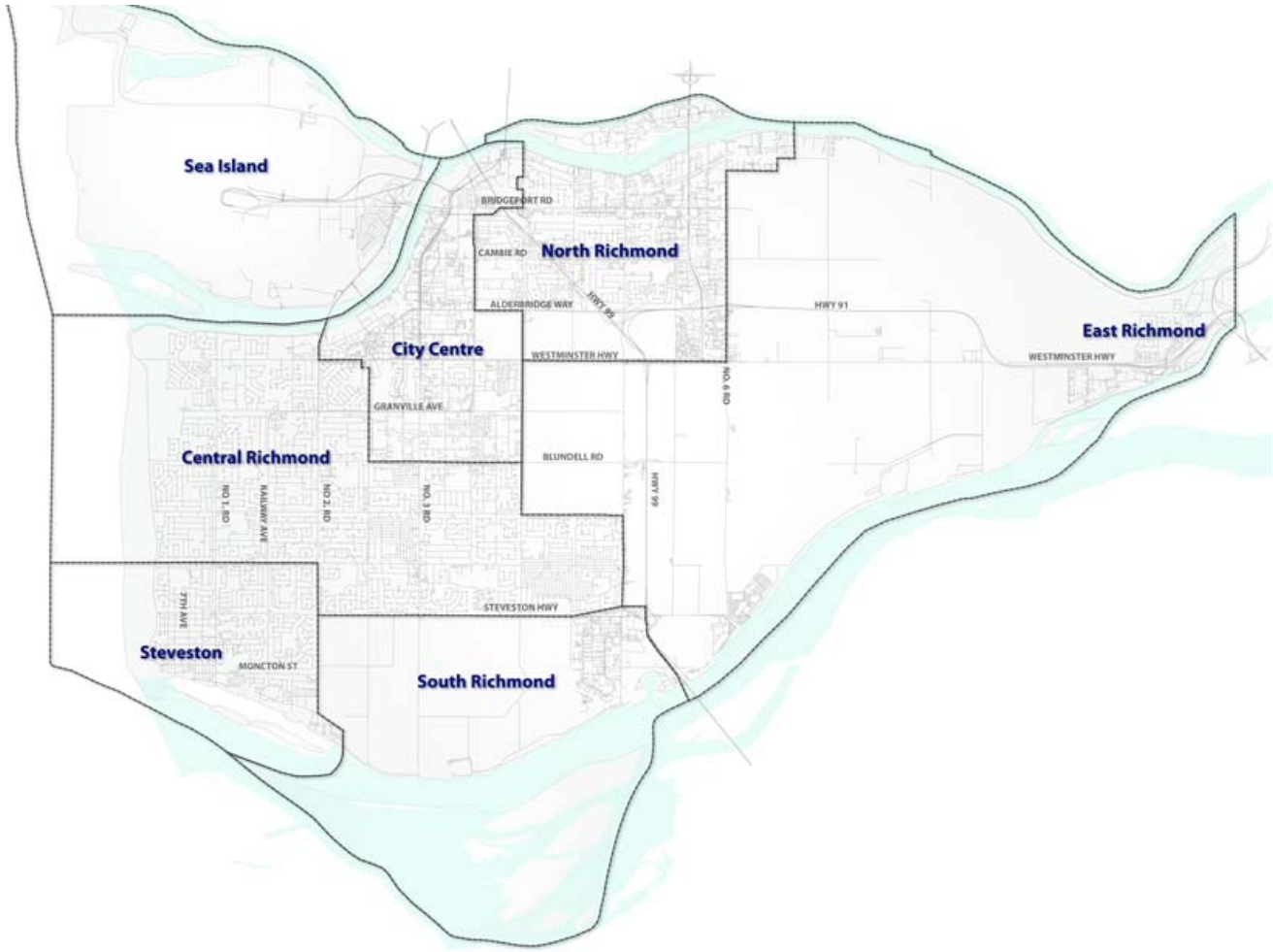


Table 1. 2041 OCP Population, Dwellings and Employment Projections by Subarea

Neighbourhood	Population (number)			Dwellings (number of units)			Employment (number of jobs)		
	Existing (2009)	New (2010-2041)	Total Future (2041)	Existing (2009)	New (2010-2041)	Total Future (2041)	Existing (2009)	New (2010-2041)	Total Future (2041)
City Centre	46,000	54,000	100,000	21,000	26,000 Ground oriented: 25% Apartment: 75%	47,000	41,000	19,000	60,000
Central Richmond	87,000	20,000	107,000	28,000	12,000 Ground oriented: 90% Apartment: 10%	40,000	11,000	2,500	13,500
East Richmond	9,000	3,000	12,000	3,000	2,000 Ground oriented: 95% Apartment: 5%	5,000	14,000	3,000	17,000
North Richmond	22,000	9,000	31,000	7,000	4,000 Ground oriented: 45% Apartment: 55%	11,000	34,500	6,500	41,000
Sea Island	830	50	880	300	0	300	24,000	11,000	35,000
South Richmond	570	150	720	300	300 Apartment: 100%	600	6,500	1,500	8,000
Steveston	25,000	3,000	28,000	9,500	2,000 Ground oriented: 40% Apartment: 60%	11,500	4,000	1,000	5,000
TOTAL Richmond	**190,000**	**88,000**	**280,000**	**69,000**	**46,000**	**115,000**	**135,000**	**45,000**	**180,000**

Figure 9. Projected Population Growth by Richmond Subarea (2011-2041)

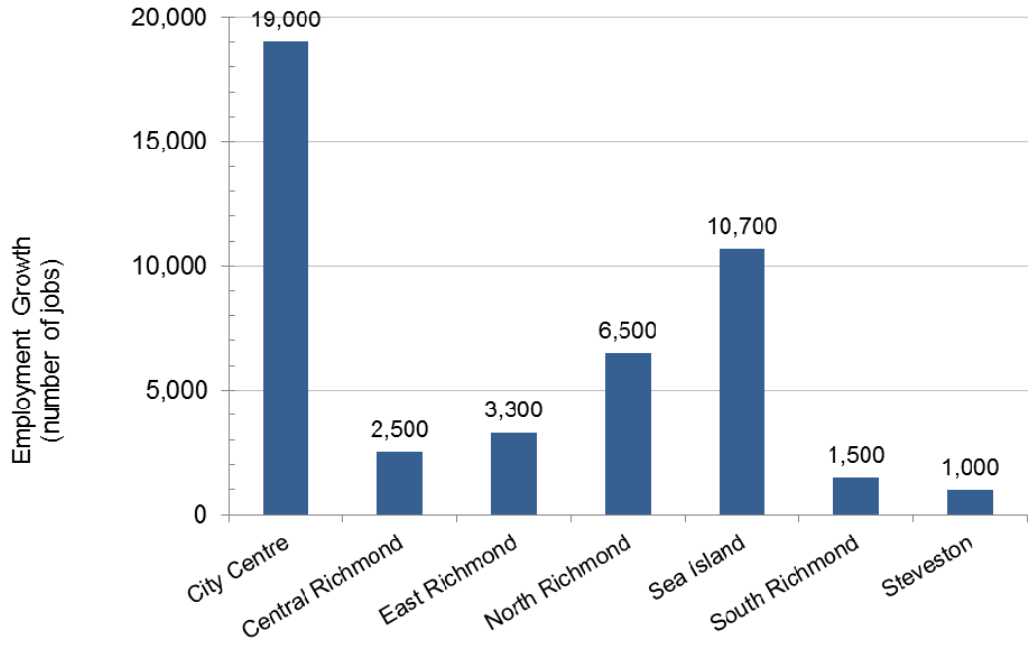
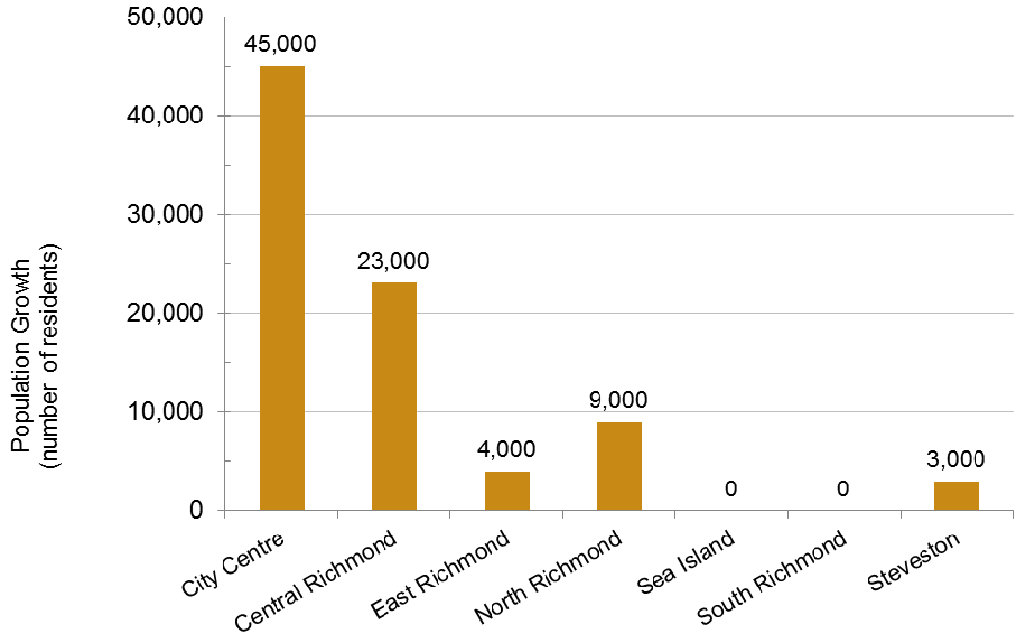


Figure 10. Projected Employment Growth by Richmond Subarea (2011-2041)



3 Where are we now?

3.1 Energy Use and GHG Emissions Baseline

Richmond's GHG emissions are those global warming gases released into the atmosphere from the community's activities. Most of the measured GHG emissions are a direct result of fossil fuel (e.g. coal, oil and natural gas) used to heat and power buildings and to drive vehicles. A lesser quantity of emissions results from the decomposition of the solid waste generated by the community.

What is a gigajoule?

A **gigajoule (GJ)** is a metric measure of energy use. One GJ is roughly equivalent to the energy of a passenger car tank of gasoline or 2 barbeque propane tanks. A typical home uses one GJ of electricity every 10 days.

3.1.1 Community Energy Use Baseline (2010)

Energy is used to heat and power buildings, drive transportation and operate businesses (Figure 11).[16] Principal energy uses in Richmond include:

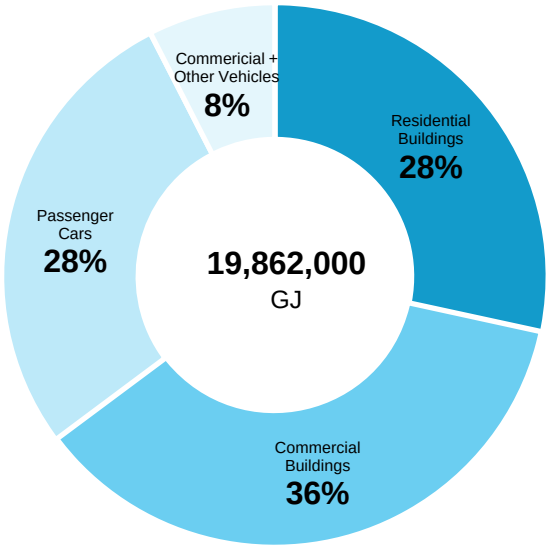
- **Buildings**

  Energy is consumed to heat, cool and power buildings and to provide a range of services. Key energy sources are natural gas—for space and hot water heating—and electricity for a range of process or "plug loads" as well as some heating and cooling

- **Transportation**

  Energy is consumed by vehicles to transport people and goods. The source of energy is typically combustion of gasoline, diesel and propane. Passenger vehicles account for the majority of the community's estimated transportation fuel use

Figure 11. Energy Use in Richmond (2010)



[16] The Province of BC has developed the Community Energy and Emissions Inventory (CEEI) initiative to provide inventories of community-wide energy consumption and GHG emissions for all municipalities and regional districts in BC. The CEEI provide the total amount of building energy consumed (electricity, natural gas) as well as modeled estimates of consumed propane, heating oil, and wood. Transportation emissions are modelled for vehicle fuels using statistics of vehicle travel and fuel economy ratings. The associated GHG emissions are calculated from energy consumed as well as from disposed waste. Inventories have been developed for the calendar years 2007 and 2010, and are expected to be produced biannually. (see www.env.gov.bc.ca/epd/climate/ceei/index.htm).

This report presents the most recent CEEI for Richmond. The targets in Richmond's OCP were developed from the 2007 baseline, using the first CEEI report available for Richmond.

Generally large industries are excluded from the CEEI inventories and typically for privacy reasons. For example, this inventory does not include emission from the Lafarge cement plant. However, this facility does report its emissions to senior government regulators.

Energy is a cost to the community, with most energy spending leaving Richmond. The most recent inventory indicates that **$440 million annually** is spent in Richmond on energy (based on 2010 inventory) or **$2,200 each** year per resident. This level of consumption is on par with other Metro Vancouver communities.

3.1.2 Community GHG Emissions Baseline (2010)

Utilizing traditional energy sources, such as combusting a fuel or consuming electricity, results in GHG emissions (Figure 12).[17] Solid waste disposal in a landfill or a waste-to-energy facility also results in emissions. Richmond's GHG emissions sources include:

- **Buildings**

  Electricity and natural gas used to heat and cool buildings lead to 43% of the community's GHG emissions. Most of the GHGs result from natural gas since electricity in BC is a relatively "low carbon" energy source

- **Transportation**

  Using gasoline, diesel and propane for transportation leads to approximately 53% of the community's GHG emissions. This community inventory includes only vehicles registered in Richmond

- **Solid waste**

  Richmond's waste that is not diverted through recycling and composting programs may end up at the landfill. There the decomposition process, if not mitigated, results in the release of methane, a potent GHG.

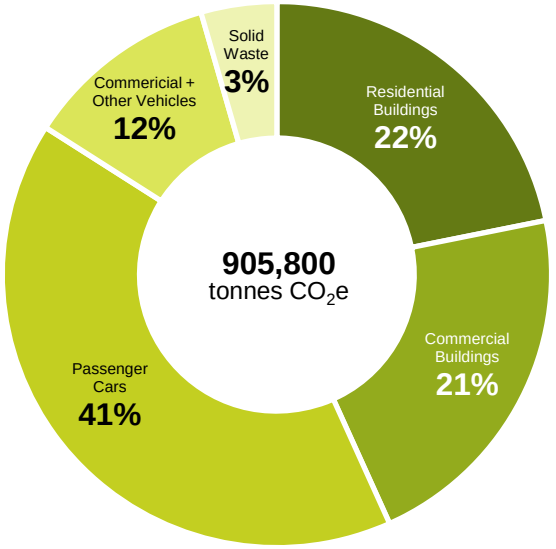
Richmond's community-wide emissions result in roughly 4.5 tonnes of CO_2e per resident each year. This is typical level of emissions for residents in the Metro Vancouver area.

What is a CO_2e?

GHG emissions are measured in **tonnes CO_2e** or equivalent carbon dioxide. This is a means to express a given GHG as a functionally equal amount of CO_2e for the purposes of understanding global warming.

In general terms, **1 tonne CO_2e** is roughly equivalent to the GHG emissions from consuming 10 passenger car tanks of gasoline.

Figure 12. GHG Emissions in Richmond (2010)



[17] For fossil fuel consumption the release of carbon occurs at the 'tailpipe" – the point of consumption. For electricity consumption the release of carbon occurs elsewhere in the electricity 'grid' and not at the point of electricity use.

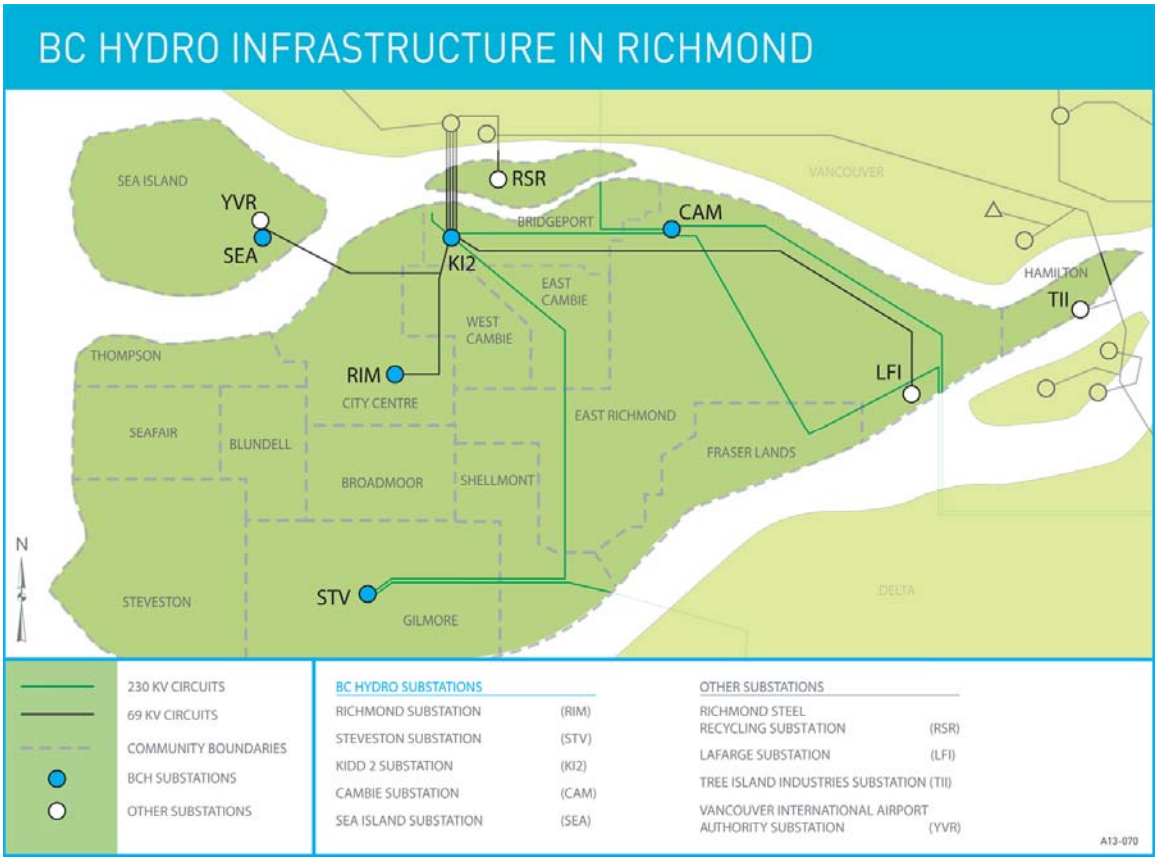
3.2 Electricity: A Unique Energy Service

Electricity is a unique fuel due to its versatility. As a high-grade energy, it is easily converted and can be applied to a range of tasks—operating machinery, lighting buildings or charging batteries. However, it is also transient in nature and cannot easily be stored.

One objective of the CEEP is to identify and carryout specific actions for reducing electricity use and potentially generating electricity within the community. These actions support BC Hydro's mandates to encourage conservation and to develop local alternative electricity sources that reduce the burden on the Provincial generation and transmission system.

Electricity infrastructure requires right-of-ways and facilities that occupy valuable land in the community (Figure 13). As Richmond grows, additional investment in infrastructure may be required. Historically, most utility infrastructure was addressed separately by each utility. However, there are increasingly opportunities to coordinate investment to the benefit of the public, City and utilities.

Figure 13. Electricity Infrastructure Schematic for Richmond



4 Where are we heading?

4.1 Current Policy Trend: Forecast Without an Action Plan

Energy consumption and GHG emissions have historically increased as the population and economy expands. This trend is expected to continue in the future. However, this increase will be tempered by greater efficiencies resulting from policy commitments at each level of government.

The primary driver on the energy and emissions forecast is population growth.[18] In the simplest form, the increase in energy and GHG emissions will be directly proportional to the expansion in population. Specific initiatives to address this growth are already underway:

- Mandatory biofuel content in gasoline and diesel fuels
- Increased vehicle fuel efficiency standards
- Improved building energy efficiency provisions of the BC Building Code
- More efficient building forms and decreased reliance on automobiles due to the densification of key areas as described in Richmond's 2041 OCP

The reductions from the 2007 baseline trajectory will be described in the "carbon wedge" diagram (

Figure **14**).

The top line represents the theoretical increase of GHG emissions if the energy use and GHG emissions continue to grow in the fashion of the 'status quo' energy use (the way that energy was consumed at the time of the 2007 baseline. In this scenario, each new resident uses the same energy and same housing stock as the existing residents.[19] Beneath the status quo growth curve are four "wedges" representing reductions attributed to committed government initiatives:

[18] A more complete description of the calculation methodology is provided in Appendix A.

[19] This status quo development forecast is something of a theoretical construct because it implies that the new residents will be housed in the same types of dwellings as the existing residents (i.e. split between single family and multi-family etc.). In practice there is not sufficient land available to do this.

- **Transportation Biofuel Content**

  The Federal government has mandated a biofuel content for gasoline and diesel fuels. These are modeled through a reduction of the emission factors for these fuels (consistent with the methodology used for BC public sector organization in the SmartTool reporting system)

- **Improved Federal Fuel Efficiency Standards for Vehicles**

  The Federal government has announced requirements for average fuel efficiency to increase between the 2010 and 2016 model year (called LDV1) and further targets are under development for further improvements for model years 2017 to 2025 (LDV2). GHG reductions may be greater than 50% of passenger vehicle emissions by 2025. As well, there are processes underway that would see (more modest) improvements in commercial vehicle efficiency as well

- **Improved BC Building Code**

  The BC government in 2007 established targets to improve the energy efficiency of commercial and residential buildings. These changes have been initiated with improvements to the building code and to energy standards for equipment

- **"Base OCP" Densification: Vehicles**

  The new OCP defines a more densely developed City Centre to accommodate the increases in population. Data shows that as density increases, the amount of vehicle kilometers travelled decreases. This is regardless of whether transit service and other amenities are developed.[20] This wedge has been shown as a "given" or input assumption because it is established

- **"Base OCP" Densification: Buildings**

  The increased densification will result in lower residential building energy consumption due to the greater share of multi-family units compared to single family units, and the fact that townhomes and apartments tend to be smaller than detached dwellings. An improvement in residential building energy is shown – commercial buildings were not assumed to be affected

The resulting emissions that remain after these wedges collectively are called the Current Policy Trend (CPT) scenario, sometimes referred to in energy and emissions plans as business as usual (

Figure **14**). The impact of the densification resulting from the development of the 2041 OCP (including the 2009 CCAP) is shown here because it is a "given" or assumption going into the CEEP.

The reductions that are shown are an attempt to quantify the impact solely of the densification. As a concept it may be called the reductions that are achieved if the densification defined in the OCP is achieved – but little else is achieved (e.g. not transit improvements, no greener buildings, etc.). As such these have been called the "Base OCP" reductions.

In practice this density will be achieved in combination with better transit, better non-vehicle transportation amenities, "above-code" building standards etc. Those activities though may be implemented to a greater or lesser degree. As a result they are considered actions for the energy plan.

[20] A description is provided in Appendix A. Transit service and amenities will enhance the reduction in vkt in addition to this base amount.

The resulting CPT scenario results for energy, electricity and GHG emissions follow (Table 2, Figure 15, Figure 16, and Figure 17).

Figure 14. Carbon Wedge for the Current Policy Trend Scenario

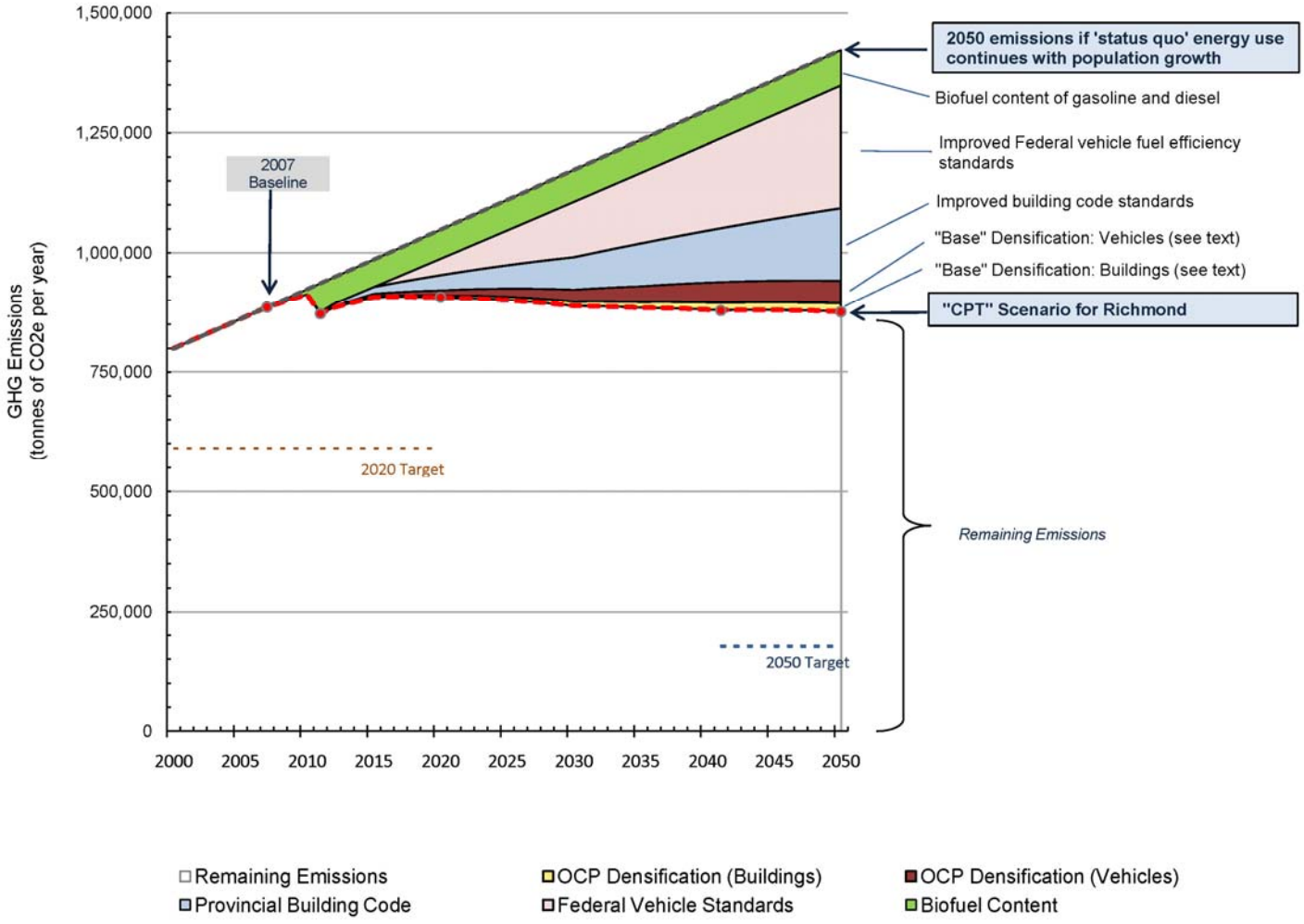
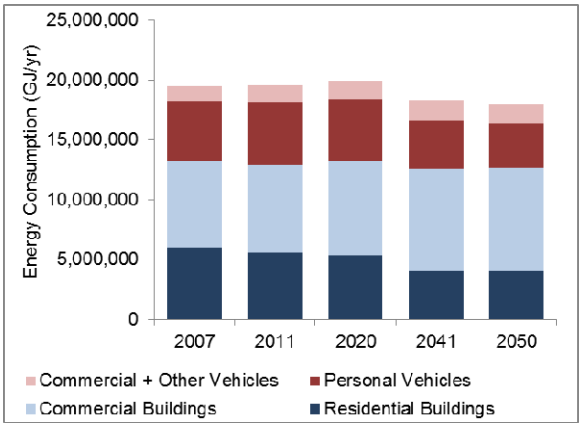


Table 2: Current Policy Trend Scenario

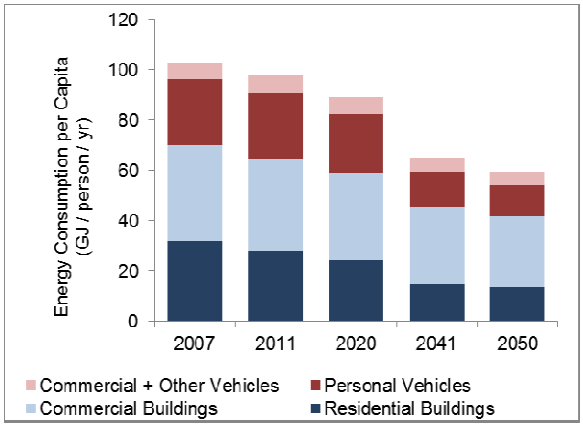
Year	2007	2010	2020	2041	2050
Population					
Residents	189,333	200,000	224,000	280,000	304,000
% change from Baseline (2007)	-	4%	18%	48%	61%
GHG Emissions (tonnes of CO_2e)					
Total GHG Emissions	886,000	910,000	906,000	880,000	877,000
% change from Baseline (2007)	-	3%	**2%**	-1%	**-1%**
Per Capita Emissions (t/person)	4.7	4.6	4.0	3.1	2.9
Electricity Consumption (GJ)					
Total Electricity Consumption (GJ)	5,927,000	5,994,000	6,226,000	6,136,000	6,196,000
% change from Baseline (2007)	-	1%	5%	4%	5%
Per Capita Electricity Consumption (GJ/person)	31.3	30.4	27.8	21.9	20.4
Total Energy Consumption (GJ)					
Total Energy Consumption (GJ)	19,549,000	19,862,000	19,940,000	18,295,000	18,062,000
% change from Baseline (2007)	-	0%	**2%**	-6%	-8%
Per Capita Energy Consumption (GJ/person)	103.3	100.7	89.0	65.3	59.4

Notes: [1] Values shown in red are comparable to OCP reduction targets of -33% reduction GHG emissions by 2020, -80% reduction GHG emissions by 2050, and 10% reduction energy by 2020, respectively
[2] Totals may not equal the sum of components due to rounding

Figure 15. CPT Forecast of Total and Per Capita ENERGY Consumption by End User

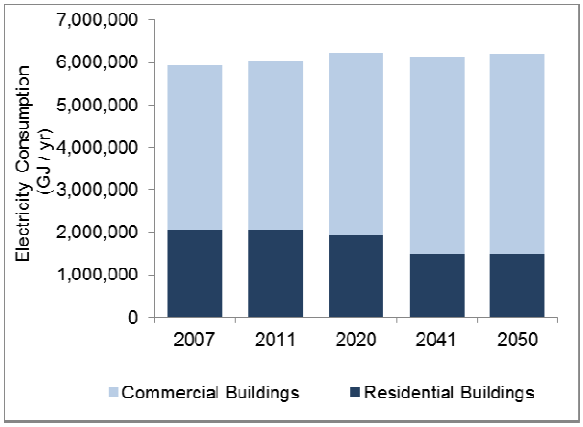


Total Energy Consumption

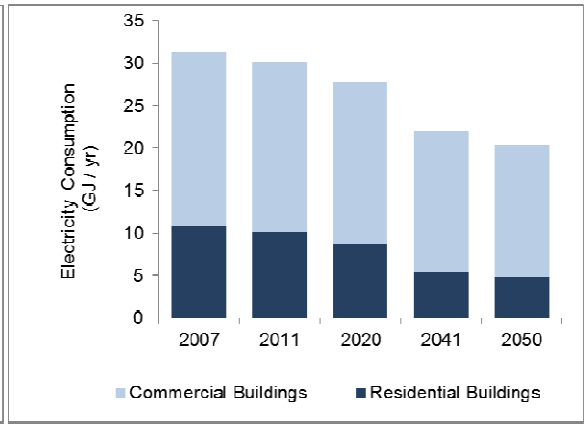


Per Capita Energy Consumption

Figure 16. CPT Forecast of Total and Per Capita ELECTRICITY Consumption by End User

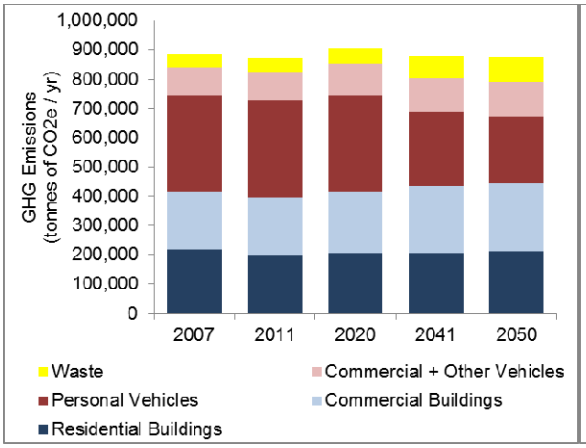


Total Electricity Consumption

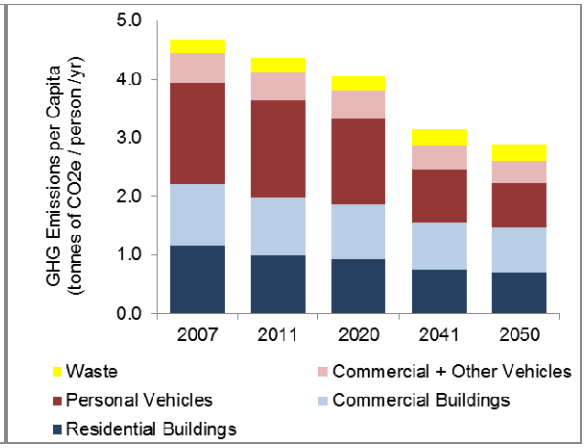


Per Capita Electricity Consumption

Figure 17. CPT Forecast of Total and Per Capita GHG emissions by End User



Total GHG Emissions



Per Capita GHG Emissions

4.2 Thermal Energy Load Growth: 2011 to 2041

As part of this project an analysis was undertaken to estimate the current (2011) energy load needed for heating throughout the community, and also to estimate where the future (2041) energy load for heating will be based on the City's projected residential and employment growth.

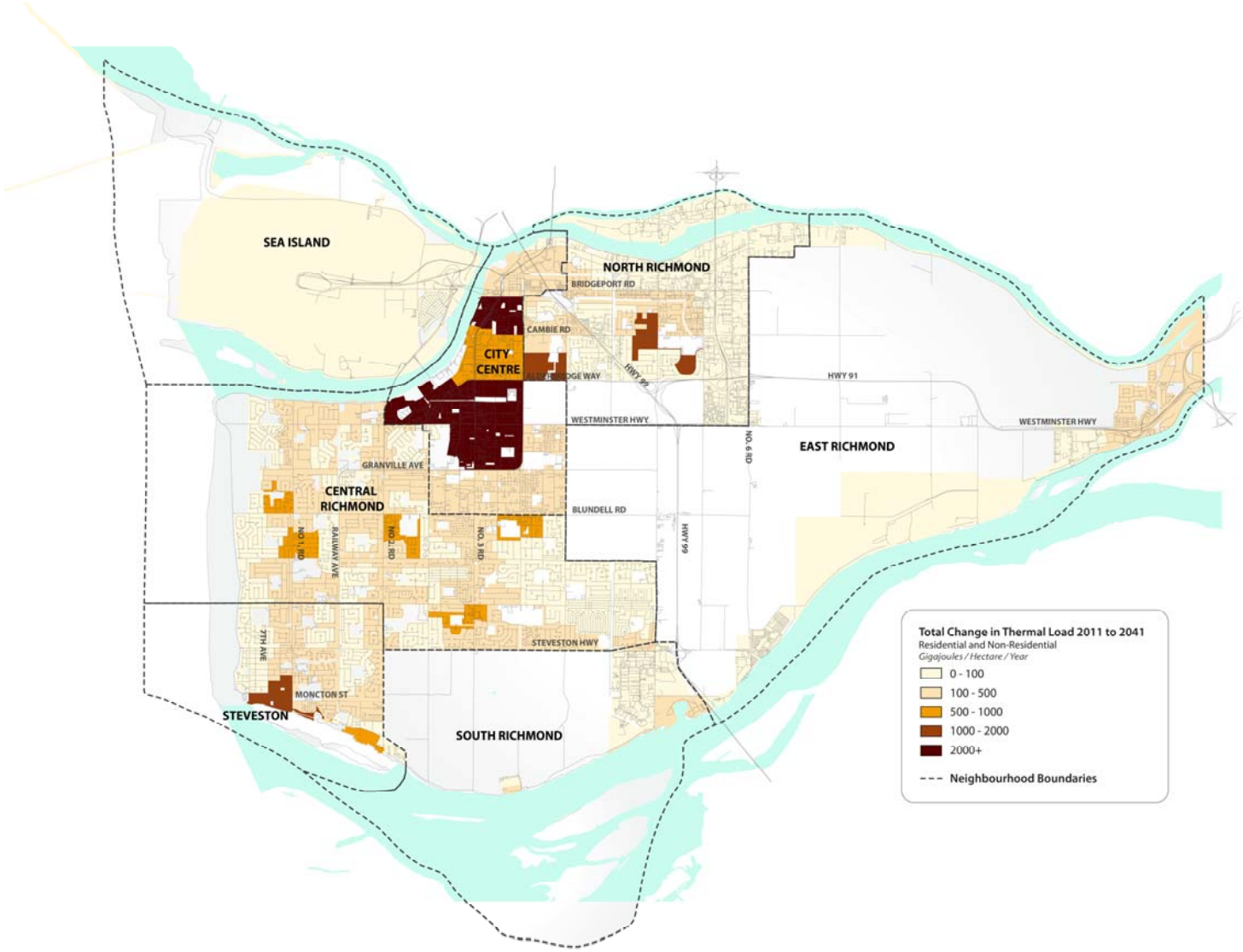
Thermal energy mapping (space and hot water heating) serves a number of purposes. First it serves as a composite measure for overall development – combining residential and commercial development. As well it can be useful to provide direction for potential future district energy opportunities. District energy feasibility is typically driven by the amount of new development – rather than the total developed area – simply because existing buildings are most often not compatible with DE systems.

As an example,

Figure 18 shows the change in anticipated thermal energy for new buildings projected to be built in Richmond between 2011 and 2041. Features that are visually apparent include:

- Large increases in heating requirements in the City Centre area – consistent with the expected redevelopment of the City Centre area,
- Lesser intensive increases along the arterial road network, and
- Limited increases in existing single-family dwelling neighbourhoods.

Figure 18. Projected Change in Annual Thermal Energy Requirements 2011 to 2041 (GJ/ha)



5 Framing the Action Plan

5.1 CEEP Vision (2010)

During the CEEP Phase 1, the City established a vision as follows:

> *The development of a Community Energy and Emissions Plan (CEEP) for Richmond supports the vision of the city as the most appealing, liveable and well managed community in Canada. A community where development strengthens social institutions and values, enables a vibrant, innovative and resource efficient economy, and protects and enhances ecological resources to ensure that these continue to provide valuable services for all, now and in the future. Richmond recognizes the challenges that climate change and changing global energy dynamics present and aims to act now to be prosperous later.*
>
> *Consistent with the City's sustainable community vision is the goal of achieving an energy-wise and low-carbon society, and enables a robust local economy, a healthy environment, and a safe, equitable, diverse, and resilient community. This vision of Richmond is predicated on a move away from fossil fuels and increasing greenhouse gas (GHG) emissions, and toward an energy future where demand for energy is reduced, more waste heat energy is recovered, renewable sources of heat are fully exploited, renewable energy for electricity generation become mainstream, and GHG emissions are lowered to the greatest extent possible.*

5.2 Richmond's GHG Reduction Targets

In the 2041 OCP, Richmond incorporated community-wide GHG emissions reductions and energy use targets as follows (OCP section 2.2, Objective 1):

> *Reduce GHG emissions from City operations and services, and support broad-base community GHG emission reduction to achieve a 33% reduction from 2007 levels by 2020 and 80% below 2007 levels by 2050.*

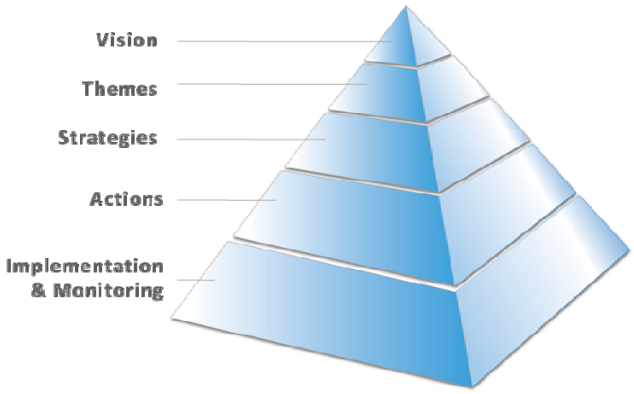
These targets align with the province-wide targets, which support the scientific consensus around the need to dramatically reduce global GHG emissions, and demonstrate a strong commitment to climate change mitigation. The targets also align with the provincial targets outlined in Bill 44, Greenhouse Gas Emission Reduction Targets Act, and also with the Metro Vancouver GHG emission targets in the Regional Growth Strategy.

During the CEEP Phase 1 project, the City also defined a target to reduce total energy use in the community by 10% from 2007 levels by 2020.

5.3 Plan Structure

A pyramid structure (Figure 19) illustrates the framework of the plan. From a single vision at the peak, the framework increases in the comprehensiveness and detail at each subsequent tier. The long-term vision remains at the top, supported by several themes and strategies, each with a set of shorter-term actions to implement the strategies. Although actions are subject to regular revisions and review, the vision should remain durable through the life of the plan. At the base of the pyramid is the actual execution of the actions as well as the measurement of the impacts. Monitoring is critical; the measurement of the impacts will inform the areas to review and revise over time.

Figure 19. Plan Structure Pyramid



5.4 Plan Themes

In recognition of the importance of the OCP as a guiding document for Richmond, the CEEP is organized into five themes that also align with the OCP chapters that are most relevant to community energy consumption, energy efficiency and GHG emissions: Neighbourhoods & Buildings, Mobility & Access, Resilient Economy, Sustainable Infrastructure & Resources, and Climate Change Leadership. A comparison of these themes and relevant OCP chapters is provided in Table 3. This highlights how the OCP document already is aligned with energy management and GHG reductions, and where the different activities are addressed by OCP policy.

Table 3. Alignment of CEEP, OCP and Key Issues

CEEP Theme	OCP Chapter	Key Issues
1. Neighbourhoods and Buildings	Ch 3: Connected Neighbourhoods with Special Places	• Land use policy for compact, complete communities • Green homes promotion • Building scale alternatives and an innovative energy supply • Retrofits of existing buildings for greater efficiency
2. Mobility and Access	Ch 8: Mobility and Access	• Shift towards non-vehicle modes • Increased transit service • Low carbon vehicle encouragement
3. Resilient Economy	Ch 6: Resilient Economy Ch 7: Agriculture and Food	• Improved commercial goods movement • Increased local, green jobs and low-impact industrial development • Commercial and industrial land protection • Higher efficiency new and existing commerical buildings • Increased alternative energy/biomass
4. Sustainable Infrastructure and Resources	Ch 12: Sustainable Infrastructure and Resources	• Solid waste resource plan support • Local energy sources utilization • Efficient infrastructure construction
5. Climate Change Leadership	Ch 2: Climate Change Response	• Education and engagement expansion • Corporate operations “lead by example”

6 Reduction Scenario

This section first presents the results of a developed "reduction scenario" and then defines the detail of the strategies and actions used to develop the scenario.

6.1 The Municipal "Toolkit"

The range of actions available to a local government is broad, but they typically are one or a combination of a four key types of activity (Table 4). Some strategies can be implemented individually, and some may require a combination of measures.

Table 4. Municipal Tools for Encouraging Action

Action	Types of Activities	Comments
Outreach and Education	Increase awareness through promotions (e.g. brochures and information), Facilitate self-motivated individuals to take action through information sharing, guidance, or seminars and workshops. Provide education and training through workshops and community events.	Generally simpler activities (some one-off, and some on-going). Many can be done in partnership with other funders or delivery agents. Generally low cost, but uptake is typically very low.
Non-financial Incentives	"Build it and they will come." Provide the infrastructure and facilities and residents will use it – connected sidewalks, neighbourhood access to amenities, bus shelters.	Aligns with municipal infrastructure activities and is part of existing activities. Strong push might require more budget capital projects.
Financial Incentives	Provide a financial incentive to take action. Examples may be a permit or fee discount, a tax break, a rebate or some other incentive for a resident / homeowner / developer to take action.	These generally become program activities requiring some ongoing maintenance or staff support – analogous to a water conservation program. Some examples exist for energy but this is generally a new area for local governments.[21]
Regulation	Require an activity through a policy statement, a bylaw, or a rezoning requirement to define an action that must be taken.	Strongest compliance since it is a requirement. However, it requires that the City be willing to enforce compliance and the activities must be pursued with consultation and communication with the affected stakeholders.

[21] An example is the Saanich Built-Green incentive that provides a building permit rebate for single family construction built to the "Built Green standard. Concerns are often cited about the cost of these programs but experiences have shown that they are not typically well subscribed initially and so require some promotion.

6.2 Reduction Scenario – Summary

6.2.1 Quantifying the Reductions

Creating a reduction scenario provides an opportunity to consider how the community will achieve its target. This involves:

- Identifying potential strategies and actions that are within the City's realm of authority, influence or ability to deliver,
- Considering what level of impact these activities may potentially have on the amount of energy consumed and/or they type of energy consumed and/or the amount of GHG emissions produced, and
- Estimating the uptake of the actions – i.e. how many people / buildings will change as a result of the action. Many factors influence the uptake of various actions, though general estimates can be made based on the tool selected (as outlined in the table above).
- Estimating the implementation time for an action. Each activity will start and at some point reach full implementation. (For example, an initiative to retrofit X % of homes, might target this to be achieved by a certain date).

Based on the actions identified, the desired goals of the OCP, literature review and input from the staff workshop, a reduction scenario has been developed. The assumptions, estimated levels of update and potential level of impact for the strategies identified in this plan are shown in Table 5.

Although specific actions have been defined in this plan as a starting point for moving forward with community energy and emissions management, it is anticipated that other actions may be identified in the future based on opportunities that present themselves during implementation (e.g. new funding becomes available for an activity that is not yet identified, but aligns with the intentions of the plan).

Table 5: Reduction Scenario Assumptions and Outcomes

Theme	Strategy	Description	Emissions Sector	Change Energy Use at 2041 (GJ)	Change in Electricity Use at 2041 (GJ)	Change in GHG Emissions at 2041 (tonnes CO_2e)
Neighbourhoods and Buildings	Strategy 1	Neighbourhood planning	Personal Vehicles	-1,176,100	-254,900	-54,400
	Strategy 2	New development efficiency	NEW Residential Buildings			
	Strategy 3	Existing buildings	NEW Residential Buildings			
Mobility and Access	Strategy 4 Strategy 5 Strategy 6	Alternative transportation Connectivity Transport behavior and mode choice	Personal Vehicles	-1,299,400	41,600	-85,000
	Strategy 7	Low carbon personal vehicles	Personal Vehicles			
Resilient Economy	Strategy 8	Energy efficient industries	Existing Commercial Buildings	-806,400	-440,800	-21,800
Sustainable Infrastructure and Resources	Strategy 9	District energy	NEW Residential and Commercial Buildings in the City Center area	-455,800	-201,100	-51,900
	Strategy 10	Local energy sources	NEW Residential and Commercial Buildings			
	Strategy 11	Waste	Waste			

6.2.2 Scenario Reductions

The results are tabulated in Table 6. For each of electricity, total energy and GHG emissions three comparisons are made:

- **Comparison to the Baseline:** This compares the value to the 2007 level. In these terms reductions are modest in percentage terms – and sometime even increasing in the early years. This result from the fact that the community is growing and reductions and efficiencies made can be overwhelmed by continued growth.
- **Comparison to the Current Policy Trend (CPT):** This compares the results to where the City might otherwise have been – and here the results are promising. Any reductions made help to divert away from the growth trajectory.
- **Comparison on a Per Capita Basis:** The reductions appear most dramatic when presented on a per capita basis. This shows the substantial reductions required of each resident, if the impacts of growth are to be met, and overcome. That is, a small reduction in total energy use, given the population growth, requires a substantial reduction in per capita energy use.

Table 6. Reduction Scenario Results

Year	2007	2010	2020	2041	2050
Population					
Population	189,333	200,000	224,000	280,000	304,000
% change from Baseline (2007)	-	**4%**	**18%**	**48%**	**61%**
GHG Emissions (tonnes of CO_2e)	**(baseline)**				
Total GHG Emissions	886,103	913,000	831,500	666,500	664,700
Change from Baseline (2007)	-	26,900	-54,600	-220,000	-221,400
% change from Baseline (2007)	**-**	**3%**	**-6%**	**-25%**	**-25%**
Change from **CPT**	0	0	-74,600	-213,100	-212,500
% change from CPT	0%	0%	**-8%**	**-23%**	**-23%**
Per Capita Emissions (t/person)	4.7	4.6	3.7	2.4	2.2
% change per capita from Baseline (2007)	**-**	**-1%**	**-21%**	**-49%**	**-53%**
Electricity Consumption (GJ)					
Total Electricity Consumption (GJ)	5,926,916	5,994,400	6,027,000	5,280,700	5,317,200
Change from Baseline (2007)	-	67,400	100,100	-646,200	-609,700
% change from Baseline (2007)	**-**	**1%**	**2%**	**-11%**	**-10%**
Change from **CPT**	0	0	-198,900	-855,200	-878,400
% change from CPT	0%	0%	**-3%**	**-14%**	**-14%**
Per Capita Electricity Consumption (GJ/person)	31.3	30.4	26.9	18.9	17.5
% change per capita from Baseline (2007)	**-**	**-3%**	**-14%**	**-40%**	**-44%**
Total Energy Consumption (GJ)					
Total Energy Consumption (GJ)	19,548,808	19,862,000	18,975,000	14,557,200	14,389,500
Change from Baseline (2007)	-	313,200	-573,800	-4,991,600	-5,159,300
% change from Baseline (2007)	**-**	**2%**	**-3%**	**-26%**	**-26%**
Change from **CPT**	0	0	-966,300	-3,737,700	-3,672,300
% change from CPT	0%	0%	**-5%**	**-20%**	**-20%**
Per Capita Energy Consumption (GJ/person)	103.3	100.7	84.7	52.0	47.3
% change per capita from Baseline (2007)	**-**	**-3%**	**-18%**	**-50%**	**-54%**

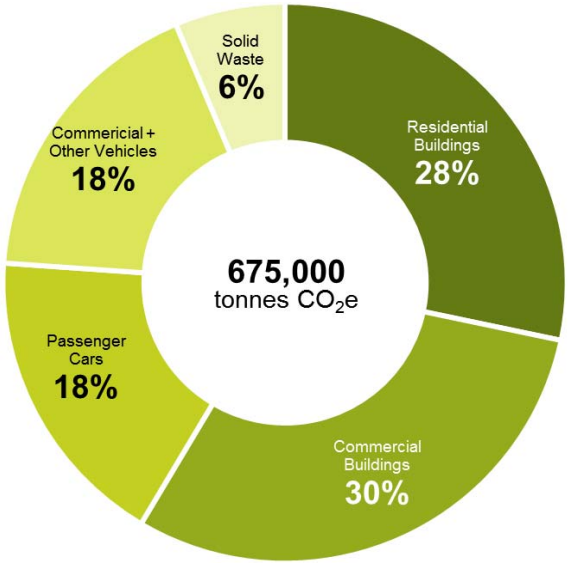
Notes: [1] Values shown in red are comparable to OCP reduction targets of -33% reduction GHG emissions by 2020, -80% reduction GHG emissions by 2050, and 10% reduction energy by 2020, respectively
[2] Totals may not equal the sum of components due to rounding

6.2.3 Emissions after the Action Plan

The remaining emissions following the action plan activities to 2050 is estimated at 675,000 tonnes of CO_2e – a 25% reduction from the 2007 baseline level. The distribution of these remaining emissions is shown in Figure 20.

What can be noted is that all components of the carbon "pie" have been reduced each to a different degree.

Figure 20. Emissions Distribution Following Action Plan Reductions (2050)



6.2.4 Carbon Wedge

The overall impact on carbon emissions is presented as a carbon wedge in Figure 21. As in the earlier presentation, the effects of growth are tempered by the higher government initiatives, and the impact of the OCP densification – an established policy.

Shown in the figure are the additional measures that form the basis for the plan – these are shown by each of the themes[22]. The important point to note, is that without the actions in the plan, these reductions are not certain to be achieved through the implementation of the OCP by itself.

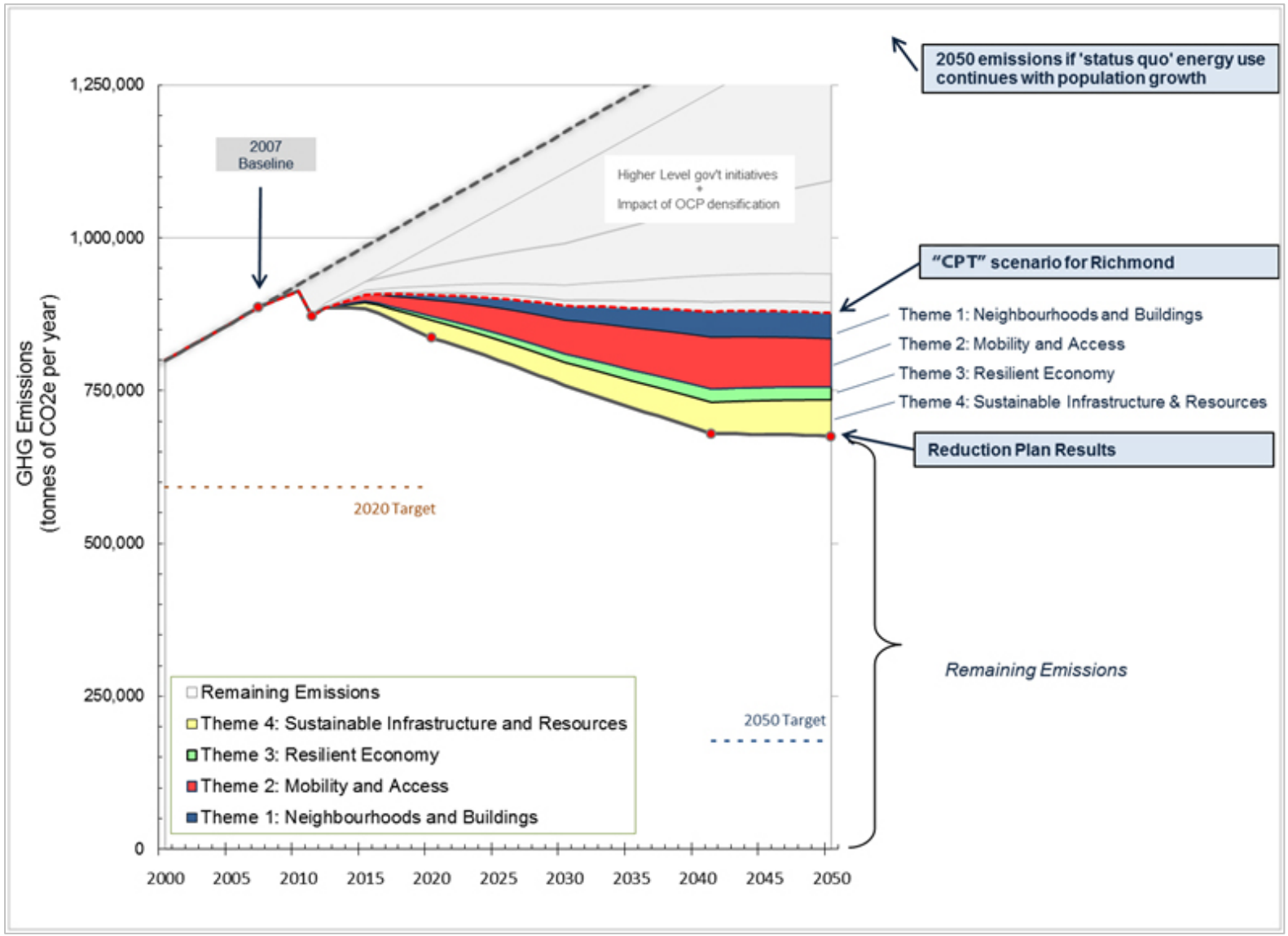
It is also worth noting that the action plan is not sufficient to meet the reduction targets established in the OCP (which match the Provincial targets). The Provincial and City targets are extremely aggressive, and as yet few – if any – communities in BC have defined, and committed to implementing a set of actions sufficient to meet these levels of reductions.

This is not a cause for inaction – rather the impetus is to begin implementation, and then to continue developing actions over time. Future opportunities, technologies, price signals and so forth may make other actions more attractive in the future.

Finally – the next section (6.3) describes in detail the actions contained within the reductions scenario.

[22] The fifth theme Climate Change Leadership is a foundational activity which provides support and encouragement for the other actions. In general the reductions will be achieved in the other four themes – acknowledging that reduction are achieved through the corporate operations plan, but these are not quantified in a separate action plan.

Figure 21. Reduction Scenario GHG Wedge



6.3 Detailed Descriptions of Strategies and Actions

Many of the actions described below are implementation actions for OCP objectives or are related to existing City policies and programs. However, the City is not currently committed to this suite of actions and some actions may require more detailed assessment, a change in policy or additional resources to implement.

THEME 1: NEIGHBOURHOODS AND BUILDINGS

This section describes strategies to address the energy and carbon aspects of:

- Neighbourhood Centre Planning
- New buildings
- Existing buildings

The way cities are planned and built has an impact on the amount of energy residents consume to get around and to heat homes and other buildings. Historically, Richmond largely accommodated new residents through single family dwellings on greenfields (land not previously developed). The city is now close to reaching its developable land capacity, but has a continued need to accommodate a growing population. Over the next 30 years, the city's population is projected to grow by 80,000 requiring approximately 45,000 new dwelling units. By concentrating new development in City Centre and Neighbourhood Centres, Richmond can preserve its natural areas and agricultural land while creating communities with recreation, shopping and employment opportunities.

The City's recent OCP update supports this form of development but also recognizes that significant growth will need to be accommodated outside the City Centre (approximately 40,000 people), and that this growth should be carefully managed to enhance existing and create new Neighbourhood Centres.

Strategy 1: Integrate Future Neighbourhood Centre Planning with Transit Planning

> *"Richmond is a place where people live, work, and prosper in a welcoming, connected, accessible and vibrant community."*

This statement from the core of the Vision of a Sustainable Richmond that guided the 2041 OCP demonstrates the importance of growing in a manner that enables residents, employees and visitors to have access to their homes, work, recreation, and amenities. Through land use and development planning, the City aims to guide growth in a manner that supports an improvement in access to all of these needs.

The OCP identifies the City's plan "to undertake, over time, separate Neighbourhood Shopping Centre planning processes to enable a wider variety of housing, stores, services, and amenities which support more jobs, effective transit, walking, rolling and cycling."[23] Increasing density is needed to support expansion of the frequent transit network. However, new dwellings must be accompanied by services, amenities, and destinations, so that the new services are of value to the residents.[24]

[23] City of Richmond Official Community Plan, 2041 OCP – Moving Towards a Sustainable Future; Section 3, Objective 2; 2012.

This CEEP strategy highlights the importance of guiding growth in a phased manner that works in concert with improved transit service. In 2014, TransLink is expected to initiate a major area plan review, and this, combined with the new OCP mandate is an opportunity to coordinate neighbourhood planning with long range transit planning.

Action 1 **Review Neighbourhood Centre development sequencing for flexibility**

The OCP 2041 defines a vision for the future – with several developable neighbourhood centres evolving from current shopping mall sites, and a frequent transit network serving the majority of the urban area. The OCP has established a starting set of priorities for neighbourhood planning.[25] As well the OCP requires any large development proposals in the East Cambie, Blundell, and Garden City areas over 1 hectare (2.5 acres), to engage in a neighbourhood master planning process. This provides an exceptional opportunity to ensure that transit and land-use planning are developed in concert.

Through this action the City will:

- Define a sequencing strategy for the East Cambie, Blundell, and Garden City neighbourhood master planning
- Develop measures to stimulate neighbourhood development according to the transit area plan[26]
- Work to include the "Six D's" of transit oriented development into the neighbourhood plans

The 6 "Ds" of Transit-Oriented Communities:

D1: Destinations: Land use planning to make destinations sites

D2: Distance: Create a well-connected street network

D3: Design: Create places for people

D4: Density: Concentrate and intensify activities near frequent transit

D5: Diversity: Encourage a mix of uses

D6: Demand Management: Discourage unnecessary driving

From: Design Guidelines for Transit-Oriented Communities, TransLink,

Action 2 **Collaborate with TransLink to update the Area Transit Plan (ATP)**

Seeing the OCP defined future 'play out' will occur through the implementation of the OCP *and* the development and implementation of TransLink's next Area Transit Plan (ATP) – anticipated to initiate an update in 2014. The transit area planning will be aided by clear guidance to TransLink on the priority areas of growth and development (Action 1).

It is important that the participation in the ATP capture the planning and land use issues and not be simply viewed as an infrastructure and engineering issue.

[24] Density is not the only element needed to create a Transit-Oriented Community. TransLink has identified the 6 "Ds" of Transit-Oriented Communities (Destinations, Distance, Design, Density, Diversity, and Demand Management). In combination these elements combine to shift mobility patterns towards transit, walking and cycling and away from automobiles.

[25] The OCP does identify general planning priorities. For example it defines the Broadmoor Neighbourhood Master Plan now completed for the shopping centre itself) and Hamilton Shopping Centre (underway) to continue, identifies East Cambie, Blundell, and Garden City as future planning areas, and defers planning for Terra Nova, Ironwood, and Seafair shopping malls into the far future. (OCP pg 3-4)

[26] Stimulus measures are not currently defined but may include packages of services, school and recreation facility planning, etc. Discussion with developers, or market studies may be required to define which measures are most suitable for each neighbourhood.

The City will:

- Partner with TransLink to align improvements to the transit network with land use plans and the defined FTN sequencing and routes[27]
- Promote the 6 ”Ds” of transit planning by developing new commercial and mixed-use spaces (Destinations and Diversity); improved links for pedestrian and cycling access (Distances); street furnishings, plantings, public art (Design), and decreased focus on automobile through reduced or priced parking (Demand Management) – see Mobility strategies for more ideas.
- Identify new infrastructure needs to assist capital and road works planning and that leverages the benefits of the Canada Line construction

Strategy 2: Increase Energy Efficiency in New Developments

Action 3 Include energy efficiency in Neighbourhood Centre planning

Current and future neighbourhood plans can define objectives for energy efficiency. The 2008 “Bill 27” amendments to the Local Government Act (LGA) and the Community Charter allowed for local governments to include energy and water efficiency and reduced GHG emissions as objectives in development permit guidelines. Defining these has not been easy but includes issues such as building orientation, solar exposure and shading, ventilation, high albedo roofing materials, maximum glazing, or on-site renewable energy production

Specific actions to explore in future planning include:

- Incentivizing high efficiency requirements for new developments
- Requiring provisions for (current or future) alternative energy and district energy-ready systems
- Include increased energy requirements for rezoned developments in neighbourhood centre rezoning similar to CCAP requirements

Action 4 Promote energy efficiency in all rezoning

The City Centre Area Plan requires that rezonings greater than 2,000 m^2 achieve LEED Silver equivalent. Action 3 (above) promotes this standard to each of the future shopping centre neighbourhood plans. This action suggests that higher energy efficiency requirements may eventually become a standard for all significant rezoning citywide.

[27] A common benchmark objective to achieve is service of a level of a Frequent Transit Network (FTN) – loosely defined as 15 min or better service, 12-15 hours per day – every day. FTN service provides a frequency that is generally regarded as the level at which customers will switch to transit over other transportation because it can be relied upon. The FTN defined in the mobility section of the OCP is an illustrative example to show the intent, and the impact of the arterial development strategy defined for the non-City Centre areas of the City. It is expected that it would be refined through the ATP process.

The City will:

- Explore options to make high-energy efficiency a requirement for all significant rezoning applications
- Identify energy efficiency requirements and application criteria in consultation with stakeholders
- Consider improved energy metering for multifamily and commercial buildings

Action 5 **Develop incentives for new development to exceed the building code energy requirements**

The BC government is pursuing energy efficiency targets through improvements to the BC Building Code and equipment standards. Incentives may help to overcome the additional cost of building a building that exceeds these more stringent code requirements during the life of the plan. This barrier is often cited as a reason for not building to higher standards. There are a variety of possible incentives including building permit fee discounts, (possibly) reduced DDC charges, revitalization tax exemptions (RTEs), or financing mechanisms.

The City will:

- Evaluate the options for an energy efficiency incentive program to encourage new developments to pursue greater efficiency. Tools may include fee reductions, rebates, revitalization tax exemptions, or other financial incentives

Action 6 **Ensure that existing building code requirements are attained**

In 2008, the energy provisions of the building code were updated to be more stringent. There has been data accumulating recently (for example by BC Hydro) that indicates that the intended energy efficiencies are not always achieved. The reasons for this are not well understood but will become more evident over time. Working to achieve better attainment of the existing building standards may have a large impact on the energy use of new development – irrespective of efforts to achieve "better than code" performance.

The City will:

- work with BC Hydro, the BC Office of Housing and Construction Standards, and other agencies to evaluate the performance of new buildings within the City, identify causes of underperformance, and define a coordinated approach to ensure that code requirements are attained
- review internal City processes to improve energy performance of new construction

Strategy 3: Improve the Performance of Existing Building Stock

Almost 2/3 of the current energy use in the City, and over 40% of the GHG emissions are due to the existing building stock. Development actions (strategy #2) provides an opportunity to improve the sustainability of new buildings – which will replace some of the existing buildings, however the majority of the structures standing today will still be in place in 2041. Since OCP land use policies and development controls do not directly impact the existing building stock, this strategy is of particular importance to the scenario reductions.

The City currently has limited interaction with residents and businesses on energy issues and will need to expand its role if it is to achieve substantial reductions. At the local level, there are limited regulatory options to increase energy efficiency of existing buildings.[28] The opportunities for the City are primarily to pursue outreach and incentive activities.

Action 7 **Promote building efficiency through outreach and education**

The city can use its "points of contact" with residents to promote and encourage residents and businesses to take action. These include tax mailings, newspaper advertisements, utility distributions, the City website, the reception desk at City Hall, and the building permit desk.

The City will:

- Review and update its communication of energy efficiency and of available incentive programs for residents and businesses
- Provide training and education (where appropriate) to city staff to help them understand the issues and communicate these to residents
- Support appropriate regional initiatives to identify cost-effective improvements to increase energy efficiency of the existing building stock

Action 8 **Provide incentives for building retrofit action**

Cost burdens are often cited as a reason for not taking action on energy efficiency. Providing some form of incentive can help mobilize action. Possibilities include:

- Building permit fee discounts for major renovations that include an energy upgrade (or perhaps simply an energy evaluation)
- Rebates for residents that conduct an energy audit
- Revitalization tax exemptions for energy efficiency (traditionally connected to historic preservation but energy conservation is allowed for an RTE bylaw)

The City will:

- Develop a program of incentive measures for existing buildings. Most likely this will start as a pilot project and may be centred on a building audit incentive program

While typically directed towards owner occupants, these incentives – particularly may be structured to provide an incentive for non-occupant owners (e.g. a tax reduction for the rental stock may be developed).[29]

[28] The City has signaled its support for alternative energy by singing on to the "solar energy ready" provisions of the BC Building Code.

[29] Rental stock can be a challenge to incentivize since the person paying for the upgrade (owner) does not benefit directly from the reduced energy costs or the improvement in living conditions.

Action 9 Develop a residential energy conservation program to support housing affordability

An area that is traditionally hard to reach with energy conservation incentives is low income residents, and in particular low income renters. Renters in particular are not able to make improvements to structures they don't own, and landlords are sometimes not motivated to make conservation measures if they do not receive the costs savings.

The city does have a strong interest in affordable housing, and there is a segment of aging rental housing. This action would target energy conservation through a small number of easy to install measures (shower heads, water fixtures, etc.) that may be installed by a resident, or by a resident with some assistance. The City may then use its access points (social services, program delivery agents, etc.) to get these installed in resident dwellings. This action may also be connected to water conservation, which is more familiar to municipal governments.

The City will:

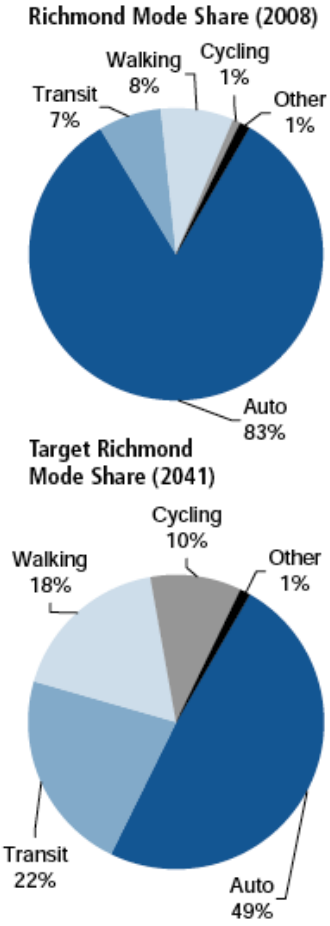
- Support awareness of and access to energy conservation programs for low income residents
- Explore opportunities to retrofit units owned and/or operated by non-market housing providers

THEME 2: MOBILITY AND ACCESS

The OCP clearly identifies the need to make significant shifts in the way we get around. By 2041, the City aims to have more than half of all trips in Richmond by non-vehicle modes – walking, cycling and transit. In 2008, that vast majority of trips in Richmond were automobile trips (83%), so shifting to 51% of trips by walking, cycling and transit will require a concerted shift in priorities during land use planning (see Connected Neighbourhoods), infrastructure planning and design, as well as a shift in people's behaviours and attitudes towards using alternative forms of transportation.

The City recognizes that achieving this significant shift is necessary to reach the community's GHG emission reduction targets, but also necessary to achieve numerous other community objectives, including providing mobility and accessibility options to all residents, maintaining the affordability of getting around, providing safe public spaces, maintaining good air quality, and avoiding costly road expansions to accommodate growing populations.

Prior to updating the OCP, the City undertook a Richmond Transportation Plan, including modeling of the current transportation system and opportunities for reducing reliance on vehicles. This study noted that the current street network does not have capacity problems within Richmond (though some were identified at connection points to other cities), and that with previously identified improvements for the City Centre, no further increases in passenger vehicle capacity are needed to 2041. This provides an opportunity to shift financing priorities towards non-vehicular transportation improvements.



An important element of Richmond's transportation system is to understand where people travel to and from. Based on TransLink's Trip Diary analysis for trips taken in the fall of 2011, a very high percentage of trips that start in Richmond stay in Richmond (67% - the highest of any sub-region in the TransLink's service area). That means people are staying within the city to do many of their errands, go to restaurants, etc. The second most popular destination is Vancouver (16% of trips), which is well supported by the Canada Line. Therefore, a key focus for this plan is how to transition those trips within Richmond away from automobile trips to walking, cycling and transit trips. The weekday trips within Richmond are currently over 80% by automobile, while transit is only used for 5% of trips.

The City's increased commitment to non-vehicular transportation over recent years is demonstrated through several initiatives:

- Transportation Demand Management (TDM) measures are sought through development and have included: electrical outlets for vehicles and bikes, improved transit, pedestrian and cycling infrastructure, provision of car-share parking space and/or vehicle (primarily in proximity to Canada Line stations) and provision of transit passes
- Consolidated existing funding programs to create the Active Transportation Improvement Program in the 2013 budget
- Annual funding for Bike to Work Week (twice per year) and for Streetwise Cycling courses (learn to ride in traffic for adults)
- Planned funding in 2013 for Bike to School (learn to ride for elementary and secondary school students)
- Annual "Island City, by Bike" Tour for the community
- Biennial publication and distribution of cycling and trails map
- Currently designing a new recreation greenway along Railway Avenue (3.7 km trail for pedestrians and cyclists)

Strategy 4: Prioritize and Fund Walking, Rolling and Cycling

Supplying safe, direct, high-quality paths to and from homes, work, transit stops and other destinations is essential to reach Richmond's target to get residents, workers and visitors out of their vehicles for half of all trips. Safe routes ensure each mode is separated (i.e. pedestrians are separated from cyclists and vehicles; cyclists are separated from pedestrians and vehicles). Direct paths provide links directly to destinations; as opposed to traditional (vehicle-focused) roadway planning that has created circuitous paths that are a major deterrent to walking for errands and access.

Through the recent OCP update, the City has adopted policies that demonstrate a significant shift in priority towards the redesign of streets to incorporate quality infrastructure and allocation of street capacity to walking, rolling, cycling and transit uses. To realize this, it will be imperative to adopt this shift in priorities into infrastructure planning and design guidelines, and to ensure the City's annual capital budgets also reflect this shift in priorities.

Action 10 **Prioritize walking, rolling and cycling infrastructure**

Over several decades Richmond's transportation network has developed with a primary focus on streets for vehicles, and limited focus on other modes of transportation until recently. The City is now facing the challenge of maintaining the current street network, while significantly enhancing the non-vehicle transport network. This will require dedicated investment and integrated planning.

Non-vehicle infrastructure typically improves with dedicated budgets for each separate mode. Richmond has made significant investments in walking, rolling and cycling infrastructure and walkways through a variety of capital improvement programs: Active Transportation, Crosswalk, Neighbourhood Walkways and Pedestrian and Roadway. Additional investment is made through the Parks Division and special transportation projects. As a result, it is difficult to isolate the total funding for the non-vehicle transport network.

There is a correlation between cycling infrastructure funding and cycling mode share observed internationally. For example, it is estimated that dedicated investment of approximately 5 to 10 USD per capita in cycling infrastructure is required to yield a modal share of 5 to 10 percent[30]. Over the long term, the pedestrian and cycling network is less expensive to maintain than the vehicle network and is one of the least expensive elements of changing land use and transportation patterns.

The City will:

- Assess capital budgets to dedicate funds for pedestrian, rolling and cycling infrastructure that is supportive of reaching the community's mode shift targets
- Seek senior government grants to assist with funding larger dedicated pathways for walking, rolling and cycling
- Target to dedicate a minimum of 10% of every roadway budget toward pedestrian safety features[31]
- Prioritize linkages to existing and future planned Neighbourhood Centres and Frequent Transit Network corridors

Freiburg, Germany (pop 218,000) dedicated $1.3 million USD annually since 1976 and has 70% local trips made by bike, foot or public transit.

Source: Share the Road: Investment in Walking and Cycling Road Infrastructure, UNEP

[30] Transport, Energy and CO2: Moving towards Sustainability, International Energy Agency IEA, 2009.

[31] The Commission for Global Road Safety recommends that a minimum 10% of total project costs be allocated to safety.

Action 11 **Continue a "Complete Streets" approach in all new street construction and rehabilitation projects**

"Complete Streets" refer to streets that are designed to accommodate many different modes, including walking, rolling, cycling, public transit and vehicles. Complete Streets typically incorporate the following design features as appropriate[32]:

- Wider and better sidewalks
- Universal design features (curbcuts and ramps)
- Crosswalks with pedestrian refuge islands
- Bike lanes
- Bus shelters and bus lanes where justified
- Centre left turn lanes
- Lower traffic speeds
- Landscaping

In addition to identifying a sustained, increased level of investment in and prioritization of non-vehicle infrastructure, the City will also need to ensure any new construction meets standards that support these new priorities.

For this action the City will:

- Review subdivision and development control bylaws to ensure designs provide safe, separated pathways for walking and cycling. To fully support non-vehicle mobility, the key will be to provide separated pathways for each mode (walking and cycling) to improve safety and comfort for all users[33]
- Identify opportunities to reduce traffic speeds on urban streets
- Identify schedules of street improvement projects based on the prioritized list of non-vehicle infrastructure needs
- Where street improvements are prioritized to support goods movement, ensure non-vehicle infrastructure is fully integrated into all rehabilitation projects

[32] "Evaluating Complete Streets The Value of Designing Roads For Diverse Modes, Users and Activities", T. Litman, Victoria Transport Policy Institute, January 2013.

[33] For guidance on cycling infrastructure refer to the BC Ministry of Transportation and Infrastructure Bicycle Facilities Design, Course Manual, 2011.

Strategy 5: Enhance Alternative Transportation Connectivity

Ensuring residents have direct, safe routes to local shopping, amenities and transit will enable an increase in the number of walking, rolling, cycling and transit trips. This supports the community's goals to provide a transportation system that supports accessibility, safety and health of all its residents and visitors. The OCP identifies existing and future greenways, and neighbourhood links for each area of Richmond (section 3.5), and also identifies a list of criteria to use for prioritizing the identified projects (within 400 m radius of a neighbourhood centre, provides direct access to local destination, etc.).

Action 12 **Improve pedestrian links throughout the city as the top transportation priority**

Walking and rolling are the most accessible, equitable, healthy forms of transportation that can be used by all residents in Richmond. But the City must ensure pathways, sidewalks and other pedestrian links are in place throughout the community.

The City will:

- Identify streets to reduce vehicle speeds, increasing pedestrian safety. Various mechanisms may be employed, including reducing vehicles to one lane each way and converting additional space into separated paths
- Prioritize all links identified within 400 m of Neighbourhood Centres that are on a current or planned Frequent Transit route and incorporate targets into Area Planning and Transit Planning processes
- Prioritize Parks planning and budgets for Greenways to complete citywide links between Neighbourhood Centres in tandem with neighbourhood development sequencing
- Seek out opportunities to improve links in neighbourhoods not being redeveloped and eliminate circuitous pedestrian routes (may require land acquisition where City land is not available)
- Fix sidewalks that limit accessibility for people that are rolling (e.g. reduce bumps at driveways)
- Provide funding to citizen groups that are promoting walking programs
- Consider the creation of car-free zones

Action 13 **Focus on providing safe school routes**

The City will prioritize pedestrian and cycling connections along school routes. This includes:

- Formalize the improvement of routes to school by funding or coordinating a citywide Safe Routes to School program[34] in conjunction with the School District, and with Parent Advisory Councils at each school
- Working with the health authority to support a campaign for parents that links active transportation with healthier, more alert school children
- Create vehicle-free zones in front of schools and designate vehicle drop-off areas further away to improve safety and improve pedestrian access

Strategy 6: Facilitate Changes in Transportation Behaviour and Mode Choice

In addition to providing improved pedestrian, rolling and cycling infrastructure, incentives and disincentives may be required to ensure significant changes in the transportation choices made by Richmond residents. These can broadly be labelled Transportation Demand Management (TDM) measures. To increase the uptake of residents choosing transit, the City can also improve the built environment around transit stops by making it an attractive, comfortable, safe place to be while waiting for transit service. Although TransLink controls transit service routes and levels, however, the transit infrastructure improvements discussed here are within the City's realm. [35]

Action 14 **Implement Transportation Demand Management projects that incentivize non-vehicle mode choice and disincentivize vehicle use**

Municipalities are in the position to undertake a wide variety of TDM projects that support this transition in transportation choices ranging from raising awareness to implementing parking fees and addressing parking supply.

The City will work to implement the following TDM projects:

- Work with TransLink's Travelsmart program to raise awareness about the benefits of non-vehicle travel among residents, employees and employers, and school children
- Reduce parking supply in transit accessible areas. Currently the City currently allows developers to build fewer spaces in exchange for various alternative transportation amenities. However, to apply more direct disincentives for automobiles, the City could consider establishing maximum parking allowances for developments in close proximity to transit facilities

[34] As an example, HASTe is a local non-profit organization that works with municipalities or other groups taking action on reducing school transportation emissions in BC.

[35] In the context of this report, "transit infrastructure" refers to street-level elements that support a transit system, but not the service itself, as the service is the responsibility of TransLink. The City takes responsibility for transit infrastructure such as: benches, shelters, public art, pedestrian and rolling access, and dedicated bus lanes which all increase the comfort and accessibility of transit and are important elements of a successful transit system.

- Support Translink in coordinating employee discount transit passes across a number of firms in a related location (e.g. a business park) where individual employers are unable to meet the minimum requirement for discounted passes. Encourage companies to fund a "top-up" on the transit pass discount to bring it to 25% (from 15%)
- Continue encouraging car share organizations to locate vehicles in Richmond at key Neighbourhood Centres and throughout the City Centre. Provide dedicated parking spaces for minimal costs and promote car share programs with residents and businesses. Encourage employers to subsidize memberships for employees
- Support regional road pricing policies

Action 15 **Reduce supply of unrestricted City-owned parking spaces**

To discourage automobile use where other alternatives are available, the City can reduce the supply of unrestricted parking spaces both on- and off-street. This aligns with the City policy of reducing parking spaces in new developments where alternatives are available. The City will investigate the potential for:

- Implementing parking fees and/or time limits throughout the day in the City Centre
- Over time consider implementing fees and/or time limits in Neighbourhood Centres where stores and amenities can be widely accessed by walking, rolling or cycling

Action 16 **Provide infrastructure improvements to support increased transit service**

To get more people riding transit, the City will need to provide improvements to the public spaces where people access and wait for transit, as well as providing dedicated bus lanes and other transit priority measures that support a more frequent service level. TransLink, in consultation with the City and other stakeholders, will define a new Richmond Area Transit Plan within the next year. Once the new plan is determined, the City will:

- Evaluate all current and future planned transit corridors for opportunities to improve the public space to make it attractive for transit users. Incorporate public art, greenery, lighting and other design elements to ensure transit users feel safe and comfortable
- Commit funding to provide bus shelters and/or benches along all Frequent Transit routes
- Implement transit priority measures (dedicated lanes, priority traffic lights, etc.) to support new service levels

Action 17 **Improve bike facilities and consider implementing a bike share system**

Facilities dedicated to cyclists are currently in place but can be expanded further over time in Richmond. In addition to separated pathways, cyclists also need bike racks and other convenient and safe storage options at all destinations. Other facilities may include cyclist-controlled traffic lights. The City will:

- Provide ample and secure bicycle parking at all City facilities
- Actively encourage other community amenities to put bicycle infrastructure in place – e.g. schools, clubs, businesses / business associations
- Require cycling amenities with new developments

Convenient access to Canada Line stations and other key FTN exchanges can be enhanced through provision of a public bicycle sharing system. There are over 300 cities around the world using public bike share systems with great success at reducing the use of personal vehicles for short trips, and for extending the reach of transit trips. Cities in Canada with existing systems include Montreal and Ottawa. The City of Vancouver is currently in the process of launching the first privately run and operated public bike share system in BC (target launch is summer 2013), and it is expected that this program will be expanded to Richmond if it is found to be successful.

In coordination with TransLink, the City will:

- Assess the feasibility of launching a public bike share system with a focus on connecting areas of high density and high employment with transit and community amenities. The system can start with a focus on the City Centre area and consider expansion to link Neighbourhood Centres over time

Strategy 7: Promote Low Carbon Personal Vehicles

There are many areas of Richmond, including single-family oriented neighbourhoods outside the current and potential future Neighbourhood Centres, and those in agricultural areas that are not expected to see any significant change in density over the next 30 years. Provision of a Frequent Transit service in close proximity to these residents is not viable.

Residents in these areas must also find alternatives that significantly reduce the distances they travel by vehicle and/or significantly increase the efficiency of their vehicles. Action can still be defined for these areas to improve the efficiency from vehicles for those trips that are still made

This strategy focuses on encouraging the use of smaller, more efficient and electric vehicles (EVs) that can achieve further reductions in the community's GHG emissions. The City has received funding and is currently installing EV charging stations across the community – 10 stations in 5 civic locations for public and City fleet use. The City also has new developments include EV charging stations as part of rezoning applications.

Action 18 **Set minimum requirements for EV infrastructure in new developments**

The OCP has identified private development EV infrastructure policy aligned with forecasted BC market penetration rates:

- A minimum of 20% parking stalls provided with a suitable receptacle for electric vehicle charging, and
- An additional 25% parking stalls pre-ducted for future wiring.

Detailed implementation will be done in consultation with stakeholders to address challenges associated with mixed use and/or strata developments. Investigate the provision of publicly accessible charging infrastructure proximate to the development in lieu of private EV infrastructure.

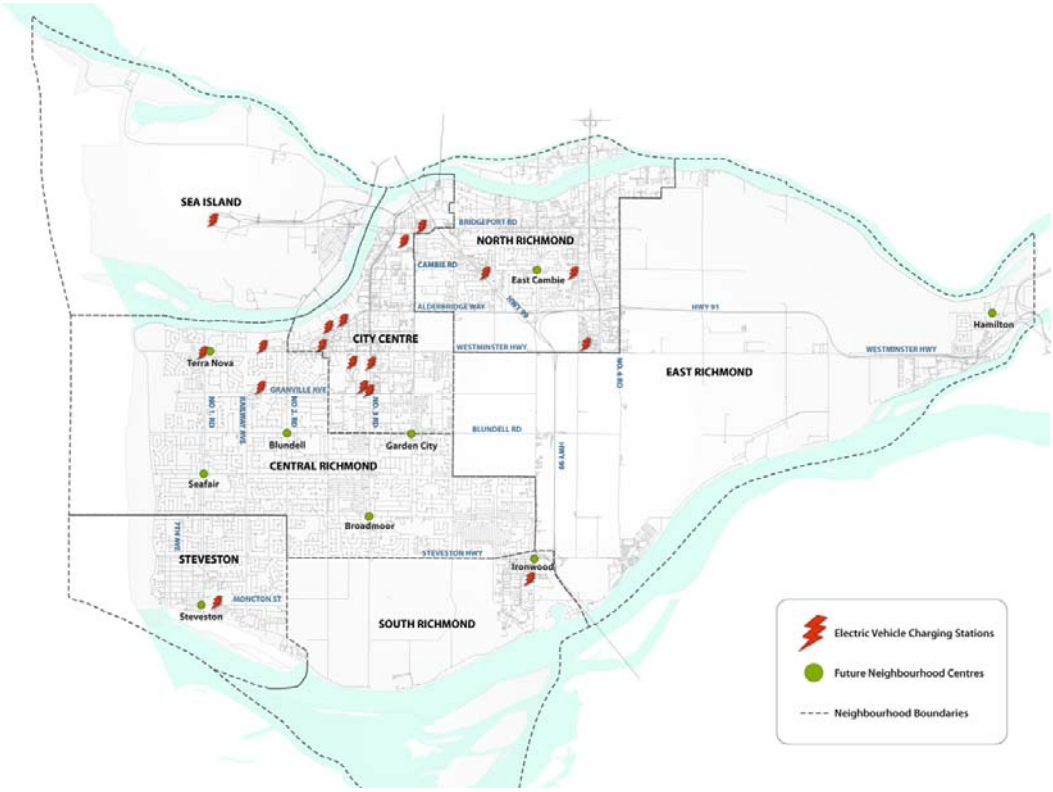
The City will also consider whether service stations should also support EV uptake by requiring new stations to include EV charging infrastructure.

Action 19 **Continue expanding the City-owned network of EV charging stations**

The existing EV charging network is largely focused in the City Centre (Figure 22), however, provision of this infrastructure in Neighbourhood Centres and at community facilities throughout the city is needed. The City will:

- Continue to install EV charging stations at key locations across the city
- Consider providing premium parking in the City Centre to electric or small (e.g. smart car) vehicles

Figure 22. Location of Electric Vehicle charging stations in Richmond



THEME 3: RESILIENT ECONOMY

From an energy and carbon perspective, the economy sector refers to light industrial and commercial buildings and commercial vehicles and goods movement. Commercial buildings consume 36 % of the energy in the community and produce 21% of the GHG emissions. Commercial vehicles use 8% of the energy and produce 12% of the GHG emissions.

Municipalities interact with their commercial businesses through new development projects, property tax and business licensing issues, the Chamber of Commerce, and potentially for occasional bylaw enforcement issues. The City has an Economic Development office, whose role is to encourage and facilitate economic expansion within the City of Richmond. It acts as a catalyst to bring together people, ideas and capital, ultimately leading to economic development and diversification.

Strategy 8: Encourage Energy Efficient Businesses

The City can encourage a greater awareness of energy efficiency and GHG reduction in the local business community. In many ways the City is already doing activities of this nature - e.g. supporting businesses to receive training from the Climate Smart Initiative. This role is generally one of facilitation, information sharing, and encouragement. Specifically the economic development office does not play a regulatory role. As a result, actions directed towards a more energy efficient economy will be supportive in nature and likely aided by partners in the community.

Action 20 **Promote energy efficient business operations**

In this action the City through its economic development activities will work to promote energy efficiency – through incentives or planning activities (e.g. eco-industrial networks) to engage and enable the business community to use energy more wisely and therefore reduce operating costs and increase business resiliency.

The City will:

- Increase engagement with businesses with respect to energy efficiency through support of established programs (e.g. ClimateSmart, LiveSmart, utility conservation programs)
- Encourage creation of green jobs during local economic development planning
- Create liaison groups for Building Energy Managers and Fleet Managers to increase opportunities for capacity building and knowledge sharing across organizations with these roles (e.g. YVR, School District, Kwantlen)
- Continue to improve the City's corporate sustainability practices, including updating the corporate sustainable procurement policy
- Raise awareness amongst the business community of the City's sustainability initiatives

THEME 4: SUSTAINABLE INFRASTRUCTURE AND RESOURCES

This section describes strategies to address the energy and carbon aspects of sustainable infrastructure and resources. The city is the owner and operators of a vast network of infrastructure – roads, sewers, drainage pumping and sewage lift stations.

The City of Richmond became an energy utility operator with the establishment of the Alexandra District Energy Utility in July 2012. The OCP directs that the City will specifically look to utilize local energy sources as a way to be more resilient and self-sufficient in energy.

Waste is also recognized more as a resource than as a disposal product. The City is aligned with Metro Vancouver's waste strategy to increase diversion from disposal to 70%.

Strategy 9: Continue Advancement of Neighbourhood District Energy Systems

The City has been experiencing significant population growth with the associated demand for new housing, additional infrastructure and amenities. It is anticipated that the population in Richmond City Centre will grow from approximately 50,000 today to 100,000 by 2040 and to 120,000 by 2100. A thermal energy demand map, developed by City staff identified this growth as a great opportunity for development of neighbourhood district energy systems.

Sustainable energy systems such as district energy provide a number of benefits for the community including environmental performance, local energy security, improved energy efficiency, fuel flexibility, and economic benefits to community. They also provide new employment opportunities during the construction and operation.

The City has shown leadership in pursuing district energy opportunities – completing a number of pre-feasibility studies, developing Richmond's first DE system utilizing ground source heat pump technology in West Cambie area, implementing Alexandra District Energy Utility service area bylaw, developing thermal energy demand map for the City Centre area, procuring detailed feasibility study for the River Green Development, defining a policy for new developments in the City Centre to be DEU–ready

Action 21 Reserve district energy rights of ways in new developments and road reconstruction

During development reviews, City staff work with proponents and developers to ensure that suitable right of ways are preserved in the roads to allow for future district energy services – but these are not codified or reserved from future use.

In this action the City will:

- Identify DE building connection standards for access across properties
- Determine a mechanism to formalize the right-of-ways being reserved for future DE services
- Encourage private DE development where appropriate

Action 22 Develop a City Centre DE Right of Way Master Plan

Develop a long term plan to maintain the future capability for District energy systems, by developing a plan for and preserving within the City Centre area suitable rights of ways and space under the streets for District Energy piping and other infrastructure.

Action 23 **Explore opportunities to connect existing buildings to DE system**

Almost 2/3 of the current energy use in the City, and over 40% of the GHG emissions are due to the existing building stock. Connecting the new buildings to district energy system provides an opportunity to improve the sustainability of new buildings; however the majority of the structures standing today will still be in place in 2041. Majority of these existing buildings use gas fired make-up-air units (MUA) for common space conditioning and gas fired boilers for domestic hot water heating.

The City will:

- Conduct a screening level analysis to identify multi-unit residential buildings located close to high density development to connect to district energy systems

Action 24 **Explore options for electricity generation from utility scale renewable sources**

There are potential energy sources that may be explored. These would need to address site-specific issues of the geography, location, and available energy sources in Richmond. The City has already explored heat capture from the Lulu Island wastewater treatment plant. Other examples might include waste heat capture from industrial facilities that may generate electricity if properly deployed.[36]

The City will:

- Conduct a screening level analysis – in partnership with BC Hydro – to identify possibilities for renewable electricity generation within the City

Action 25 **Integrate energy infrastructure into community planning**

Utilities – including BC Hydro have traditionally executed their infrastructure planning independently of municipal infrastructure. Interactions would typically be for permits and rights of way reviews. More recently there is an interest for infrastructure and utility planning to be better coordinated – and this may be specifically valuable in Richmond where the scale of new electricity demand is requiring BC Hydro to plan for upgrades to their infrastructure.

The City will:

- Work more proactively with BC Hydro and other utilities to coordinate civil engineering work with energy utility work

[36] Each community has different opportunities for renewable energy. Specific factors in Richmond energy source may

Strategy 10: Utilize Local Energy Sources

Most community energy systems (vehicles, electricity, natural gas, etc.) bring energy from far away and deliver it to a community. This system has in the past been very successful, and as a result cities are intensive energy consumers, but not effective at energy generation. As new sources of energy become more expensive, or their reliability more uncertain, it is valuable to look again for energy sources within the community.

Local energy sources can be developed to provide a portion of the community's energy supply. This can have many benefits – most notable are the potential to defer major infrastructure upgrades, and to have a more resilient and varied energy supply system. There may also be potential to create jobs in the community through the development of energy sources.

Action 26 **Promote building scale renewable energy**

Innovative technologies can be applied at the building scale to reduce conventional energy consumption. At present the most common application is rooftop solar panels to provide water heat.[37] Other applications may include photo-voltaic (PV) systems for electricity, small wind generation systems, and a range of innovative heat pump applications.

Barriers to implementation of new technologies include cost, lack of proven examples or certification, uncertainty with permitting, unfamiliarity to approving officers and industry, and concerns over system impacts such as noise, reliability, servicing, etc.

To improve the uptake of these technologies, the City will:

- Explicitly define considerations for renewable energy technologies (rooftop solar, small scale wind, heat pump locations and operation) when developing or updating neighbourhood plans and development permit area guidelines [38]
- Invest in training and education of City staff regarding new innovative energy technologies
- Perform community level study for the effectiveness of the solar thermal systems for single family dwellings
- Actively promote the use of solar thermal heating in new dwelling construction
- Explore requiring or incentivizing renewable technologies including solar air heating and ventilation (solar walls)

[37] Richmond has signed-on to the solar ready building code amendment which requires that new detached dwellings provide suitable rooftop, conduit, and utility room space for the future installation of sola hot water systems.

[38] For example, the corporation of Delta has developed a rooftop thermal energy bylaw that states that the height of roof top solar panels is not included in the building height calculation.

Strategy 11: Maximize Use of Waste

The City has set aggressive diversion targets as part of the regional Integrated Solid Waste and Resource Management Plan (ISWRMP) and Integrated Liquid Waste and Resource Management Plan (ILWRMP). Waste diversion can create energy recovery opportunities (e.g. through biogas creation from separated organics).

Action 27 **Continue to implement the Integrated Solid Waste and Resource Management Plan**

The OCP commitment and the ISWRMP have set enthusiastic targets for waste diversion and the City is proactive in this area.

The City will:

- Continue to implement waste diversion activities in support of a 70% diversion target
- Encourage waste to be used as a resource

Action 28 **Continue to implement the Integrated Liquid Waste and Resource Management Plan**

The ILWRMP has a goal to use liquid waste as a resource and the City is proactive in this area.

The City will:

- Seek opportunities to recover heat from sewerage
- Encourage the capture and use of biogas generated in the treatment process

THEME 5: CLIMATE CHANGE LEADERSHIP

The OCP defines climate action as an important consideration for the City in its planning and development. Part of that response will be to demonstrate that the City is committed to action, and will support all sectors of the community.

Although these strategies do not directly achieve community reductions, they are foundational and are part of a consolidated approach to building support for energy conservation and efficiency.

Strategy 12: Encourage Sustained Action by Senior Levels of Government

Action 29 Continue to advocate for support from senior levels of government

The Federal and Provincial governments have a crucial role to play to reduce GHG emissions – through their roles as regulators (e.g. setting vehicle fuel efficiency standards, building code requirements, equipment efficiency standards), and as funders (through incentive measures, grant programs, and tax policy).

For this action the City will:

- Advocate for more aggressive action by Federal and Provincial agencies, independently and through the Union of BC Municipalities (UBCM), and the Federation of Canadian Municipalities (FCM).
- Support the achievement of GHG reduction targets at the Federal and Provincial level.

Strategy 13: "Lead by example" with City Operations Energy Management

Richmond has been a leader in "walking the talk" of conservation in its own operations. Several years ago it first established fleet management initiatives directed specifically to energy conservation and was among the first municipalities to define a policy for green building requirements in municipal facilities.[39] It has a dedicated staff role as an operations energy manager. As well it has signed the BC Climate Action Charter and reports annually on its operations and carbon footprint.

Pursuing the council approved energy and GHG reduction targets will mean that the City is going to ask its residents and businesses to take action. To be perceived as credible, the City will need to demonstrate that it has made a similar commitment to what it is asking residents and businesses to make.

Action 30 Develop long-term funding for climate activities in the city

Energy and emissions management are new areas that are largely unfunded, or are funded for short term, or project based activities through grants and partnerships. Recognizing that these issues are new, they will require incremental funding beyond existing resources. This funding will require a combination of staff time, and disbursements. Possible sources of this funding are general revenues, and the Carbon tax rebate (CARIP grant), which some communities have dedicated to be used to fund sustainability initiatives. Note, however, that grant funding is only certain on a year-to-year basis.

[39] Using the green building standards Leadership in Energy and Environmental Design (LEED™), the City established a policy that all municipal buildings be designed in accordance with LEED™

The City will:

- Secure long term budget funding for community climate change action.[40]

Action 31 **Integrate climate change into other municipal activities**

Taking action cannot be seen as an isolated activity. Rather it needs to align well with other initiatives. The 2041 OCP document includes many initiatives that have multiple community benefits, one of which is energy efficiency. Those benefits may not be explicitly identified as being climate driven.

The City will:

- Include considerations for energy conservation in other planning and infrastructure activities
- Continue developing the Sustainability Framework and expanding to other municipal activity areas.
- Continue its efforts to reduce energy use and carbon emissions in its building, fleet, and infrastructure operations.

Action 32 **Provide incentives to encourage alternative transportation use by staff**

Promoting alternative transportation with staff is a highly visible way to demonstrate leadership to the community. Opportunities to take action include fostering car-pooling, providing facilities at municipal facilities for staff to use alternative transportation, and providing incentives for transit. Many staff already use alternative transportation or transit for their commute.

[40] In 2012 the city received Climate Action Revenue Incentive Program (CARIP) grant of $232,000. This is essentially a reimbursement of the carbon tax paid by the City. Richmond dedicates these funds to the Carbon Provisional Account. The purpose of the fund is to reduce corporate emissions, support community-based GHG reduction action and protect the City from financial exposure should purchase of external offsets be required.

The City will:

- Review its major workplaces facilities for any gaps in provision of cycling, walking or transit opportunities.
- Consider providing top-up incentives (e.g. perhaps a matching 15% or something similar) to encourage employees to join the program.[41]

Action 33 **Define a climate change portfolio / staff person**

Experiences throughout the province have shown that without defined roles and responsibilities to specific staff, climate action is slow to start and the results are rarely fully realized.

The City will:

- Create clearly defined roles and responsibilities for the implementation of specific activities among existing departments (where appropriate) and provide job responsibilities for proper administration of this initiative.[42]

Strategy 14: Engage the Community on Climate Action

The OCP encourages the City to be an active player in moving forward resident and business action on energy conservation.

Action 34 **Develop an outreach program to residents and businesses on climate action**

Motivating and enabling residents and businesses to take their own action have been identified as key areas where the City can take action. The City is a contact point between residents, businesses and government in so many areas – utilities, services, development, recreation, culture, and more – that it is a natural place for the City to play a role.

[41] TransLink offers a program whereby employers can arrange for their staff to receive a discount (typically 15%) on monthly bus pass purchases. This is a voluntary program but has some restrictions – including that employees must sign up for a year at a time for the program. The one-year sign-up has been seen as a barrier to join the program as the 15% discount is neutralized by unused transit days (vacation, other modes of commuting).

[42] See Chapter 7, for a description of the expected implementation requirements.

Opportunities for the City to take action include:

- Promoting existing senior government incentives for homeowners and business owners
- Dedicating City webpage space to helping homeowners and businesses learn about energy conservation
- Using City “contact points” more aggressively to promote energy efficiency – e.g. the building permit desk, etc.
- Supporting NGO events related to climate change and energy through use of City land and facilities
- Developing a small grant program (possible via Grants in Aid, or using the Climate Provisional Account)

7 Beyond the Plan: "Breakthrough" Actions

It is acknowledged that the plan-defined actions are not likely to be sufficient to achieve the desired GHG reductions. This is not a unique situation; in fact, few if any communities have defined and committed to implement the types and strength of actions that would be required to meet reductions in the range of 80% in 40 years. If it were easy, we would already be done!

The future though is wildly uncertain, and 40 years is a sufficient time for many unpredictable things to occur: oil prices could spike, new technologies could make new buildings highly efficient and rising costs for electricity of other fuels could inspire a level of conservation that we can't anticipate at the present.

This section explores the potential impact of three major breakthroughs and uses the wedge presentation format to highlight the magnitude of impact of these measures.

These are presented to help us appreciate the impact of these large game changers. Rather than work to discern whether some or all or many or most residents would take an action these are presented as "What if we all did this?" statements.

Three "big breakthroughs" are selected:

- **Complete conversion of passenger vehicles to electric:** the electric car has reached commercialized status. At present the cost and charging infrastructure make it a niche product. At the same time, global oil forecasts vary widely from a future of shortage, to one of new found cheap oil. However, those supplies could be vulnerable, or volatile, or perhaps a future with a price on carbon makes them expensive. For this breakthrough, some combination of price changes and broader acceptance of electric vehicles results in near complete conversion of the passenger vehicles fleet to electric cars by 2041.[43]
- **Carbon Zero Buildings:** Architectural and engineering visioning has placed the idea of a net zero (energy) building as the norm. The new CIRS building at UBC is designed to be a net generator of energy. Even within the more modest realm of the building code, the continual updating of the ASHRAE 90.1 energy performance standard is driving more and more efficient building design and operation with a targets for dramatic improvements in energy performance over the coming 20 years. For this "big breakthrough" we have assumed that by 2025 all new buildings are "net zero" carbon emitters. [44]

[43] The average age of a vehicle in the lower mainland is about 10 years. Achieving this break through does not mean that everyone must buy an electric car for their next purchase, rather that by the time they buy their third vehicle, it is an electric one.

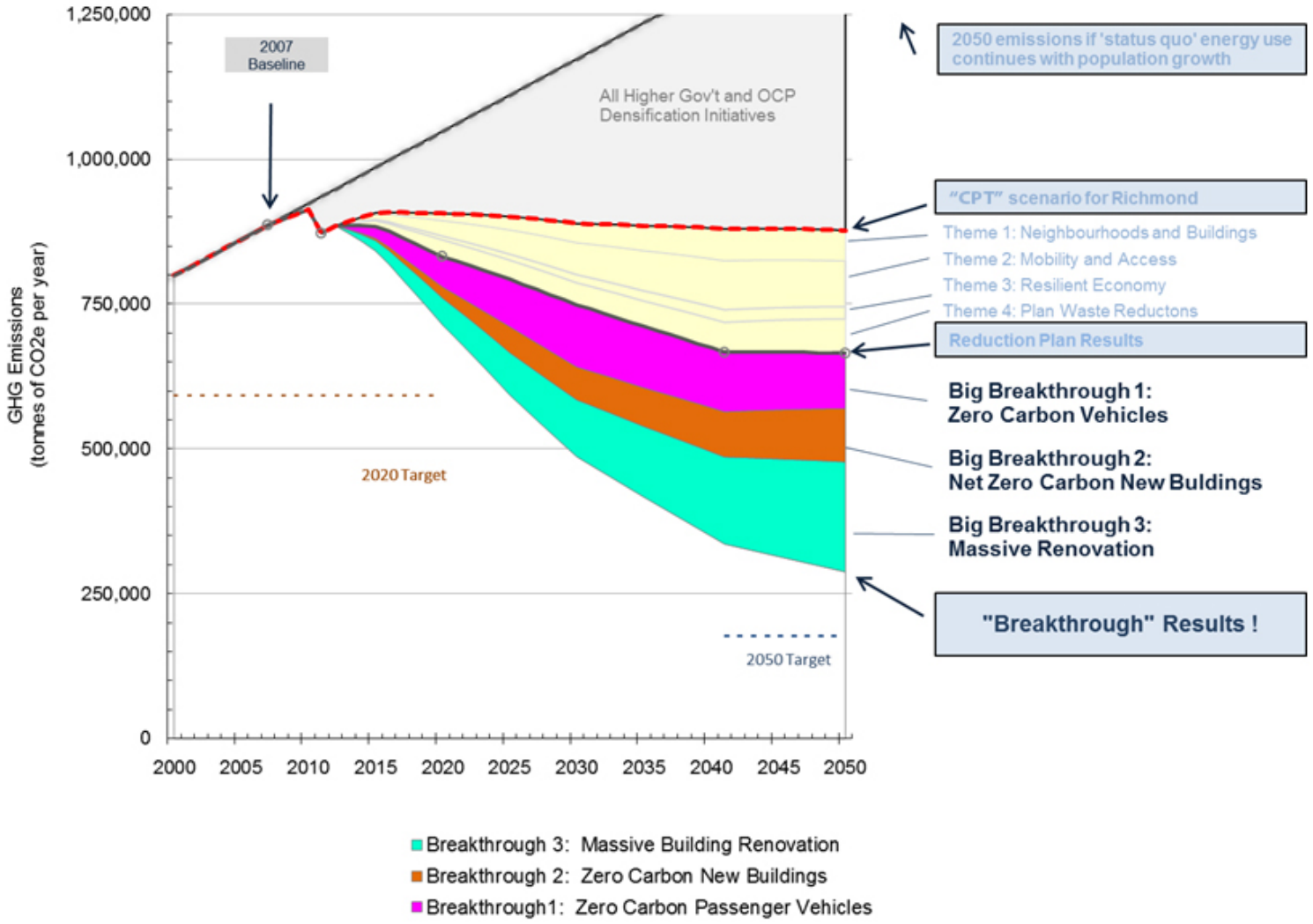
[44] Net zero implies that while they may consume some carbon fuel at some times, they also export energy to displace a similar amount of carbon fuel elsewhere.

- **Massive building stock renovation:** The energy elephant in the room in many communities is the stock of existing buildings. While new dwellings are built by the hundreds each year, and each one becoming more efficient than the last as the building code evolves, there are thousands of existing buildings in the community. These are unaffected generally by municipal activity, and are only affected by the owners, at their discretion. However, energy price swings, owner awareness, demographic turnover of housing stock etc. could drive a desire for residents to retrofit and upgrade the energy efficiency of their homes and businesses. For the big breakthrough it is assumed that by 2050 all existing buildings have had a major renovation that dramatically reduces their external energy needs and carbon emissions. Many of these buildings obtain a portion of their energy from on-site renewables and have deployed low carbon energy sources.

The results of these “Big Breakthroughs” are shown Figure 23. From this it is evident that more dramatic reductions are possible. To occur there will be a number of drivers beyond the municipal actions in this plan.

The wedge also shows us that no one action will be a silver bullet. To make large scale reductions will require action on each activity.

Figure 23. Carbon Wedge Results of the "Big Breakthrough" Actions



8 Implementation

8.1 Governance and Management

Preparation of the plan required staff resources from Sustainability and District Energy. It also required smaller allocations of time from departmental representatives participating in a staff working group to review drafts of the plan. The BC Hydro Sustainable Communities Program contributed to City funding for external expertise.

The plan presents a set of strategies and actions that will assist the City in taking steps to achieve its long-term energy vision and emission reduction targets.

8.2 5-Year Action-Level Implementation

Effective implementation of this plan requires some level of dedicated resources to ensure that actions are implemented and coordinated among departments and that progress is tracked. Sustainability and District Energy will be primarily responsible for the overall plan implementation with individual actions the responsibility of the relevant departments as deemed appropriate by their respective Directors. Additionally, some actions may require new resources not currently allocated in the City budget. As a starting point in understanding the level of resources that may be needed to create a Community Energy and Emissions Program, each action was assessed for its potential resource needs and costs.

The required staff, disbursements and capital costs are identified for resource planning purposes. Although much of the implementation requirements will rely on existing resources, there may be elements of the implementation plan that cannot be covered without additional resources or expertise. Similar to the preparation of the plan, the City will seek external funding as available.

The following table provides an action-level estimation with high-level costing estimate to implement the plan. As well, it identifies a number of considerations and co-benefits of the plan activity including:

- Approximate start year for implementing each action (between 2013 and 2018)
- Lead department – there may be a need to coordinate across departments, however this identifies the likely department to coordinate and lead the action
- Scale of City resources that may be needed to implement each action – considers potential additional staff resources that go beyond the existing staff roles, also provides very broad estimates for potential disbursements for studies, and notes where potential additional capital costs may be necessary
- Qualitative assessment of the potential cost to the community of the action – considers whether implementation of the action will result in reduced, neutral, or increased costs for affected parties. Note, this does not consider changes in municipal taxes – as these can be represented in the cost to the City.

At the same time as taking action to mitigate climate change and improve energy efficiency, the City is also undertaking numerous other activities to obtain other key community goals and objectives (e.g. increasing supply of affordable housing, protecting natural areas, creating vibrant arts, heritage and cultural communities, preserving clean air, etc.). Although these are not directly listed as the vision or key objectives of the Community Energy and Emissions Plan, it is important to recognize how the actions identified may have a positive or negative impact on these community objectives. The last seven columns of the table present areas where the CEEP actions may provide co-benefits or positive impacts. The seven criteria were selected based on the City's Sustainability Framework and other priority areas identified during discussions with staff:

- Inclusive, Safe, Accessible Communities
- Vibrant Communities
- Sustainable Business
- Natural Environment
- Affordable Living
- Clean Air
- Resilient Infrastructure

Table 7. Action Level Implementation Guide

Resources and costs are rough estimates based on the findings of other municipalities completing CEEPs in the Lower Mainland. These may vary for the City of Richmond and require further review. The required staff, disbursements and/or capital costs are identified for resource planning purposes and it is anticipated that much of the implementation requirements will utilize existing resources.

	Strategy / Action	Estimated year to start implementation	Lead department	Resource planning (estimated staff, disbursements and/or capital costs)	Cost to community (reduce, neutral, increase)	Inclusive, Safe, Accessible Communities	Vibrant Communities	Sustainable Business	Natural Environment	Affordable Living	Clean Air	Resilient Infrastructure
Theme 1: Neighbourhoods and Buildings						**Sustainability framework goals and co-benefits**						
Strategy 1: Integrate Future Neighbourhood Centre Planning with Transit Planning												
1	Review Neighbourhood Centre development sequencing for flexibility	2013	Policy Planning (Planning & Development)	existing	neutral	X	X		X		X	
2	Collaborate with TransLink to update the Area Transit Plan (ATP)	2014	Transportation (Planning & Development)	existing	neutral	X				X	X	
Strategy 2: Increase Energy Efficiency in New Developments												
3	Include energy efficiency in Neighbourhood Centre planning	align with area planning	Sustainability (Engineering & Public Works) AND Policy Planning (Planning & Development)	20k$ to 40k$ disbursement for technical studies (potential BC Hydro funding)	possible increased development cost; reduce occupant energy costs					X		X
4	Promote energy efficiency in all rezoning	2013	Sustainability (Engineering & Public Works)	existing resources	increase development cost; reduce occupant energy costs					X		X
5	Develop incentives for new development to exceed the building code energy requirements	2013; align with area planning	Sustainability (Engineering & Public Works)	0.5 PY for 2 years to develop program; 25k$ disbursement for economic analysis.	neutral or increase development cost; reduce occupant energy costs					X		X
6	Ensure that existing building code requirements are attained	2013	Building Approvals (Planning & Development)	0.5 PY ongoing to review plans and ensure compliance	reduce occupant energy costs							X

Strategy 3: Improve the Performance of Existing Building Stock												
7	Promote building efficiency through outreach and education	2013	Sustainability (Engineering & Public Works)	0.25 PY for 3 years	neutral							X
8	Provide incentives for building retrofit action	2015	Sustainability (Engineering & Public Works)	0.5 PY for 2 years; 10k$ disbursement marketing materials; pilot $300k$ incentives ($300 x 1,000)	neutral					X		X
9	Develop a residential energy conservation program to support housing affordability	2014	Sustainability (Engineering & Public Works) AND Community Social Development (Community Services)	0.25 PY for 2 years	decrease energy costs for participants					X		X
Theme 2: Mobility and Access												
Strategy 4: Prioritize and Fund Walking, Rolling, Cycling Infrastructure												
10	Prioritize walking, rolling and cycling infrastructure	2014	Transportation (Planning & Development) AND Parks (Community Services)	capital budget shift or increase estimated at $1M per yr	neutral; may reduce travel costs	X	X			X		X
11	Continue "Complete Streets" for street construction and rehabilitation projects	2014	Transportation (Planning & Development)	existing staff	neutral; may reduce travel costs	X	X			X		X
Strategy 5: Enhance Alternative Transportation Connectivity												
12	Improve pedestrian links throughout the city as the top transportation priority	2013	Transportation (Planning & Development) AND Parks (Community Services)	existing staff; capital budget (Action 10)	neutral; may reduce travel costs	X	X		X	X	X	X
13	Focus on providing safe school routes	2014	Transportation (Planning & Development)	0.5 PY for 3 years (share with TDM coordinator)	neutral; may reduce travel costs	X	X			X	X	

Strategy 6: Facilitate Changes in Transportation Behaviour and Mode Choice												
14	Implement TDM projects that incentivize non-vehicle mode choice and disincentive vehicle use	2014	Transportation (Planning & Development)	0.5 PY for 3 years (share with safe school routes)	reduce costs for alternatives; increase vehicle costs			X			X	
15	Reduce supply of unrestricted City-owned parking spaces	2018	Transportation (Planning & Development) AND Parks (Community Services)	existing staff	increase parking costs						X	
16	Provide infrastructure improvements to support increased transit service	2016 to align with service	Transportation (Planning & Development)	capital budget shift or increase estimated at 200k$ per year	reduce travel costs	X				X	X	X
17	Improve bike facilities and consider implementing a bike share system	2015	Transportation (Planning & Development)	capital budget shift or increase (Action 10)	neutral; may reduce travel costs	X	X			X	X	X
Strategy 7: Promote Low Carbon Personal Vehicles												
18	Set minimum requirements for EV charging stations in new developments	2013	Transportation (Planning & Development)	existing resources	neutral						X	
19	Continue expanding the City-owned network of EV charging stations	2015	Engineering & Public Works	estimated 5$k per station x 20 stations	neutral						X	
Theme 3: Resilient Economy												
Strategy 8: Encourage Energy Efficient Businesses												
20	Promote energy efficient business operations	2015	Sustainability (Engineering & Public Works)	0.3 PY for 2 years; 20k$ disbursement for study	reduce business operating costs			X				X

Theme 4: Sustainable Infrastructure and Resources												
Strategy 9: Continue Advancement of Neighbourhood District Energy Systems												
21	Reserve district energy rights of ways in new developments and road construction	2013	Engineering (Engineering & Public Works)	0.5 PY for 6 months to define standards and mechanism	neutral							X
22	Develop a City Centre DE Right of Way Master Plan	2015	District Energy (Engineering & Public Works)	0.5 PY for 6 months; 80k$ disbursement for study	neutral							X
23	Explore opportunities to connect existing buildings to DE system	2015	District Energy (Engineering & Public Works)	0.3 PY for 6 months; 50k$ disbursement for study	neutral							X
24	Explore options for electricity generation from utility scale renewable sources	2015	District Energy (Engineering & Public Works)	0.3 PY for 6 months; 50k$ disbursement for study	neutral							X
25	Integrate energy infrastructure into community planning	2013	District Energy & Engineering (Engineering & Public Works)	existing staff	neutral							X
Strategy 10: Utilize Local Energy Sources												
26	Promote building scale renewable energy	2015	Sustainability (Engineering & Public Works)	0.3 PY for 2 years; 50k$ for study	neutral				X			X
Strategy 11: Maximize Use of Waste												
27	Continue to support the ISWRMP	2013	Engineering (Engineering & Public Works)	existing staff	neutral					X		X
28	Continue to support the ILWRMP	2013	Engineering (Engineering & Public Works)	existing staff	neutral					X		X

Theme 5: Climate Change Leadership												
Strategy 12: Encourage Sustained Action by Higher Levels of Government												
29	Continue to advocate for support from higher governments	2013	Sustainability (Engineering & Public Works)	existing staff	neutral							
Strategy 13: "Lead by example" with City Operations Energy Management												
30	Develop long-term funding for climate activities in the city	2015	Sustainability (Engineering & Public Works)	existing staff (corporate energy manager)	neutral							X
31	Integrate climate change into other municipal activities	2014	Sustainability (Engineering & Public Works)	existing staff	neutral	X	X					X
32	Provide incentives for alternative transportation by staff	2014	Sustainability (Engineering & Public Works)	incentive program 5k$ per year	neutral					X	X	
33	Define a climate change portfolio / staff person	2014	Sustainability (Engineering & Public Works)	0.25 PY for 5 years (management of plan - other time is in other Actions)	neutral							X
Strategy 14: Engage the Community on Climate Action												
34	Develop an outreach program to residents and businesses on climate action	2014	Sustainability (Engineering & Public Works)	0.25 PY for 2 years	neutral	X	X					

8.3 Monitoring Framework

As described earlier in section 5, the base of the plan pyramid represents the numerous activities involved in implementation and tracking the progress of that implementation. A monitoring framework provides a list of items to track that will help re-assess the effectiveness of the plan over time. The framework should assist with answering:

1. Direct progress towards the vision and targets:
    - Primary indicators include progress made towards community energy use and GHG reduction targets
2. Progress on other indicators that provide indirect measures of energy and GHG impacts:
    - Secondary indicators include progress made towards related targets (e.g. change in mode split) that are linked to achieving the overall targets
3. Progress on plan implementation:
    - Implementation includes the number of actions completed, progressing and unstarted

8.3.1 Primary Indicators: CEEI Reports

In BC, the provincial Climate Action Secretariat (Ministry of Environment) has undertaken efforts to quantify these primary indicators for every municipality on a biannual basis through the Community Energy and Emissions Inventory initiative. The City can continue to monitor these reports, understanding that they are likely useful to demonstrate general trends across numerous years, but are not refined enough to provide a precise measure of progress towards GHG targets. Indicators include:

- Total GHG emissions from community sources (tonnes CO_2e)
- Total GHG emissions from buildings (tonnes CO_2e)
- Total GHG emissions from transportation (tonnes CO_2e)
- Total GHG emission from waste (tonnes CO_2e)
- Total energy consumption (GJ)
- Total electricity consumption (kWh)

8.3.2 Secondary Indicators

Secondary indicators provide an additional method of understanding whether progress is being made towards the overall targets, and are particularly useful when the overall targets are challenging to measure with much certainty. They also provide clarity on whether identified strategies and actions are resulting in the desired outcomes. Possible tracking indicators include:

Neighbourhoods:

- Percent of new dwellings located within 400m of a frequent transit route, or 800m of a Canada Line station
- Percent of population living within 400m of a frequent transit route, or 800m of a Canada Line station
- Percent of population within walking distance of a grocery store and park

Buildings:

- Percent of new buildings exceeding energy performance standards in the current building code
- Percent of existing buildings renovated to high energy performance standards

Mobility and Access:

- Mode split for all trips (walking/rolling, cycling, transit, vehicle) *
- Percent of completed pedestrian links within 400m of current or planned Frequent Transit route **
- Percent of completed cycling links identified in the OCP
- Percent bus stops on frequent transit routes with shelters; Percent with benches

Resilient Economy:

- Percent of employees working within 400m of a frequent transit route, or 800m of a Canada Line station [may be challenging to track], alternatively:
- Mode split of commuters travelling to Richmond for work

Sustainable Infrastructure and Resources:

- Number of building scale renewable energy systems installed
- Percent of road construction projects with reserved DE right of ways (in areas identified for future DE)
- Number of new buildings connected to DE systems utilizing or with planned phases to utilize low-carbon energy sources
- Number of existing buildings connected to DE system utilizing or with planned phases to utilize low-carbon energy sources
- Percent of waste diversion*

Climate Change Leadership:

- Total GHG emissions from City facilities (tonnes CO_2e)
- Mode split for staff commute trips to work

** Richmond target exists already for these indicators.*

*** This plan has identified the need to conduct analysis and set specific targets for these secondary indicators.*

8.3.3 Plan Implementation Indicators

The following indicators are suggested as mechanisms for tracking the overall progress of implementing the action plan:

- Number of actions underway
- Number of actions completed

Actions that are primarily outreach or incentive-based may benefit from understanding the level of uptake in the community, for example:

- Action 8: Number of energy audits completed (incentives distributed)
- Action 9: Number of residential energy conservation kits distributed
- Action 13: Number of schools participating in the safe routes to school program
- Action 14: Number of employers providing incentives for employee transit passes
- Action 26: Number of City staff completed building scale renewable energy awareness training program (in building permit department)
- Action 32: Number of City staff using the transit incentive program
- Action 34: Number of residents and businesses participating in the outreach program

9 Conclusion

Action is required to respond to the changing climate. There is consensus among scientists that carbon emissions are affecting the climate and must be reduced. There is also an evolving public opinion that governments have a responsibility to act.

Energy consumption and GHG emissions have traditionally been closely tied to population growth. Over the next 30 years, Richmond is expected to grow by 80,000 people. Managing that growth while reducing carbon emissions is a challenge for all communities. In order to achieve a more sustainable future, communities will have to both conserve energy and to develop new energy sources that do not create more carbon emissions.

The availability of new energy efficient technologies, combined with stronger senior government regulations for efficiency in vehicle standards and building code standards will help Richmond reduce overall GHG emissions. But action from senior governments alone will not be enough and finding substantial reductions will require actions by all players in the economy.

The City has already taken steps to set the community on a more sustainable path through compact, mixed-use development and improved options for getting around without a vehicle. This plan defines further strategies and actions the City can take to realize more substantial reductions in GHG emissions from the community.

Residents and businesses in the community will also need to make choices that support the community's energy vision, identified through Phase 1 of the CEEP:

> *"an energy-wise and low-carbon society that enables a robust local economy, a healthy environment, and a safe, equitable, diverse and resilient community."*

The actions defined in this plan represent an enthusiastic effort by the City. Implementing these will require determined effort and will make substantial reductions in the City's carbon footprint. However, these actions alone will not fully meet the targets defined in the OCP. This challenge is not cause for inaction however, as all parts of society must contribute to finding solutions to climate change.

To reach the defined targets larger actions will be required. The magnitude of the reductions required will require major breakthroughs in how we develop our communities – though no substantive technology breakthroughs are required (i.e. these breakthroughs can be achieved with current technologies but will require efforts larger than the City alone can implement). Given the long-term time frame (40 years) for the plan's vision, it is not unthinkable that these may well come to pass.

Appendix A: Calculation Methodology

A.1: GHG reduction "Wedge"

The data inputs for E2 include freely available data. Minimizing specialized data sets is a feature of the tool. Key data requirements for the base model predictions include:

- Statistics Canada population and housing data,
- Community Energy and Emissions Inventory (CEEI) or equivalent community-scale energy and emissions inventory data
- Estimates from staff, or other sources of the possible population growth.

The tool accounts for both the impacts of population growth and other initiatives by higher levels of government. Population growth results in increased energy consumption and GHG emissions. Provincial and Federal initiatives accounted for include increased fuel efficiency standards for passenger and commercial vehicles, and proposed building code and equipment improvements.

A.2: Energy and GHG reductions from Actions

Reductions from the implementation of a measure are defined by the savings for each person (or dwelling) implementing the measure, multiplied by the uptake of the measure. For example:

- Reduction potential: If a new commercial building meets the Leadership in Energy and Environmental Design (LEED) Gold standard, it is expected that the building will consume approximately 30% less energy than a new commercial building that meets current building code.
- Level of uptake: If the local government provides a financial incentive to encourage commercial developers to meet the standard it may be estimated that modest level of uptake might occur. Defining the uptake is a subjective activity though it is usually informed by the strength of the measure that the community wishes to deploy (e.g. information/outreach, non-financial incentive, financial incentive, and regulation). For example, an outreach campaign may result in a small portion of the population (e.g. <1% to 10%) adopting a particular action or behaviour, whereas providing a financial incentive may result in a larger uptake rate. Regulation has the greatest uptake, though it is not always permitted as a tool.

A.3: Population and Housing Allocation

The current location of population and housing is available from the Statistics Canada 2011 Census at the Dissemination Area (DA) level. The current dwelling densities (dwellings per hectare) by DA are shown in the figure below.

The projections developed by Urban Futures for the City as a background to the 2041 OCP update helped identify where new population, housing and employment will be located. These projections were done at the planning area scale. For this analysis, these were further refined spatially by allocating the dwellings in Neighbourhood Centres and along the Future Transit Network that is outlined in the OCP. This scenario provides one potential growth scenario based on the available information prior to completion. The 2041 dwelling density figure demonstrates the results of this allocation – clear density increases in the City Centre in residential areas, increases in density near Neighbourhood Centres, and along the frequent transit network.

Figure A-1: Dwelling Unit Density 2011

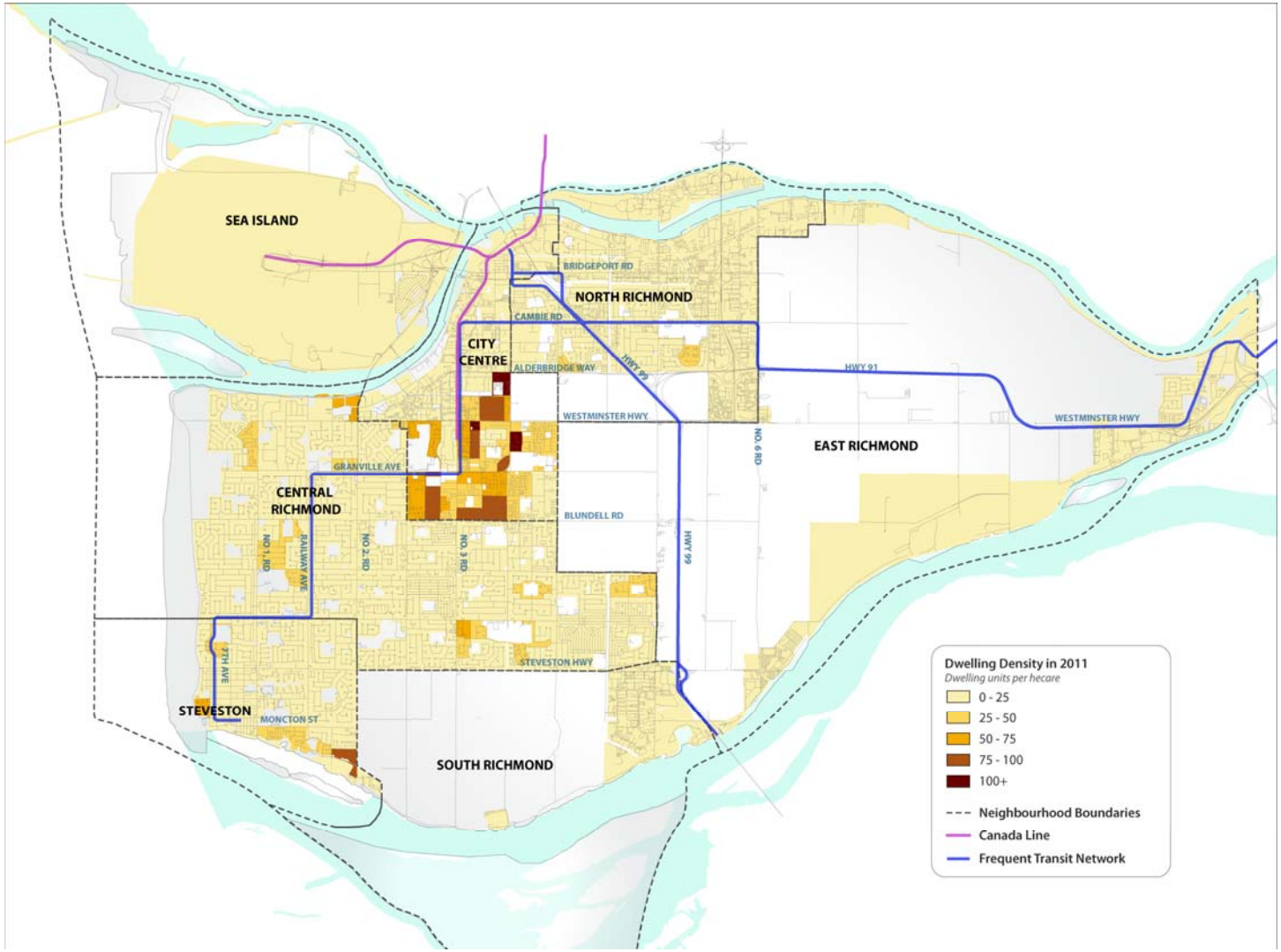
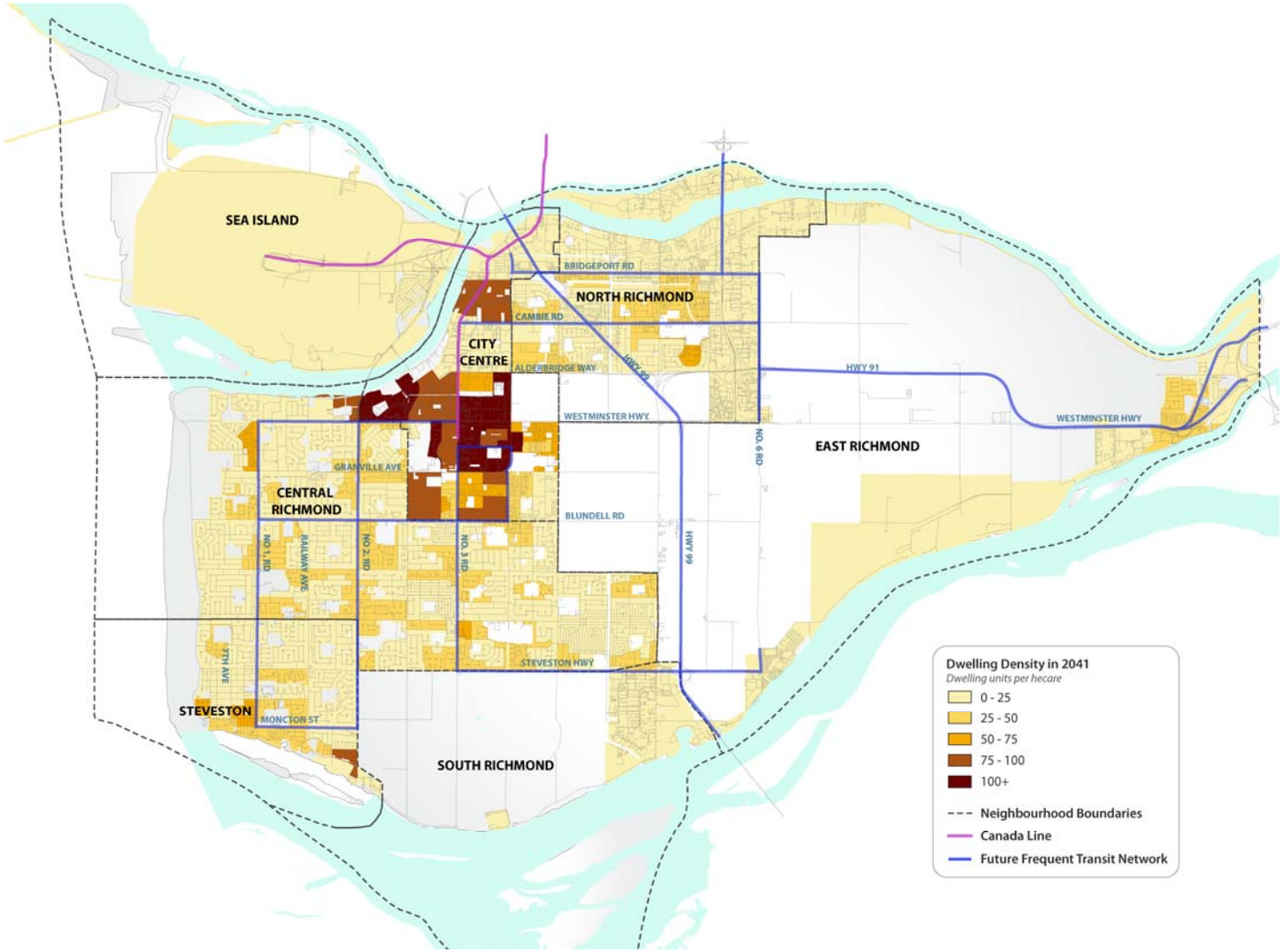


Figure A-2: Projected Dwelling Unit Density 2041



A.4: Density Impacts on Residential and passenger Vehicle energy consumption

Vehicle reductions are based on estimated changes in vkt due to densification. Each DA was identified as either in or out of the current FTN network. Then the percentages changes in Vehicle Kilometres Travelled (VKT) for each DA were estimated.[45]

A.5: Thermal Energy density mapping:

An analysis was undertaken to estimate the current (2011) energy load needed for heating throughout the community, and also to estimate where the future (2041) energy load for heating will be based on the City's projected residential and employment growth.

This involved:

- Determining the location and types of housing based on Statistics Canada Census data. (shown above)
- Determining the location and types of non-residential floor space area from the BC Assessment Authority.
- Applying expected heating load requirements to those baselines based on the type of dwelling / type of non-residential use (for example, a single family home located in the Lower Mainland is expected to use almost 80 GJ of energy per year for space heating and hot water)[46].
- Applying expected building efficiency improvements for all new growth due to improvements in the BC Building Code, as well as efficiency improvements to the existing building stock for expected changes in technology (e.g. furnace upgrades) and other renovations over time.
- Representing the projected changes in thermal load resulting from population and employment growth as a Change in Thermal Energy Density map of Richmond (Figure A-3).

[45] Estimates based on methodology outlined in "Using Residential Patterns and Transit to Decrease Auto Dependence and Costs", John Holtzclaw, 1994

[46] BC Hydro Conservation Potential Review, Marbek Resource Consultants Ltd., 2007

Figure A-3: Estimated New Incremental Thermal Heat Load 2011 - 2041

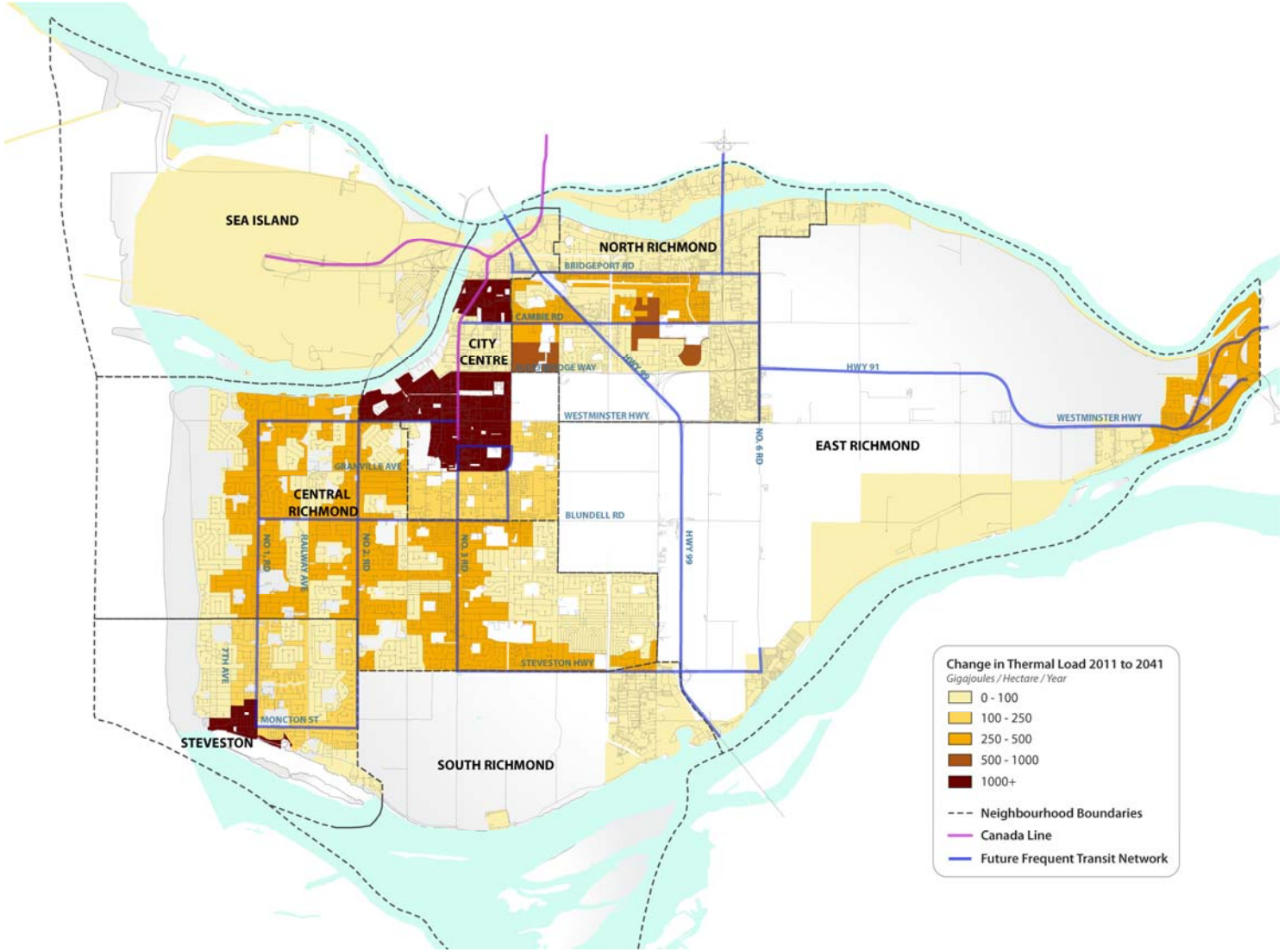


Figure A-4: Estimated Thermal Heat Load 2041