Climate Zone-Based Energy Retrofits In Canada For Current and Future Climate Change Scenarios

by
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A Thesis
presented to
The University of Guelph

In partial fulfillment of requirements
for the degree of
Masters of Applied Science
in
Engineering

Guelph, Ontario, Canada

ABSTRACT

CLIMATE ZONE-BASED ENERGY RETROFITS IN CANADA

FOR CURRENT AND FUTURE CLIMATE CHANGE SCENARIOS

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Anthropogenic activities are accelerating climate change, mitigation efforts in all sectors are needed to reduce the effects. hlThis research used an urban physics model known as the Vertical City Weather Generator (VCWG), to model gas and electricity consumption of a base building and then a retrofitted building under current and future climate change scenarios. The aim was to reduce CO_2e emissions in low-rise single family residential buildings, in a cost effective way. A secondary aim was to identify the difference in performance of mitigation efforts with respect to different climate zones. Using EnergyPlus Weather files for current climate modelling and CanRCM4 files for future climate modelling under Representative Concentration Pathway (RCP) 4.5 and RCP 8.5 [W m^{-2}] climate scenarios. The years considered were 2020 for present cliamte, and 2040, 2060, 2080, 2100 for future climates. A house was modelled in Vancouver and Toronto to represent National Building Code of Canada climate zones 4 and 5, respectively. Retrofit scenarios are considered for a base house with mitigation efforts: increased vegetation, increased insulation, decreased infiltration/exfiltration, added cool roof, and added photovoltaic systems. An economic and greenhouse gas emissions (CO_2e) analyses are performed.

The economic analysis showed that cost savings for mitigation efforts are dependent on individual costs in each city. The electricity price in Vancouver is cheap, which makes the use of PV systems too expensive. However, in Toronto the electricity price is higher, making a PV system cost effective. The mitigation strategy that produced the largest cost and CO_2e savings in Vancouver and Toronto was the reduction in infiltration/exfiltration. Sealing air-leakage sites reduces gas consumption (by 15.3 and 14.9 [m^3 m^{-2} per year] for Vancouver and Toronto, respectively), operational cost (by 28.5 and 21.7 % for Vancouver and Toronto, respectively) and CO_2e emissions (by 142.9 and 105.6 [Tonnes per 20 years] for Vancouver and Toronto, respectively). Other mitigation efforts, such as increased insulation, can produce modest CO_2e emissions savings but are not cost effective. The decision to focus on cost savings or CO_2e emissions savings would need to fall on homeowners.

ACKNOWLEDGEMENTS

I would like to thank my supervisor Dr. Aliabadi for his immense support and guidance throughout my masters. I've learned that it's the little rewards and the exciting adventures that lead to rewarding outcomes. Thank you to Dr. Tasnim for meeting with me and offering support. Thank you to my mom, Worship Margot McLeod, and my family for their encouragement. Thanks to Colin for listening and offering advice. Thank you to previous members of the AIR Lab whose hard work paved the way for my research project.

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ABBREVIATIONS

AR	Assessment Report
AC	Alternating Current
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BITES	Building Integrated Thermal Energy Storage
CDF	Cumulative Distribution Function
CDD	Cooling Degree Day
CM	Climate Model
CRF	Capital Recovery Factor
DC	Direct Current
ECMWF	European Centre for Medium-Range Weather Forcasts
EEIF	Electric Emissions Intensity Factor
EPW	EnergyPlus Weather
FS	Finkelstein-Schafer
GCM	Global Climate Model
GHG	Greenhouse Gas
GVI	Green View Index
GMT	Greenwich Mean Time
HDD	Heating Degree Day
IPCC	Intergovernmental Panel on Climate Change
NDC	Nationally Determined Contributions

NRCan	Natural Resources Canada
NECB	National Energy Code of Canada for Buildings
PCM	Phase Chanage Material
PV	Photovoltaic
PWF	Present Worth Factor
QQ	Quantile-Quantile
RCM	Regional Climate Model
RCP	Representative Concentration Pathways
UHI	Urban Heat Island
UPM	Urban Physics Model
VCWG	Vertical City Weather Generator
VWFG	Vatic Weather File Generator
WG	Working Group
WS	Weighted Sum

SYMBOLS

A	Area [m^2]
B	Bias [-]
C	Annualized Cost [$]
C_p	Thermal Heat Capacity [J kg^{-1} K^{-1}]
COP	Coefficient of Performance [-]
CRF	Capital Recovery Factor [-]
E	Annual Electricity Consumption [kW-hr m^{-2}]
EEI	Electric Emissions Intensity [kg CO_2e kW-hr^{-1}]
$ElecCO_{2_{sav}}$	Carbon Dioxide Emissions Savings by Saving Electricity Consumption [kg]
F	Salvage Factor [-]
FS	Finkelstein-Schafer Statistic [-]
G	Annual Gas Consumption [m^3 m^{-2}]
$GasCO_{2_{sav}}$	Carbon Dioxide Emissions Savings by Saving Natural Gas Consumption [kg]
i	Interest Rate [-]
i_n	Nominal Interest Rate [-]
ITC	Rebate [varies]
j	Inflation Rate [-]
L	Latent Heat of Vaporization [J kg^{-1}]
LAD	Leaf Area Density [m^2 m^{-3}]
LAI	Leaf Area Index [m^2 m^{-2}]
$\dot{m}$	Mass Flow Rate [kg s^{-1}]
MW	Molecular Weight [kg mol^{-1}]
N	Number of Years
n	Number of Data Points

OM	Operation and Maintanance Cost [varies]
P	Price [varies]
pa	Climate Model Surface Pressure [Pa]
q	Heat Transfer Rate [W]
R	Thermal Resistance [m^2 K W^{-1}]
$rlds$	Climate Model Surface Downwelling Longwave Radiation Flux [W m^{-2}]
$rsds$	Climate Model Surface Downwelling Shortwave Radiation Flux [W m^{-2}]
S	Standard Deviation
$sfcWind$	Climate Model Surface Wind Speed [m s^{-1}]
$SHGC$	Solar Heat Gain Coefficient [-]
T	Temperature [K]
ta	Climate Model Dry Bulb Temperature [K]
$TECD$	Total Electricity Consumption for Cooling [kW-hr m^{-2}]
$TCO_{2_{save}}$	Total Carbon Dioxide Emissions Savings [kg]
$TEDD$	Total Electricity Domestic Demand [kW-hr m^{-2}]
TEP	Total Electricity Produced [kW-hr m^{-2}]
$TGCH$	Total Gas Consumption for Heating [m^3 m^{-2}]
$Tree$	Number of Trees [tree]
w	Weighting Factor [-]
W_{PV}	Photovoltaic Power [W]
WS	Weighted Sum [-]
x	Wall Thickness [m]
X	Quantile Value [-]
$VegCO_{2_{sav}}$	Carbon Dioxide Emissions Savings by Adding Urban Vegetation [kg]

GREEK SYMBOLS

β_{PV}	Photovoltaic Panel Tilt Angle [°]
θ_a	Azimuth Angle [°]
θ_z	Zenith Angle [°]
κ	Thermal Conductivity [W m^{-1} K^{-1}]
ν_{PV}	Photovoltaic Conversion Efficiency [-]
ρ	Density [kg m^{-3}]

LIST OF APPENDICES

Chapter 1

Introduction

1.1 Background

1.1.1 Overview of Global Impacts of Climate Change

The Intergovernmental Panel on Climate Change (IPCC) is an international body made up of three Working Groups (WG): The Physical Science Basis of Climate Change (WG1), Its Impacts and Adaptation (WG2), and Mitigation Strategies (WG3) [76]. The IPCC's objective is to provide a global understanding of Climate Change. To accomplish this, each WG publishes Assessment Reports (AR) based on global research, reports are published about every five years. The IPCC is currently on its Sixth Assessment Report (AR6). The continuing consensus within all reports is that anthropogenic factors are contributing to Global Warming. Between the period of 1850-1900 and 2017 there has been global warming of 1°C [74], between the period of 1850-1900 and the period of 2006-2015 the global mean surface temperature increased by roughly 0.87°C, and each decade anthropogenic warming increased by about 0.20 °C. The increase in global temperatures has a direct link to ocean temperature increase [73, 74]. Between 1971 and 2018, ocean heat increased by 0.278-0.55 Yottajoule (YJ) due to the amount of heat stored from the atmosphere, this warming is expected to continue even with the strictest mitigation efforts [74, 75]. Since 1750, the largest contribution of warming has come from CO_2e emissions, naturally and anthropogenically [74]. Figure 1.1 from IPCC's AR6 shows an increase in radiative forcing due to Greenhouse Gas (GHG) emissions from 1750 to 2019. Radiative forcing describes the net change in radiative flux [W m^{-2}] when there are changes in climate change drivers (e.g. CO_2e concentration, reflectivity/absorption of solar radiation, and volcanic activity). Atmospheric CO_2e is the leading cause of positive total radiative forcing, with a total 40 % increase since 1750 [72].

Reducing Anthropogenic Global Warming activity to reduce the rate of Global Warming is at the forefront of the climate movement. Much of the mitigation strategies focus on reducing GHG emissions from the supply sector, such as switching to renewable and non-emitting energy sources to meet demand [55, 72]. Companies are creating more efficient heating and cooling systems, the automotive industry is moving towards electric vehicles, and the construction industry is moving towards eco-friendly and green building materials. All of these efforts to reduce GHG emissions are fruitless unless there is demand from consumers to adopt such technologies. As far as demands for housing consumers are concerned, relevant mitigation technologies include smart sensors, energy efficient heating and cooling systems, renewable energy sources, changing comfort levels by reducing thermostat set-points, changing eating habits, and reducing waste [72].

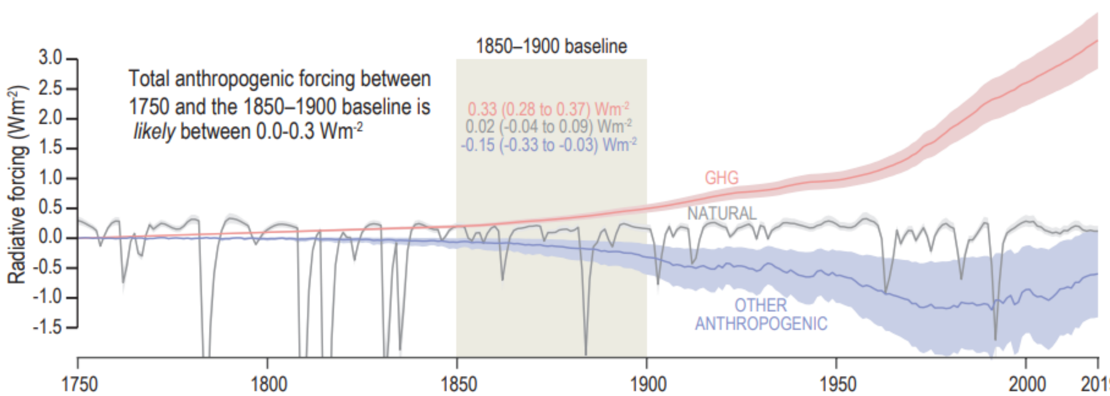


Figure 1.1: Radiative forcing changes from 1750 to 2019; developed by IPCC published in AR6 [74].

1.1.2 Canada's Mitigation Efforts

Canada has a large landmass with a variety of ecozones, land uses, and topographies that makeup regional climates. This makes parts of Canada particularly vulnerable to Climate Change. Canada is warming at twice the global average; regions further north are warming at three times the average [56].

The 2015 Paris Agreement was signed by 192 countries with the goal of 1) maintaining a global average temperature increase below 2°C by end of century, 2) implementing adaptations and resiliency measures, and 3) making it financially possible to reduce GHG emissions according to goal 2 [96]. Each country produced their own Nationally Determined Contributions (NDCs) to meet the Paris Agreement goals. Canada has pledged to reduce its GHG emissions to 10-45% below 2005 levels by 2030 and is working on a plan to reach Net Zero emissions by 2050 [36, 60]. To meet these goals, in 2016, Canada released the *Pan-Canadian Framework on Clean Growth and Climate Change* to provide a foundational plan that would meet emission targets, boost the economy, and improve infrastructure resiliency towards climate change effects [34]. Then, in 2020, a strengthened climate plan called *A Healthy Economy and a Healthy Environment* was released that outlined Canada's progress towards its 2016 goals and addressed the impacts that the COVID-19 pandemic has had on the economy and the environment [35]. Most recently, in 2022, the *2030 Emissions Reduction Plan: Clean Air, String Economy* was published, giving specific details on what has been accomplished and future plans for the following sectors: building, electricity, heavy industry, oil and gas, transportation, agriculture, and waste [59]. Most of the actions taken are related to project funding and intensive programs. In the electricity sector, $964 million has been allocated to develop a Smart Renewable Electrification Pathway Program that would implement smart renewable energy into the grid and modernize the grid. In the building sector, $150 million has been allocated to develop a Net-Zero program called Canada Green Building Strategy, and another $874.5 million has been allocated to retrofit existing homes across the country and to support a climate resilient construction sector. In the oil and gas sector, the federal government implemented regulations for the sector to meet the set methane emissions targets by 2025 and created a $750 million Emissions Reduction Fund to assist companies to invest in green alternatives [59].

Canada has started to take action in meeting its GHG emissions goals to slow the effects of climate change by allocating funding to support research, to create incentive programs for both supply and demand sides, and to implement effective legislation. This research will focus on mitigation measures to reduce GHG emissions in the building sector, specifically the single-family low-rise residential buildings.

1.1.3 Housing Retrofits

The building sector is the fourth largest GHG emitter, followed by transportation, oil and gas, and heavy industry [59]. Residential space heating and cooling account for 63.6% and 1.6% of energy use, respectively [61]. One of the main forms for heating is fuelled by natural gas [111], which accounts for 17% of GHG emissions [34]. Implementing retrofits that reduce heating and cooling loads can save the gas and electricity consumption, which can reduce the residential CO_2e emissions. Housing retrofits encompass any adjustments that a homeowner can make to make the building more energy efficient such as adding insulation or replacing light fixtures to more energy efficient ones. The Government of Canada has a list of possible housing retrofits [47]:

- Sealing air leakage points
- Increasing insulation
- Upgrading to energy efficient lighting
- Upgrading to thermal efficient windows and doors
- Upgrading to energy efficient heating and cooling systems

- Upgrading to low-flow faucets
- Adding energy efficient systems such as heat-pumps or photovoltaic panels.

Liu et al. [84] studied the energy consumption, CO_2e emissions, and profitability of 11 residential buildings in Sweden after retrofitting the buildings. The researchers simulated the building performance with different retrofit packages available through a simulation platform. Building owners were able to create a package of their desired retrofits to be simulated, the physical buildings were then retrofitted. The seven retrofits that were included with each package were: adding wall insulation, new windows with lower conductivity (2 types), solar thermal system, Photovoltaic (PV) system, and heat recovery system. The research showed that the energy reduction, cost, and CO_2e savings were not necessarily uniform for all buildings for a given retrofit. However, PV panels and adjusting the heating system were always cost effective.

Menicou et al. [86] performed a simulation-based energy and cost analysis of a typical residential building in Cyprus after implementing four retrofits: increase wall insulation, increase roof insulation, decrease glazing, a combination of increased wall and roof insulation, and a combination of all three retrofits. The authors then performed a risk analysis by choosing ten parameters, each with a range of values that were randomly chosen to create an outcome scenario. This process was repeated 5000 times to determine which retrofit scenario was able to consistently provide cost savings. The study found that increasing roof insulation had the best overall cost savings and was the most financially achievable option. Interestingly, increasing wall insulation was not cost effective in 95% of cases.

As the sample literature shows, there are many different types of retrofit options but their ability to reduce heating and cooling loads as well as cost effectiveness is dependent on region and building type. To meet Canada's climate goals, retrofit options need to be chosen based on their ability to 1) reduce carbon emissions through the reduction of gas and electricity consumption and 2) be cost effective. The challenge is determining which retrofit options are the best for different residential buildings and different income levels.

1.1.4 Global and Regional Climate Modelling

Global Climate Models (GCM) are math and physics based computer models used to simulate the earths climate by considering the interactions between physical processes in the atmosphere, ocean, and land surface. These models take historical climate data and GHG emissions to create daily weather values over many years, this data is interpreted statistically to give an understanding of what the future climate will look like [25]. A drawback of climate models is that they are only as good as their assumed parameters. Current weather files can be used to model current climates with a relatively low degree of certainty but when looking at modelling future climates the assumed parameters are dependent on our current and historical climate data. The degree of uncertainty is much larger in this case because its hard to predict future anthropogenic behaviour, climate conditions, and GHG emissions. If we continue on with a 'business as usual' GHG emission case, we could assume a steady trend from historical data to predict our future climate. From the outlined mitigation efforts we know that there is a global shift to reduce GHG emissions so how do we model the future climate without knowing how much we will be emitting in the future?

To accurately predict the future of our climate, scientist have developed emissions scenarios [93]. These scenarios factor in socioeconomic situations, technological conditions, environmental conditions, emissions of GHGs, emissions of aerosols, and climate conditions. A description of each factor can be found in Figure 1.2.

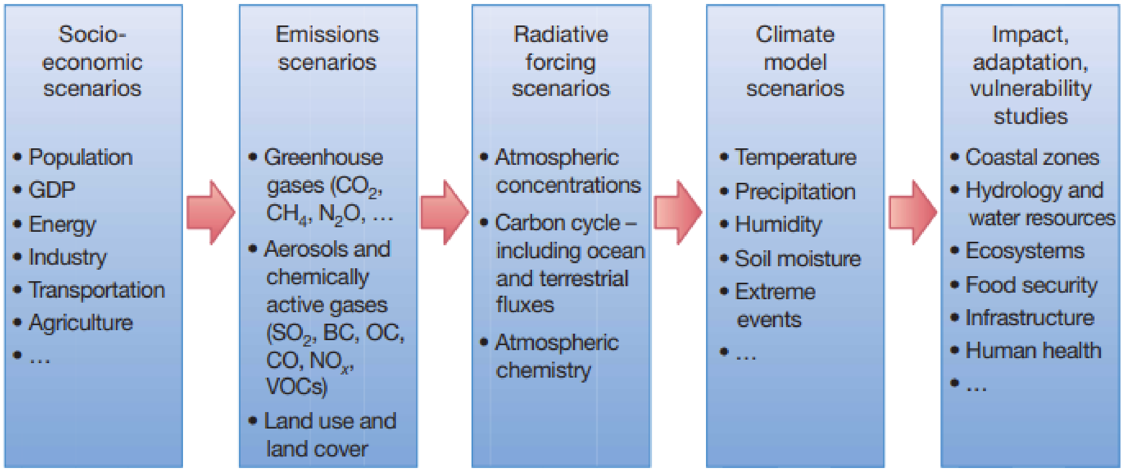


Figure 1.2: RCP Scenario considerations [74].

These emissions scenarios are called 'Representative Concentration Pathways' (RCPs) [71, 92, 93], referring to concentrations of anthropogenic GHG emissions. Each scenario factor, see Figure 1.2, has a large range of uncertainty that depends on human activity, which can produce thousands of possible future climate outcomes. The IPCC created four RCP pathways to represent [92]: high concentration (RCP 8.5 [W m^{-2}]), stabilized concentrations (RCP 6.0 and RCP 4.5 [W m^{-2}]), and declining concentrations (RCP 2.6 [W m^{-2}]). A breakdown of their specifications can be found in Table 1.1 from [93]. These emissions scenarios were chosen based on the IPCC Fourth Assessment Report and IPCC Expert Meeting Report [71, 92] to capture future climates under mitigation efforts.

Name	Radiative Forcing	Concentration [ppm]	Pathway
RCP 8.5	8.5 [W m^{-2}]	$>$ 1370 CO_2e	Increasing
RCP 6.0	6 [W m^{-2}]	$\sim$ 850 CO_2e	Stabilized
RCP 4.5	4.5 [W m^{-2}]	$\sim$ 650 CO_2e	Stabilized
RCP 2.6	3 [W m^{-2}]	$\sim$ 490 CO_2e	Decreasing after Peak

Table 1.1: RCP scenarios specifications. RCP 8.5 [W m^{-2}] is the worst case that will continue to increase the anthropogenic impacts on the climate after 2100; RCP 6.0 and 4.5 [W m^{-2}] will stabilize the anthropogenic impact after 2100; and RCP 2.6 [W m^{-2}] will peak the anthropogenic impact at the indicated values of CO_2e levels but then decrease the impact before 2100.

RCP scenarios are being used in GCMs in a variety of research areas such as future vegetation growth, temperature and precipitation trends, and hydrology modelling [27, 106]. However, GCMs are limited by their course horizontal grid resolutions of 250-600 km and coarse temporal resolutions (daily), making them unable to accurately represent how regional topography, land use, and diurnal variations of weather variables influences the climate. Downscaling is a technique used to refine GCM data, both spatially and temporally, using regional data. Downscaling can be achieved through dynamical or statistical approaches. Dynamical downscaling is achieved by running a climate model with a finer spatial resolution (25-50 km) and a finer temporal resolution (hourly) [70]) that considers regional topography and land use while using GCM outputs as forcing parameters [44, 110]. These climate models are known as Regional Climate Models (RCMs). Dynamical downscaling is computationally intensive. Researchers rely on an easier form of downscaling known as statistical downscaling, which finds a statistical relationship between historically observed or reanalyzed data and historical GCM data, which can be used to predict future climates at higher spatio-temporal resolutions [85]. More information on downscaling can be found in Section 2.2.1.

1.1.5 Urban Physics Modelling

Urbanization causes changes to physical environmental processes. An increase in impervious surfaces such as roads reduces infiltration, increases water pooling, and impacts vegetation, which negatively impacts the water cycle [90]. Similarly, an increase in impervious surfaces and buildings with high albedos and emsissivities causes a change in surface-atmospheric thermal energy exchange. Urban environments generate and trap heat to such an extent that there is a clear temperature difference between them and surrounding rural areas. This phenomenon is known as the Urban Heat Island (UHI) [89]. While GCMs and RCMs model global and regional climates, Urban Physics Models (UPMs) are used to model the effects of urbanization on the environment at micro-scales of cities and neighborhoods.

Using weather or climate data for top forcing (forced from the top of the city/neighbourhood domain) or rural forcing (forced from a nearby rural site), UPMs model the momentum and energy exchanges between the atmosphere, buildings (indoor and outdoor), vegetation, and hydrology cycle. Most UPMs do not cover all physical processes (see Figure 1.3). System-building scale UPMs such as EnergyPlus and TRNSYS have the capability to model building energy flows for complex building systems, but they do not consider the urban canopy interactions, which are accounted for in micro- and meso-scale UPMs. On the flip side, many micro- and meso-scale UPMs, such as UWG, Envi-met, or City-FFD, can model more physical interactions between buildings and the outdoor environment. However, they lack the ability to incorporate renewable energy.

The Vertical City Weather Generator (VCWG), developed by the Atmospheric Innovations Research (AIR) Lab at the University of Guelph [3, 89, 90], bridges the gap between system-building scales and micro-scale models. It considers more physical interactions between environmental processes and the built environment, while being able to model renewable energy systems. For these reasons, VCWG was used in this analysis to model the energy consumption of a residential building. More detail regarding VCWGs configuration is discussed in Section 2.1.

		System-Building Scale				Micro-Scale Neighborhood-Scale						City-Scale Meso-Scale			
	Scales	1cm-10m, 1s-1hr				10m-1km, 1min-1hr						1km-100km, 1hr-1day			
Process	Outdoor-Indoor Interaction					○			○		○				
	Canopy Vegetation					○		○		○	○				
	Canopy Thermo-Fluids					○	○	○	○	○	○	○	○	○	○
	Canopy Radiation	○	○	○	○	○		○	○	○	○	○	○	○	○
	Canopy Humidity	○	○			○		○	○	○	○				
	Building Energy	○	○	○	○	○			○		○	○	○		
	Alternative-Renewable Energy	○	○	○	○						○				
	Hydrology									○	○	○	○	○	○
	Economic Analysis			○	○						○				
	Extreme Weather										○	○	○	○	○
Model		TRNSYS	EnergyPlus	IES	RETScreen	Envi-met City-FFD	CFD	BEP-Tree	UWG	UT&C	VCWG	WRF-BEP-BEM	WRF-SLUCM	CanRCM4	CanESM2

Figure 1.3: Urban Physics Models (UPM) [4]

1.2 Climate Zones

Vegetation in urban environments has environmental, economic, and social benefits [94]. Trees are able to reduce outdoor thermal discomfort during the day through evapotranspiration and by blocking the amount of solar radiation reaching the ground [109, 124].

Canada has a wide range of tree types that thrive in different regional climates. These regions are known as forest zones and are classified based on: ecozone, forest region, forest composition, and plant hardiness [53]. Canada's large landmass and abundance of natural resources made it necessary to begin with a broad classification system known as Ecozones. Ecozones are meant to give an understanding of the ecology in a given area: the interaction between climate, soil, vegetation, and wildlife [53, 113]. Currently, Canada has 20 ecozones [53]. Forest regions are classified based on the dominant tree type (see Figure 1.4). Forest Composition classifies trees by their genus. Lastly, Plant hardiness classifies vegetation based on their ability to withstand harsh climate conditions. Plant hardiness and forest regions are discussed in further detail below and in Sections 1.4.2, 2.1.3.3, and 2.5.

1.2.1 Canada's Forest Regions

Forest regions are classified based on the most dominant trees in a given region, regional climates have a large contribution towards this. The west cost (mainly British Columbia) has one of the most topographically interesting landscapes in Canada with its mountainous regions, lakes and rivers, and proximity to the oceans. All of these factors contribute to the west coast being the most diverse forest landscape encompassing the Coastal, Montane, Subalpine, and Columbia forests along with grasslands (non forest) regions [53, 113] (see Figure 1.4). Trees in this area are coniferous meaning they do not shed their leaves all at once during the fall season. Travelling eastwards into Alberta, Saskatchewan, and Manitoba, the landscape flattens with the dominant forest region being the Boreal forest or no forest region known as grasslands. The Boreal forest is a mixture of coniferous and deciduous (meaning they shed all of their leaves during the fall season). In fact, the dominant forest region across Canada is the Boreal forest. Further east into Ontario and Quebec the topography is flat but with an abundance of trees. The dominant regions are Boreal and Great Lakes. Ontario is unique in having the only Carolinian forest region in Canada. The Carolinian forest region has conifers but is dominated by deciduous trees. Finally, the maritime regions, New Brunswick, Nova Scotia, and PEI are dominated by the Acadian forest region, which is a mixture of coniferous and deciduous trees. The only distinction made between the forest regions so far are either coniferous or deciduous. The types of coniferous and deciduous trees differ between regions, a list adapted from the Government of Canada [53] and from Lauriault [80] can be found in Table 1.2. The specifications between different species is beyond the scope of this research;

however two specific species are discussed in the following text. Regions further north are not mentioned because they do not account for a large portion of the Canadian population and their housing choices.

Forest Region	Dominant Species	Classification
Coastal	western redcedar, western hemlock, sitka spruce	coniferous
Subalpine	engelmann spruce, subalpine fir, lodgepole pine	coniferous
Montane	douglas-fir, lodgepole pine, ponderosa pine	coniferous
Columbia	western redcedar, western hemlock, douglas-fir	coniferous
Boreal	white spruce, black spruce, willow	mixed
Great Lakes	red pine, yellow birch, oak	mixed
Carolinian	beech, maple, black walnut	deciduous
Acadian	red spruce, balsam fir, yellow birch	mixed

Table 1.2: Brief list of the most dominant tree species across Canada's forest regions and their distinction of coniferous, deciduous, or a mixture of both

Forests play a critical role in Canada's ecosystems and natural resource economy. Timber has been harvested in Canada for generations contributing to Canada's economy, in 2015 Crown land timber sales accounted for about $1.3 billion in revenue [115]. Forests provide habitats for animals, filter out air pollutants, filter water via the hydrological cycle, maintain soil nutrients, sequester carbon, and protect against natural disasters such as floods [115].

Overtime forests change due to invasive insects, natural disaster (floods and fires), climate conditions, and harvesting. Some of these changes are natural while others are caused by human activity such as urbanization.

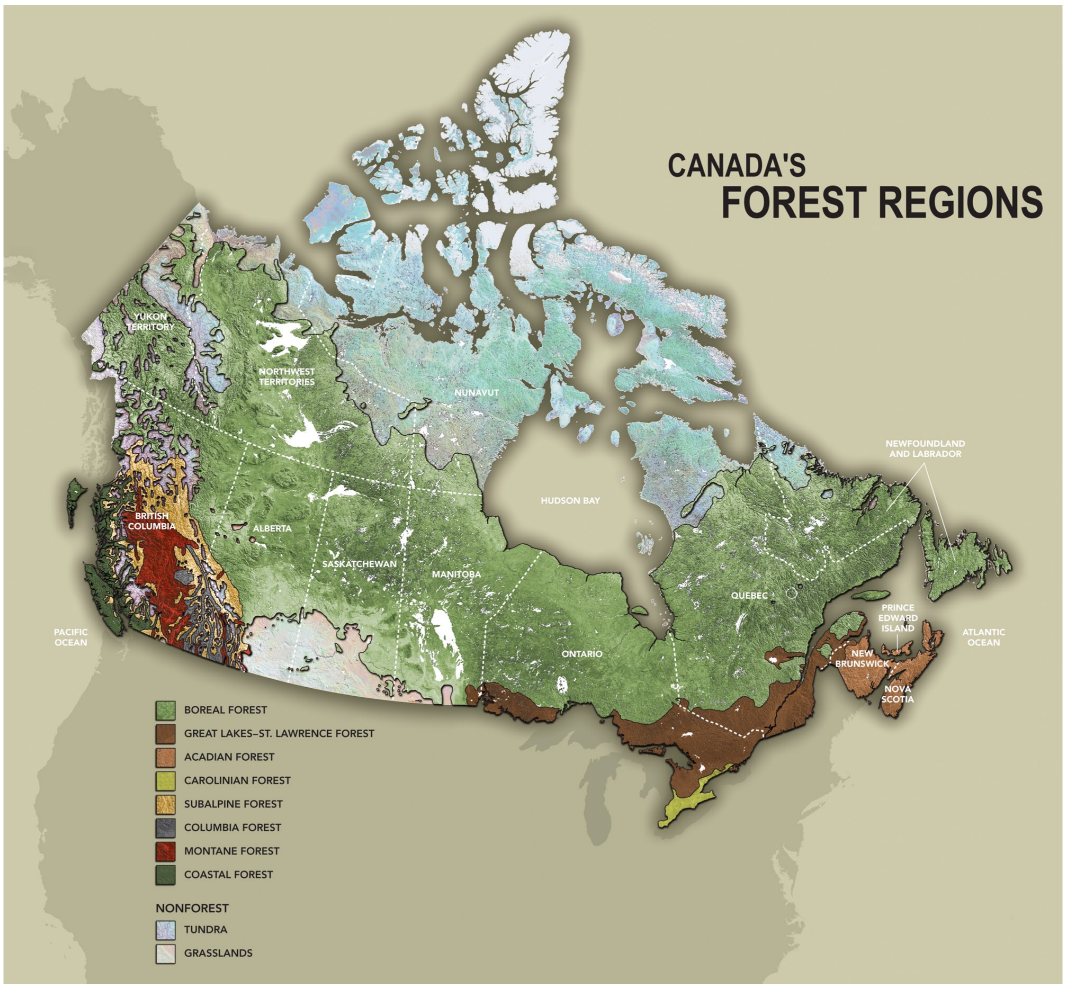
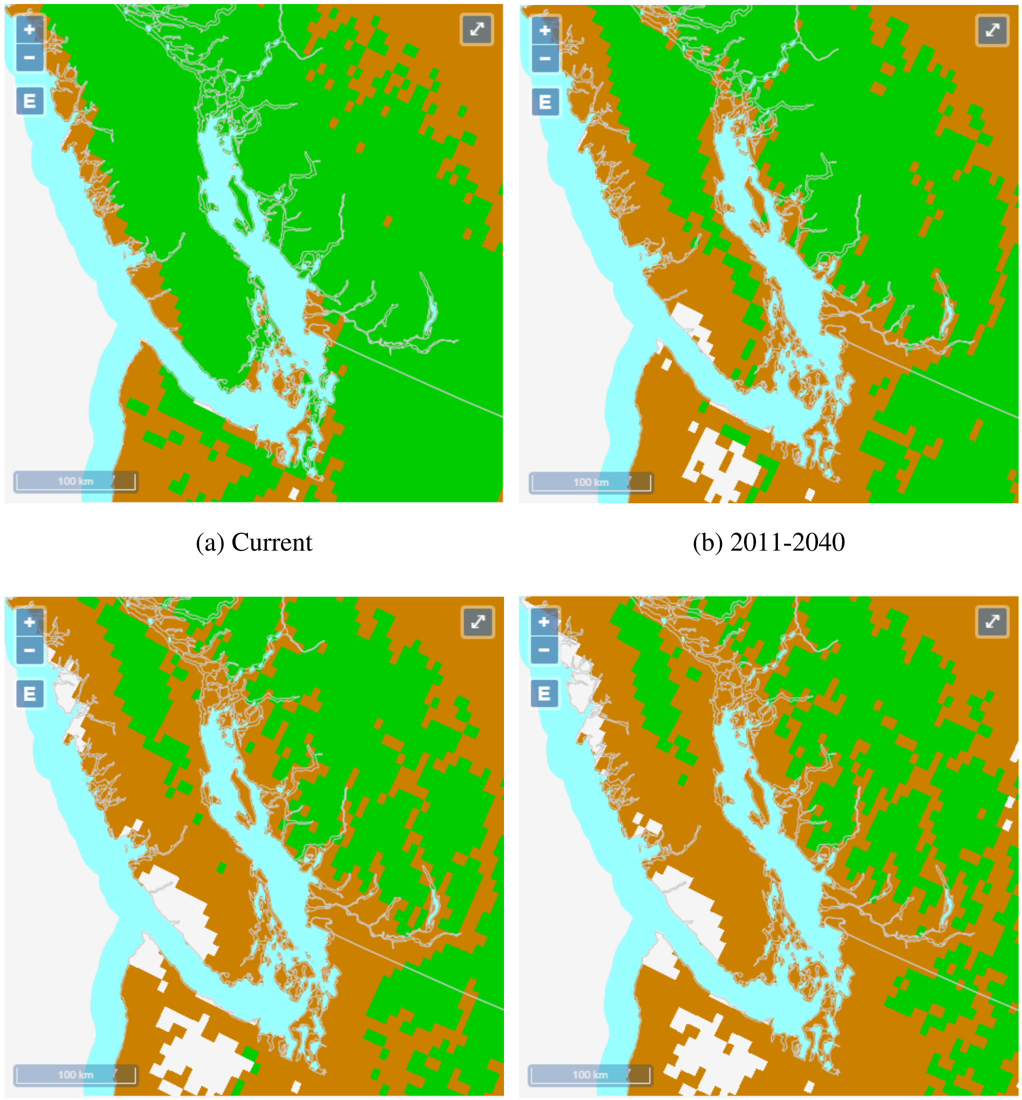


Figure 1.4: Canadian forest regions; image obtained from The Government of Canada [53]

1.2.2 The Effects of Climate Change

As climate conditions change and temperatures increase (see Section 1.1.1), and regions suitable for particular tree species change. To adapt, tree species have been dispersing further into new regions with more suitable climate conditions [62]. This type of adaptation can have an impact on Canadian forest regions. Figure 1.4 could be redrawn in the next century. Natural Resource Canada (NRCan) has developed a Plant Hardiness Site [99] that shows the current distribution of a plant species as well as the projected distribution in 30-year intervals until 2100. This map considers tree distribution under RCP 2.5, RCP 4.5, and RCP 8.5 [W m^{-2}] using CanESM2, Canada's GCM (see Section 1.1.4). Figure 1.5 shows the current distribution of western hemlock, a coniferous tree species dominant in BC, under the RCP 4.5 [W m^{-2}]. The green indicates the trees core distribution and the brown indicates the possible distribution range. As the climate changes, the core distribution recedes but the distribution range indicates that western hemlock has the potential to still inhabit the area. In Appendix A.1, Figure A.1 shows the distribution of western hemlock under the more extreme case of RCP 8.5 [W m^{-2}] scenario. By 2100 western hemlock has a very little core range and the potential distribution range has receded.

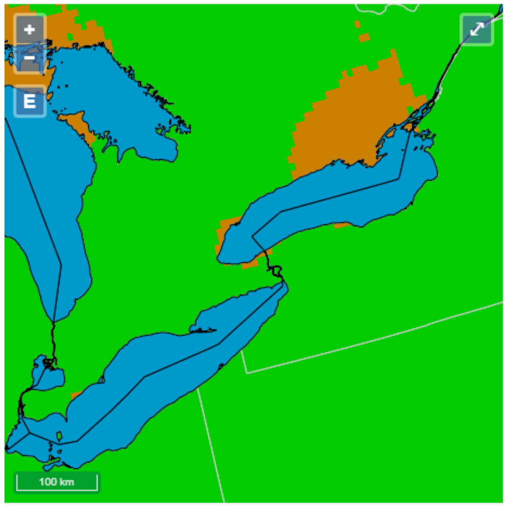


(a) Current (b) 2011-2040

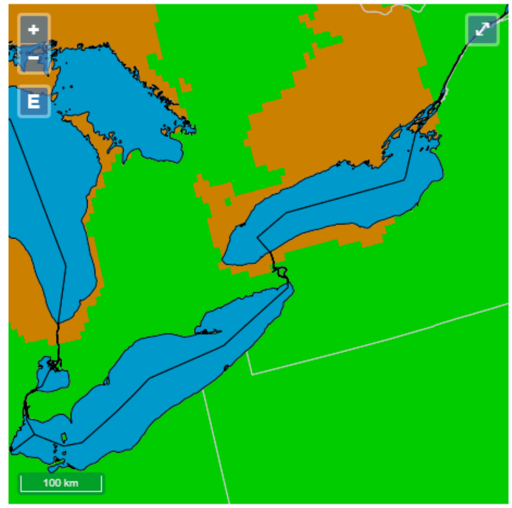
(c) 2041-2070 (d) 2071-2100

Figure 1.5: Western hemlock distribution in Vancouver under RCP 4.5 [W m^{-2}] [99]

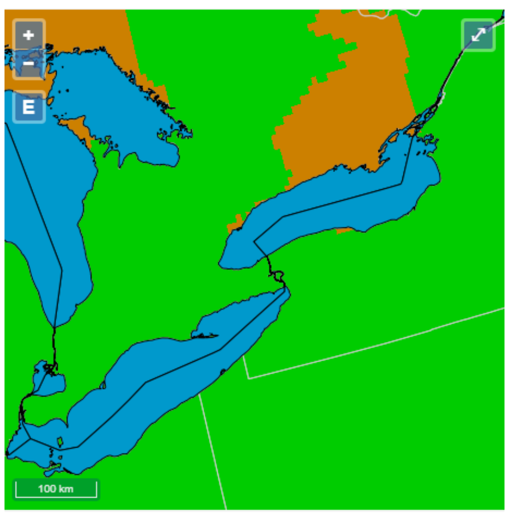
Another example shown in Figure 1.6 shows the distribution of red maple, a deciduous species in Ontario, under RCP 4.5 [W m^{-2}]. During the first 20 years the core area has a small decrease but by 2100 the core area and the potential will be unchanged. However, in Appendix A.1, Figure A.2, under RCP 8.5 [W m^{-2}], climate change reaches a tipping point and there is a drastic decrease in core area. This shows that the effects of climate change on forests is dependent on our mitigation efforts.



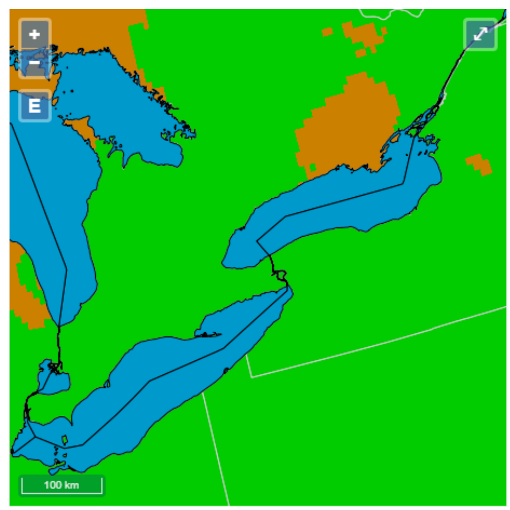
(a) Current



(b) 2040



(c) 2070



(d) 2100

Figure 1.6: Red Maple distribution in Toronto under RCP 4.5 [W m^{-2}] [99]

Another consideration for future climate change scenarios are extreme weather events. In 2021 Canada's top ten weather events were the most extreme ever seen [52] from record breaking heat waves, forest fires, and droughts, to flooding, mass freezing events, and windstorms. These 'weather extremes' are becoming more common every year with 2021 being the 26th consecutive year for record-breaking heat waves [52]. Extreme weather events cost billions in damages to city infrastructure and residential buildings. Although extreme weather events can have a huge impact on building infrastructure and energy consumption, this research does not consider the cost of damages due to extreme weather events. This research is focused on annual weather conditions, extreme events can be captured in the Regional Climate Models with daily time resolution but they are not the focus of this study and will therefore not be discussed.

1.3 Building Codes and Standards

1.3.1 ASHRAE

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is an international member-based society composed of 50,000 members [12]. It provides recommendations for codes and standards for the built environment. Any member can propose changes to standards by submitting a change proposal, this leads to a continuous updating of current standards. Many countries partially or fully adopt ASHRAE standards. Building standards are influenced heavily by local climate. ASHRAE commonly uses Heating Degree Days (HDD) and Cooling Degree Days (CDD) to split regions into Climate Zones; standards are then assigned to each Climate Zone. Without a building energy system, when the average outdoor temperature is less than the desired set-point (commonly 18.3°C) in a day, the number of degrees off is the contributor to HDD within that day [9]. The same is true for CDD except the temperature is greater than the set-point. The annual sums of HDDs and CDDs determine, separately, which Climate Zone a region is in. There are 8 Climate Zones with sub classifications A-C. Zones 1-3 are warm climate that use CDD, Zones 3C-4 are mild regions that use CDD and HDD, and Zones 4C-8 are cold regions that use HDD. The sub-classifications represent humid (A), dry (B), and marine (C) regions. Appendix A.2 shows a Table of Climate Zone temperature ranges. A breakdown of cities and their Climate

Zone can be found in ASHRAE's *Climate Data for Building Design Standards*, due to availability the addenda version is referenced [9]. Common ASHRAE standards used for building energy modelling can be found in Table 1.3.

Standards	Name
Standard 55-2020	Thermal Environmental Conditions for Human Occupancy [10]
Standard 62.2-2019	Ventilation for Acceptable Indoor Air Quality in Residential Buildings [11]
Standard 90.1-2018	Energy Standard for Buildings Except Low-Rise Residential Buildings [7]
Standard 90.2-2018	Energy Efficiency Design of Low-Rise Residential Buildings [6]
Standard 100-2018	Energy Efficiency in Existing Buildings [8]

Table 1.3: Common ASHRAE standards used in building energy modelling.

1.3.2 NECB

The National Energy Code of Canada for Buildings (NECB) is a guideline to assist provinces and territories with their development of legislation on building design and constitution regulations. The code is meant to promote building regulation consistency across Canada but it is not a requirement for provinces and territories to follow them, they are merely recommendations [97]. NECB adapts many of their codes from ASHRAE standards. For example, Climate Zone ranges follow the same definitions in NECB as they do in ASHRAE with two modifications. The first is the elimination of sub-classifications A, B, and C. The second modification is a split in Zone 7 to produce Zone 7A ($5000 < \text{HDD18°C} < 6000$) and 7B ($6000 \leq \text{HDD18°C} < 7000$). Figure 1.7 shows the Canadian Climate Zones based on NECB definitions.

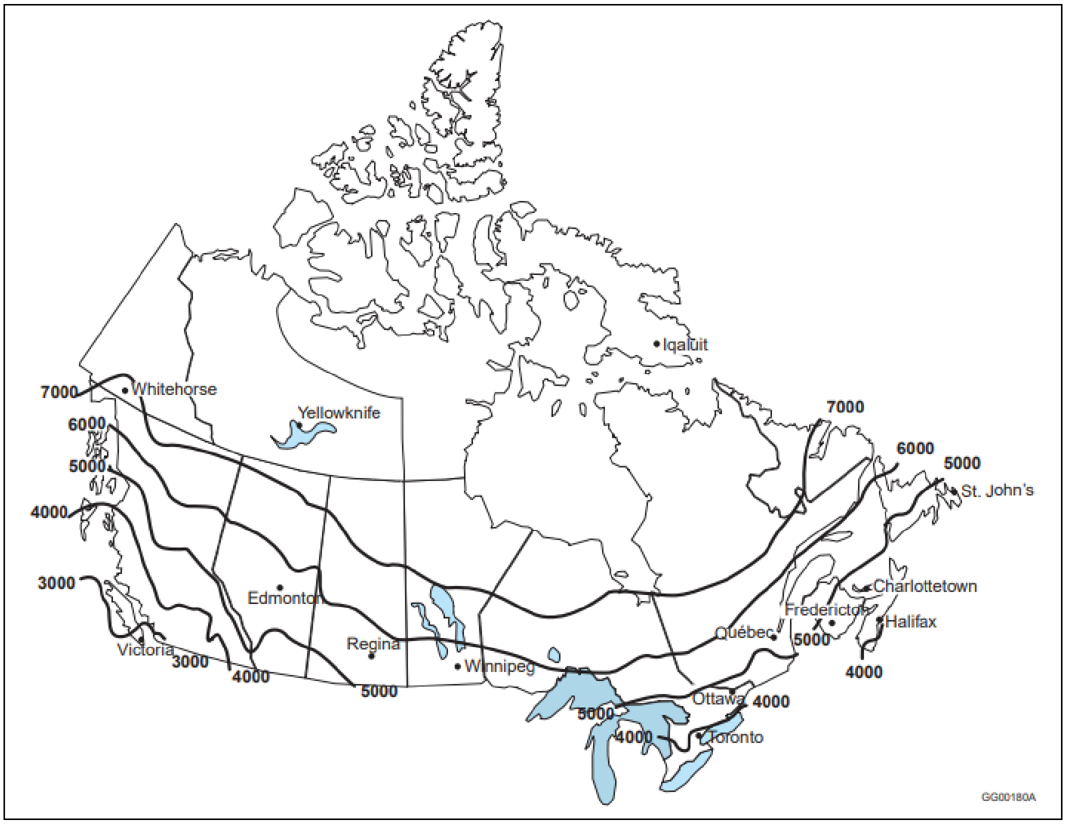


Figure 1.7: Canadian Climate Zones; image obtained from the Canadian Commission on Building and Fire Codes National Research Council (NRC) of Canada's publication of National Energy Code of Canada for Buildings (NECB) in 2015 [97].

In most cases the NECB lists specific standards if they are different from ASHRAE, if there is no change then the appropriate ASHRAE documentation is refereed to.

1.4 Retrofits

1.4.1 Envelope Thermal Resistance and Infiltration/Exfiltration

Buildings provide shelter for people from environmental conditions such as the sun, hot and cold weather, and rain. Improvements to the building envelope have been ongoing for hundreds of years; residential roofs used to be made from straw or other dried vegetation (thatched roofs), and today they are predominantly made using asphalt shingles in Canada. One of the main goals for ongoing building envelope improvements is to meet human thermal comfort needs in a cost-effective way. ASHRAE standard 55 [10] lists a thermal comfort range of 19.5-27.5°C depending on the season and relative humidity. Heat transfer can occur via conduction through the walls or by convection through leakage points. Additional heat gain or loss increase building thermal energy loads to meet the thermal comfort range. Common building envelope retrofits to reduce the building energy load include increasing insulation, decreasing infiltration/exfiltration, reducing glazing ratio, and adding energy efficient windows. Daouas [26] investigates the effects of insulation thickness on heating and cooling loads in Tunisia. The study found that each wall had its own optimal insulation thickness and associated energy saving. The south facing wall was able to produce the largest energy saving of 71.33% with a thickness of 10.1 cm. A study performed by Kim and Moon [79] investigated increased wall, roof, and window insulation in a cold and hot climate. They found that increasing wall, roof, and window insulation in cold climates was able to save on heating energy but there were almost no energy savings in warm climates.

Air leakage through foundation cracks or improper window sealing is another form of heat loss/gain, especially in older buildings. Performing an air-tightness test to seal leakage points can reduce heat transfer and air leakage [107]. A downside in reducing infiltration/exfiltration is the effect that it would pose to indoor air quality. Decreasing infiltration/exfiltration reduces the amount of fresh air entering the building, leading to an accumulation of CO_2, leading to a toxic indoor environment [67]. To combat a reduction in air quality, an increased ventilation rate must be considered. However, this leads to an increase in energy consumption, which leads to an increase in CO_2e emissions. There is a trade-off between air quality and reduction in CO_2e emissions. Indoor air-quality is beyond the scope of this research and will therefore not be considered.

1.4.2 Vegetation

In urban areas trees provide many benefits to infrastructure, health, thermal comfort, and climate change mitigation. Trees increase infiltration and interception, which reduce storm water runoff and flooding caused by impervious surfaces [89, 94].

Trees are able to block solar radiation providing shade and reducing road and building thermal gain. During the summer months neighborhoods increase in temperature, which can make the outdoor environment uncomfortable for people. Zhao et al. [126] found that tree placement and increasing tree density can offer neighborhood cooling of up to 10°C on hot days. Reduction in neighborhood heating can reduce household cooling loads, which leads directly into energy savings [94].

Trees and forests are one of the largest carbon storage systems. During photosynthesis trees capture carbon dioxide and store it as glucose, which is used to develop leaves, bark, and roots. Young trees grow faster leading to a faster carbon sequester rate, but older trees have a larger carbon storage capacity [82]. Nowak et al. [101] studied the amount of carbon sequestration in United States as a result of urban forests. The results showed an annual sequestration of about 25 million tonnes across the entirety of the United States. This shows a large potential for carbon capture by urban vegetation.

Aside from the environmental benefits, urban trees have social and health benefits. Trees are known to filter out air pollutants and improve air quality [94], but another less known benefit are their ability to decrease neighborhood crime. Lin et al. [83] studied the effects of tree placement and characteristics on crime rates and found that increased tree canopy cover, increased Green View Index (GVI), and increased tree species diversity all had high correlations with reduced crime rates.

1.4.3 Cool Roof

The Urban Heat Island (UHI) effect occurs in urban areas that have an increased outdoor air temperature compared to their surrounding rural areas. This is due to 1) the built environment (i.e. roads and buildings) replacing natural vegetation and 2) the types of materials used in the built environment [102]. Prior to urbanization, vegetation and soil would reflect incoming solar radiation and reduce daytime temperatures via evapotranspiration, which reduces outdoor heat [1]. Low albedo and high emsissivities of constriction materials used in urban areas are major contributors to UHI. Materials such as concrete, asphalt, and pavement are usually darker and retain heat from solar radiation and release it by means of convective heat transfer into the air. Construction materials can reach up to 40 °C higher temperatures than outdoor air temperatures [20]. The ability of these construction materials to store heat not only affects the ambient outdoor temperature but also increases indoor temperatures when heat is transferred by conduction into the indoor environment via walls and roofs. The increase in indoor temperature during the cooling season leads to an increase in building cooling load [1], which increases electricity cost. The effects of UHI are not new but they are becoming more serious with the increase in population density and urbanization. Countries in warm climates, like Greece, have been combating UHI effects for many years with the use of cool materials [1, 20].

Cool materials are defined by their high albedo, which is a measure of a materials reflectivity for shortwave sun light, when compared to traditional construction materials. Albedo is measured on a scale from 0 to 1 [-], where measurements of 0.8 to 0.9 [-] are high reflectivity and 0.1 to 0.2 [-] are low reflectivity. Current construction materials have low albedos but by implementing cool materials with high albedos, temperature differences between the surface and outdoor air can decrease to just 10 °C [2]. The most common location on a building to implement cool materials is the roof because of the large surface area - known as a cool roof. Increasing the roof albedo by adding lighter colour material with high albedos and high emsissivities, the built environment can increase its the amount of solar radiation that is reflected.

1.4.4 Photovoltaic Systems

To meet its GHG emissions targets, Canada has been transitioning towards cleaner sources of energy, specifically away from coal and natural gas to electricity. Canada's size and access to natural resources makes this energy transition easier; in fact, 80% of Canada's electricity production is non-emitting as a result of hydroelectric dams and nuclear energy [24]. Two actions were outlined in the Pan-Canadian Framework on Clean Growth and Climate Change [34]: 1) increase renewable energy sources and 2) modernize electricity systems. The first action requires phasing out coal and reducing the use of natural gas by creating and relying on renewable energy sources; the second action aims to improve the electrical grid by implementing a 'smart-grid'. A smart-grid would decentralize electricity production, allowing residential buildings to produce their own electricity and send excess electricity to the grid, reducing electrical energy waste [51]. Photovoltaic (PV) panels are instrumental in accomplishing this by offsetting grid electrical consumption to meet cooling demands. Ideally, electricity would also offset heating demands but the majority of homes in Canada, which use natural gas for space heating. The considerations for transitioning from natural gas to electrical appliances are beyond the scope of this research. Implementation of PV systems will only be discussed to meet cooling needs and providing electricity for domestic use.

Photovoltaic panels are made up of a group of cells that convert sunlight into Direct Current (DC) electricity using semiconductors that generate an electric field. DC electricity is converted in Alternating Current (AC) via inverters, this electricity can be used to power appliances or meet the residential electric cooling demand [40, 88, 122]. There are different types of PV cells to choose from depending on materials, efficiency, and cost. The main cell types are: single-crystal cells, poly-crystal cells, thin film cells, and triple junction cells [40, 88, 122]. Single-crystal cells are a single crystal with an efficiency of about 25%. Poly-crystals are similar to single-crystal cells except they are made up of multiple crystal structures and are 1-2% less efficient then single-crystal cells. Thin film cells use thin cuts (micrometers) of silicon crystal, much thinner than single- and poly-crystals, with an efficiency of about 10%. Triple junction cells have layers of crystal cells cuts to absorb a wider range of wavelengths with an efficiency of 40%. Thin film cells are usually more expensive whereas single- and poly- crystal cells are cheaper and therefor more widely used [40, 88, 122].

The drawback to PV electricity production is that there is not enough electrical generation to meet demand due to its reliance on sunlight, climate zone, climate conditions, PV cell type, and natural deterioration [23, 40, 87, 122]. When seasons change so do daylight hours. During the spring and summer seasons days are longer with more sunlight availability leading to a larger PV electricity generation. Fall and winter seasons have shorter days, and therefore, PV electricity production declines in these seasons.

Seasonal changes are not the only factors that influence PV electricity production. Weather conditions can reduce direct shortwave solar radiation intensity reaching the PV system, reducing electricity production. When days are cloudy, direct shortwave solar radiation intensity decreases. Studies have shown that other weather conditions such as high levels of humidity, high temperature, pollution, and rain can reduce the desired solar radiation intensity and reduce PV system performance [40, 43, 45, 78, 122]. Light snow levels have little impact on PV production because light can scatter and reach PV cells [42] but when snow can no longer be blown away by the wind it can have a negative effect on PV production [42, 43].

Since weather conditions affect the PV electricity production, it follows that climate zones have the same effect. Each climate zone can have a number of different climate conditions depending on the observed city, since this analysis is for Vancouver and Toronto, the effect of these climate zones will be discussed. The Canadian Government has developed an interactive map, Figure 1.8, that shows the annual PV potential across Canada. Overlaying Figure 1.8 with Figure 1.7, there is a correspondence between PV production and climate zone. Vancouver is a coastal city, although the effects of coastal regions on PV production has not been studied extensively, there are some studies that suggest PV systems are less effective [33]. Vancouver is generally a cloudy and rainy place compared to other cities in Canada; this can also negatively impact PV performance. In contrast, Toronto has clearer skies but does experience harsher winters leading to snow covered panels.

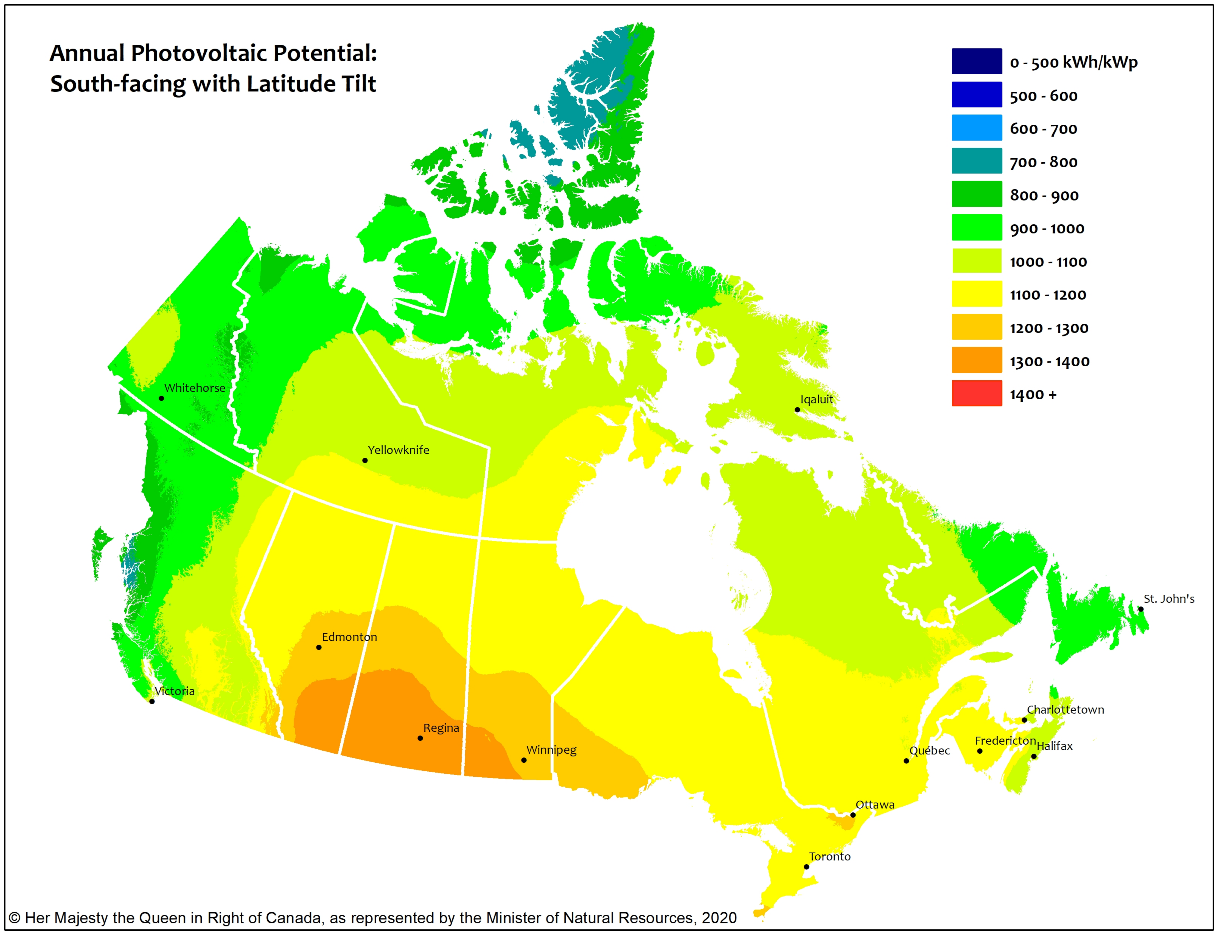


Figure 1.8: Annual photovoltaic potential in [kWh kWp^{-1}] across Canada [50].

Knowing the benefits and drawbacks of PV panels is beneficial for understanding the usefulness of PV panels in current climates as well as future climates in Canada. With the effects of climate change, climate zones are shifting. This shift can impact future PV production capabilities in

Vancouver and Toronto.

1.5 Study Objectives

Implementing building energy mitigation strategies can help reduce GHG emissions but it is unclear which strategies are best suited in different climate zones of Canada. There are also research gaps in understanding which mitigation strategies will be useful in the long term due to climate change. This study focuses on single-family low-rise residential buildings in Vancouver and Toronto. Two neighborhoods from climate zones 4 and 5 are considered for Vancouver and Toronto, respectively.

This research investigates building energy consumption change associated with five mitigation strategies: increasing vegetation, increasing envelop thermal insulation, decreasing infiltration/exfiltration, adding cool roofs, and adding photovoltaic systems. The simple mitigation measures studied here are accessible to most home owners, while other sophisticated technologies (e.g. heat pumps, building thermal energy storage, phase change materials, solar thermal energy, and more) may be out of reach for most home owners.

Operating cost and carbon emissions analyses for each mitigation strategy are conducted. Building energy consumption is simulated for the current climate (2020), and the future climate under RCP 4.5 and RCP 8.5 [W m^{-2}] for 2040, 2060, 2080, and 2100. The operating cost and carbon emissions analyses are conducted over 20-year periods, the average lifespan of a building energy-retrofit investment. The economic and carbon emissions results inform which mitigation strategies are best to reduce building energy consumption for each climate zone most cost-effectively. To summarize, the following research questions are addressed:

1. Which mitigation strategies reduce energy consumption of single-family low-rise residential buildings in Canadian climate zones 4 and 5, associated with two neighborhoods in Vancouver and Toronto, respectively?

2. Which mitigation strategies reduce GHG emissions most cost-effectively for climate zones 4 and 5?

3. What is the future landscape of mitigation strategies under future climate change scenarios of RCP 4.5 and 8.5 [W m^{-2}] for climate zones 4 and 5?

1.6 Author Contributions

The urban physics model used in this study is titled the Vertical City Weather Generator (VCWG). VCWG was developed by Mohsen Moradi and Amir A. Aliabadi at the Atmospheric Innovations Research (AIR) lab. The author used this model for simulations in this study.

The statistical downscaling model in this study is titled the Vatic Weather File Generator (VWFG). This model generates future weather files to force the VCWG simulations. The author assisted Amir A. Aliabadi to develop VWFG. The author downloaded all the required reanalysis and climate model datasets for use by VWFG.

The author conducted all the VCWG simulations, post processed the results, created the tables and figures, interpreted the results, and wrote the content of this thesis. Syeda Tasnim and Amir A. Aliabadi helped revise and edit the thesis.

Chapter 2

Methodology

2.1 Vertical City Weather Generator (VCWG)

The urban physics model used for the investigations of this study is the Vertical City Weather Generator (VCWG) developed by the Atmospheric Innovations Research (AIR) lab. The full description of the model is provided in the literature [3, 4, 89, 90], while in this study only parts of the VCWG process are described that are most relevant to the analysis of this study. The follow sub sections provide details of VCWG configuration, forcing conditions, and boundary conditions.

2.1.1 Configuration

The current VCWG version is composed of five sub-models 1) rural model, 2) urban energy balance and radiation models, 3) urban vertical diffusion and building energy models, 4) hydrology model, and 5) alternative and renewable energy model. See Figure 2.1 for a schematic of the sub-models.

VCWG v1.3.2 was the first published version and only considered the physical interactions between the buildings and the environment [89]. After verification of VCWG's performance, VCWG v1.4.5 was released which incorporated the following renewable and alternative energy calculations: heat pump, solar thermal collector, photovoltaic panel, Phase Change Material (PCM), Building Integrated Thermal Energy Storage (BITES), and wind energy [3]. A study performed by Aliabadi et al. [3], using VCWG v1.4.5 and an economic analysis, showed that all renewable and alternative energy options may not be cost effective for a low-rise single-family residential home owner. Further, VCWG v1.4.6 was developed that permits the user to use no renewable/alternative energy options, all renewable/alternative energy options, or just PV and wind energy. The latest version is VCWG v2.0.0, which incorporates the hydrology model [90].

This research uses VCWG v1.4.6 for the benefit of reducing mitigation costs to the home owner by choosing only one form of renewable energy: the PV option. Other options investigated, such as reducing infiltration/exfiltration, reducing ventilation, or increasing the building envelope thermal resistance, are already enabled in VCWG v1.4.6 and previous versions. VCWG can be forced from the top of the urban domain or the rural area using appropriate weather files. This study uses rural forcing.

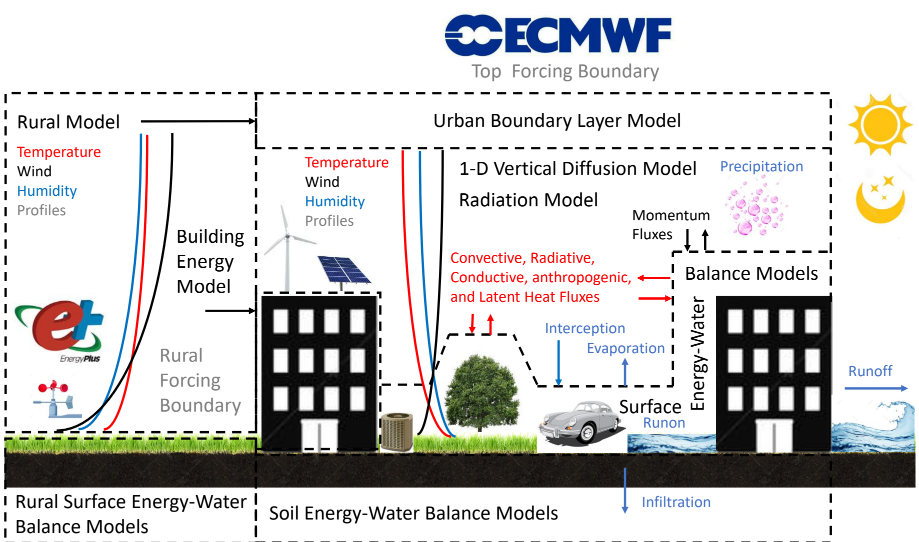


Figure 2.1: Vertical City Weather Generator (VCWG) sub-models [3, 89, 90].

2.1.2 Forcing Conditions

VCWG is forced using weather data of a nearby rural site. Weather data is retrieved from the European Centre for Medium-Range Weather Forecasts (ECMWF), which produces a weather reanalysis dataset known as ERA5, with two sub-datasets known as ERA5[29] and ERA5-Land [31]. ERA5 files contain hourly reanalysis data of atmospheric, land, and ocean variables with a spatial grid resolution of 30 km from 1959 to present [28]. ERA5-Land is the land portion of ERA5 with a finer spatial resolution of 9 km from 1950 to present [30].

When conducting an analysis for the current or historical weather, a single year is sufficient to download. When analyzing future climate scenarios, historical and validation periods are required and thus, many years (roughly 30) must be downloaded. See section 2.2 for details. ERA5 datasets offer weather data for this required length of time.

The first step is to identify a longitude (lon) and latitude (lat) of a neighborhood that does not experience ocean or lake winds, with a rural site that is ideally about 10 km away from a city's edge. This distance away from the city would ensure that appropriate weather data is downloaded from a rural grid cell. Once an appropriate neighborhood is chosen, weather data can be downloaded. The rural model of VCWG requires forcing parameters that are listed in Table 2.1 from ERA5 and ERA5-Land datasets. VCWG requires the EnergyPlus Weather (EPW) file format; however, datasets from ECMWF are downloaded as NetCDF files, whose format must be converted.

Climate dataset	Name
ERA5	Total sky direct solar radiation at surface [W m^{-2}]
ERA5	Surface solar radiation downwards [W m^{-2}]
ERA5	Surface thermal radiation downwards [W m^{-2}]
ERA5-Land	2m dewpoint temperature [°C]
ERA5-Land	2m temperature [°C]
ERA5-Land	Soil temperature level 1, 2, and 3 [°C]
ERA5-Land	10m u-component of wind [m s^{-1}]
ERA5-Land	10m v-component of wind [m s^{-1}]
ERA5-Land	Surface pressure [Pa]
ERA5-Land	Total precipitation [mm]
ERA5-Land	Leaf area index, high vegetation [m^2 m^{-2}]
ERA5-Land	Leaf area index, low vegetation [m^2 m^{-2}]

Table 2.1: ERA data downloaded.

2.1.3 Boundary Conditions

2.1.3.1 Building Envelope

The building envelope describes the structure and components of its walls, roof, and floor. Houses are classified as less energy efficient when they have a poor building envelope. A poor building envelope has poor insulation, allowing for thermal energy loss/gain by conductive heat transfer. Heat is transferred through walls, roofs, and floors when there is a temperature difference between the materials inside and outside facing facades. This is known as conductive heat transfer, which can be expressed by Fourier's Equation 2.1:

$$q = -\kappa A \frac{\Delta T}{\Delta x}, \tag{2.1}$$

where q is the rate of heat transfer [W], κ is thermal conductivity [W m^{-1} K^{-1}], A is the cross sectional area [m^2], ΔT [K] is the change in temperature, and Δx is the thickness of the material [m]. This equation can be represented by the thermal resistance, R [m^2 K W^{-1}], of the material using the relationship in Equation 2.2 produce Equation 2.3

$$R = \frac{\Delta x}{\kappa}, \tag{2.2}$$

$$q = -A \frac{\Delta T}{R}. \tag{2.3}$$

When the thermal resistance (R-value) of a component increases the heat transfer decreases. Decreasing heat transfer is beneficial for both winter and summer months. In the winter wanted heat is lost to the outside environment and in the summer there is unwanted heat gain. When not properly insulated, conductive heat transfer can increase heating and cooling loads during their respective seasons, which increases heating and cooling energy consumption and costs.

Convective heat transfer occurs between fluids through direct contact. Convective heat transfer occurs in residential buildings where there is air leakage through foundation cracks and/or window/door openings. Older houses tend to be leakier because of foundation degradation. Single zone air leakage (sensible heat) can be calculated using Equation 2.4 for a single zone

$$q_{inf} = \pm \dot{m}_{inf} C_p (|T_{out} - T_{in}|), \tag{2.4}$$

where $\dot{m}_{inf}$ [kg s^{-1}] is the mass flow rate of the infiltrating/exfiltrating air, C_p [J kg^{-1} K^{-1}] is the heat capacity, T_{out} [K] is the outdoor temperature, and T_{in} [K] is the indoor temperature.

Indoor humidity level is affected by the temperature difference between the outdoor and indoor environment. Heat can be lost/gained through latent heat via air leakage points when humidity levels are different. This is considered in equation 2.5, which is the latent heat flux.

$$q_{inf} = \pm \dot{m}_{inf} L(|Q_{out} - Q_{in}|), \tag{2.5}$$

where $\dot{m}_{inf}$ [kg s^{-1}] is the mass flow rate of the infiltrating/exfiltrating air, L [J kg^{-1}] is the latent heat of vaporization, and Q_{out} and Q_{in} [kg kg^{-1}] are specific humanities for the outdoor and indoor environments, respectively.

Infiltration causes heat loss/gain when there are cracks in the buildings foundation allowing for heat loss/gain during heating and cooling seasons.

In this study, an increased value of wall thermal resistance (*RvalH*) and two decreased values of infiltration/exfiltration (*InfL*, *InfLL*) will be investigated. A single value of thermal resistance was chosen based on price per unit of thermal resistance (1 unit = 4 m^2 K W^{-1} of resistance). Two values of infiltration/exfiltration were chosen based on assumed possible future code requirements for Net-Zero Buildings, academic literature [84], and what could be attainable.

In VCWG, wall resistance has its own input that can be easily changed. In Equation 2.2, the thickness of the envelope does not change when adding insulation however thermal conductivity does. This is internally calculated in VCWG with a new thermal resistance input. Inputs for infiltration/exfiltration are also directly set for the VCWG model and can be changed for investigation.

2.1.3.2 PV and Cool Roof

The factors that affect the efficiency of photovoltaic systems are outlined in Section 1.4.4. The efficiency of PV panels to convert solar radiation to electricity is dependent on the type of material used in the cells, the amount of solar radiation, and the tilt angle. From Aliabadi et al. [3] the power conversion of the PV system is calculated in VCWG by Equation 2.6

$$W_{PV} = \nu_{PV} A_{PV} S^{\downarrow dir} cos\theta_{\mathrm{a}} cos(\theta_{\mathrm{z}} - \beta_{PV}), \tag{2.6}$$

where ν_{PV} [-] is the conversion efficiency, A_{PV} [m^2] is the area of the PV system, $S^{\downarrow dir}$ [W m^{-2}] is the direct shortwave radiation flux, θ_{a} [°] is the azimuth angle, θ_{z} [°] is the zenith angle, and β_{PV} [°] is the tilt angle of the PV system.

Two PV system sizes are considered in this study to determine if there are any changes in PV benefits in future years under future climate scenarios. PV system sizing is shown as a percentage of half the sun facing roof, *PVH* = 35 % and *PVHH* = 69 % (see Figure 2.2). Details regarding the economic analysis can be found in Section 2.4.

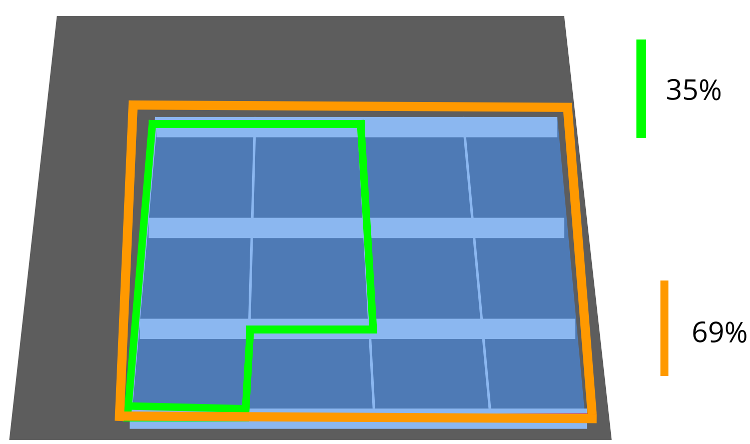


Figure 2.2: PV percent coverage on the sun facing roof

The decrease in UHI is not the only benefit of a cool roof, studies have shown there can be cost savings via a reduction in electricity consumption in tropical and subtropical climates [2, 21, 119]. The literature is clear that cool roofs are beneficial in tropical climates; however, the benefits of a cool roof in cold climates is not as well known. Canada experiences heating and cooling months with a large change in seasonal temperature. Therefore, the degree of heating and cooling loads vary across Canada (see Section 1.3.2). Tzempelikos et al. [120] studied the effects of cool roofs in different building types and climate zones and saw negative and positive cost savings depending on building type, climate zone, roof insulation, and building durability. The economic benefit of a cool roof is also dependent on the material used. A list of materials and costs can be found in Table 2.2; values were taken from The United States Environmental Protection Agency (USEPA) publication *Reducing Urban Heat Islands: Compendium of Strategies Cool Roofs* [37]. The goal of this research is to find easy retrofits that are cost effective; as such, a liquid applied coating was chosen as the cool roof material because 1) it is the most cost effective, 2) it has a high albedo and emississivity, and 3) it can be painted and thus making it easy to apply. Ideally, an albedo of 0.85 would be used in tropical and hot regions, but roofs experience weathering from seasonal changes, which would reduce the albedo. To account for weathering effects and to be consistent with other cool roof studies [14, 90], an albedo of 0.6 [-] was chosen.

Cool Roof Material	Albedo [-]	Costs [$ m^{-2}]
Single-Ply Membrane	0.4 - 0.78	10.76 - 22.06
Metal Roof	0.4 - 0.7	19.37 - 40.35
Liquid Applied Coating	0.5 - 0.85	6.46 - 8.61
Concrete Tile	0.4 - 0.7	10.76 - 64.56
Clay Tile	0.4 - 0.7	32.28 - 53.80

Table 2.2: Albedo and cost range of different cool roof materials [37]

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2.1.3.3 Vegetation

The initial assumption is that there is one tree in front of the house, this was based off of the google images for each chosen neighbourhood, as seen in Figures 2.8 and 2.12. The objective is to decrease electricity consumption by increasing the tree number by one tree and then again by another tree. VCWG does not consider the number of trees but instead the Leaf Area Density (LAD) [m^2 m^{-3}], which is the leaf area per unit volume of tree canopy. LAD [m^2 m^{-3}] describes the tree profile. The profile is broken up into equal vertical segments i that add up to the height of the building z = 6 [m] for a two-storey residential house. The Leaf Area Index (LAI) [m^2 m^{-2}] is the vertical integral of LAD, which represents the total area canopy cover. The relationship can be seen in Equation 2.7:

$$LAI = \sum_{i=1}^{z} LAD_i \Delta z. \tag{2.7}$$

Unfortunately, there is no standard way to calculate LAI, the literature produces vastly different values. This analysis considers an LAI range from [89] and assumes a single tree will have an LAI range of $0 < LAI \leq 0.5$ [m^2 m^{-2}], while two trees will have an LAI range of $0.5 < LAI \leq 1.0$ [m^2 m^{-2}], and three trees will have an LAI range of $1.0 < LAI \leq 1.5$ [m^2 m^{-2}]. See Figure 2.3.

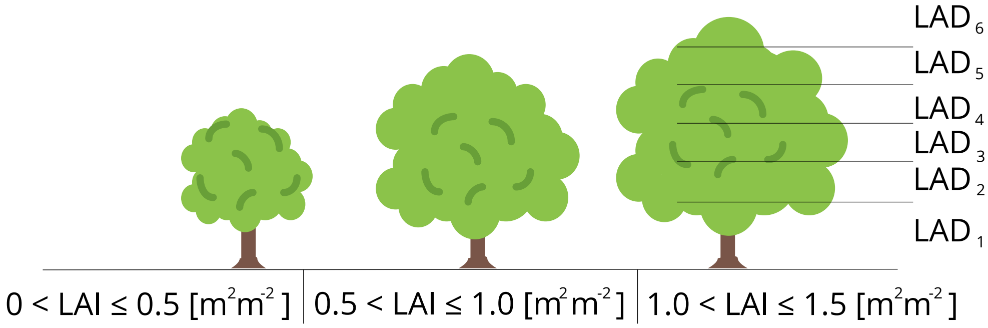

Figure 2.3: Leaf Area Density LAD [m^2 m^{-3}] and Leaf Area Index LAI [m^2 m^{-2}]

LAI changes monthly based on the season. The ratio between LAI values from ERA5-Land were maintained but the range was shifted to match the criteria above. The shift occurred around LAI peak month, July. LAI outputs can be found in Appendix B.1. An example calculation for the base case can be seen below.

LAI from ERA5-Land can be found in Table 2.3 for each month. An LAD [m^2 m^{-3}] profile for January was created based on the LAI. LAD for February was then calculated by multiplying LAI by the ratio between February and January LAI. A sample calculation is shown in Table 2.3 for February profile 1. Steps are repeated for the following months.

The ratio of the maximum LAI in July (1.89 [m^2 m^{-2}]) to the maximum desired LAI (0.5 [m^2 m^{-2}]) was calculated and applied to all monthly LAIs and LADs to adjust the vegetation parameters properly. For example, this ratio for $0 < LAI \leq 0.5$ [m^2 m^{-2}] will be 0.5 [m^2 m^{-2}] / 1.89 [m^2 m^{-2}] = 0.2645. Results can be seen in Table 2.4.

Month	LAI [m^2 m^{-2}]	Ratio	LAD Profile 0-6 [m^2 m^{-3}]
Jan	1.31	-	0, 0.36, 0.34, 0.3, 0.21, 0.1, 0
Feb	1.28	1.28/1.31 = 0.977	0, 0.977×0.36 = 0.35, 0.33, 0.29, 0.21, 0.10, 0
Mar	1.30	-	0, 0.36, 0.34, 0.30, 0.21, 0.10, 0
Apr	1.42	-	0, 0.39, 0.37, 0.33, 0.23, 0.11, 0
May	1.57	-	0, 0.43, 0.41, 0.36, 0.25, 0.12, 0
Jun	1.71	-	0, 0.47, 0.44, 0.39, 0.27, 0.13, 0
Jul	1.89	-	0, 0.52, 0.49, 0.43, 0.30, 0.14, 0
Aug	1.58	-	0, 0.43, 0.41, 0.36, 0.25, 0.12, 0
Sep	1.67	-	0, 0.46, 0.43, 0.38, 0.27, 0.13, 0
Oct	1.50	-	0, 0.41, 0.39, 0.34, 0.24, 0.11, 0
Nov	1.42	-	0, 0.39, 0.37, 0.33, 0.23, 0.11, 0
Dec	1.38	-	0, 0.38, 0.36, 0.32, 0.22, 0.11, 0

Table 2.3: Original LAI [m^2 m^{-2}] from ERA5-Land data along with LAD profiles [m^2 m^{-3}].

Month	LAI [m^2 m^{-2}]	LAD Profile 0-6 [m^2 m^{-3}]
Jan	1.31 $\times$ 0.2645 = 0.35	0, 0.2645 $\times$ 0.35 = 0.10, 0.09, 0.08, 0.06, 0.03, 0
Feb	0.34	0, 0.12, 0.10, 0.07, 0.03, 0.02, 0
Mar	0.34	0, 0.12, 0.10, 0.07, 0.03, 0.02, 0
Apr	0.38	0, 0.13, 0.11, 0.08, 0.04, 0.02, 0
May	0.42	0, 0.14, 0.12, 0.08, 0.04, 0.02, 0
Jun	0.45	0, 0.15, 0.14, 0.09, 0.05, 0.03, 0
Jul	$\underline{0.50}$	0, 0.17, 0.15, 0.10, 0.05, 0.03, 0
Aug	0.42	0, 0.14, 0.13, 0.08, 0.04, 0.03, 0
Sep	0.44	0, 0.15, 0.13, 0.09, 0.04, 0.03, 0
Oct	0.40	0, 0.13, 0.12, 0.08, 0.04, 0.02, 0
Nov	0.38	0, 0.13, 0.11, 0.08, 0.04, 0.02, 0
Dec	0.37	0, 0.12, 0.11, 0.07, 0.04, 0.02, 0

Table 2.4: Adjusted LAIs [m^2 m^{-2}] to meet the range $0 < LAI \leq 0.5$ [m^2 m^{-2}] for a single tree along with the LAD [m^2 m^{-3}] profile.

2.2 Vatic Weather File Generator (VWFG)

To force VCWG with future weather files, for investigation of future climate scenarios, it is required to generate future weather files using the statistical downscaling approach. The Vatic Weather File Generator (VWFG), developed by the Atmospheric Innovations Research (AIR) lab, achieves this task. In the following subsections the downscaling methods, VWFG inputs, process, and calculations are discussed.

2.2.1 Downscaling Methods

Global Climate Models (GCMs) were created to model the earth's physical and chemical processes at coarse spatio-temporal scales. The main objective of GCMs is to reveal the future evolution of the earth's system in many decades. Although they can be used to predict future global climate data, GCMs have coarse spatial ($\sim$ 200 km) an temporal (daily) resolutions. This limits GCMs' capability to provide data required for building energy modelling at micro scales. When looking at how global climate change affects regional climates, higher spatio-temporal resolutions are necessary. Models with higher spatial resolutions are known as Regional Climate Models (RCMs), with horizontal resolutions of 25 km to 50 km [70]. A study completed by Jentsch et al. [77] shows the benefits of using RCM data vs GCM data for building energy models. For example, using GCM data, there tends to be an underestimation of future climate impacts on building energy consumption in Maritime areas; this impact is not as large when studying regions that have a more continental climate. Many RCMs used today are nested within GCMs. With higher spatio-temporal resolutions, in fact RCMs are downscaled GCMs [70, 85, 112, 125]. This is known as dynamical downscaling and is computationally intensive.

Depending on the use of climate model data, the appropriate resolutions depend on purpose. When using climate model data to study droughts, higher spatial ($\sim$ 1000km) and temporal ($\sim$ years) resolutions from a GCM are sufficient. However, when looking at river flooding data, higher spatial ($\sim$ 50 km) and temporal ($\sim$ days) resolutions from an RCM are necessary [13, 85, 112]. When even higher temporal resolutions are needed, such as in the case of running an urban physics model like VCWG requiring an hourly forcing dataset, further downscaling of RCM data can be performed either by dynamical or statistical downscaling methods. As mentioned, dynamical downscaling is computationally intensive, which makes the use of statistical downscaling more common.

Statistical downscaling analyzes the statistical trends within observed/reanalyzed and future

RCM data. The important assumption to keep in mind with statistical downscaling is that it assumes the statistics do not change over time [85]. The downside of this is that it is unable to predict extreme weather events [123]. Fortunately, in most building energy simulation models, analysis of extreme weather events are not necessary.

There are three main statistical downscaling methods used [123]: Weather Classification (WC), Weather Generators (WG), and Regression Models (RM). WC will usually use a machine learning algorithm to group historic days into weather types based on their similarities. Climate model data are then sorted into these weather types based on there similarities to each weather type [18, 123]. WG is a stochastic process, where climate model data and observed/reanalysis data are used in statistical models to output hourly weather parameters in the future [85, 123]. The drawbacks to this method are that 1) weather generators model short term scales, which may not be able to accurately represent future climates and 2) output weather data are artificially generated with only the same statistical characteristics as the climate model data; this can be an issue when predicting multiple weather parameters simultaneously [85]. RM is the most common downscaling method due to its simplicity. A linear or non-linear statistical relationship is determined between daily (or coarser temporal resolutions) historical and future data that is then applied to the hourly historical data, which then becomes the downscaled future data [85, 123]. Both WC and WG are computationally intensive and developing a machine learning algorithm or a statistical model for their purpose is beyond the scope of this research. Implementing the WC and RM methods to downscale the RCM data is sufficient for this study.

These methods can be used together or in combination with other methods to reduce their limitations. Hosseini et al. [64, 65] used the WC method and a machine learning regression model. The WC method is unable to predict future weather values that are outside the range of historical values. A machine learning algorithm is used to predict a future month of climate data when a future month cannot be matched within a given uncertainty. The algorithm is trained and validated using a validation period.

This study created a software for statistical downscaling called the Vatic Weather File Generator (VWFG) using WC and RC for downscaling and bias correction. The WC method used come from Hosseini et al. [64, 65] and the RC method used is known as the delta or morphing method developed by Belcher et al. [19], and it is a widely used downscaling method [19, 85, 114].

2.2.2 VWFG Inputs

This method requires a minimum of 30 years of data to insure there are enough historical and validation records for statistical manipulation. As discussed in Section 2.1, VCWG uses ERA5 data that are converted to EnergyPlus Weather (EPW) file format. These can also be used as observed/reanalyzed weather files. Files from 1980 - 1999 were used for the historical period and 2007-2020 were used as the validation period. ERA5 files from 2000-2006 were not used because ECMWF reported a cold bias developed from their bias correction method [63]. Other options for observed/reanalyzed historical files can come from the Canadian Weather year for Energy Calculation (CWEC) used in Hosseini et al. [64] or The Canadian Weather Energy and Engineering Datasets (CWEEDS) used by Mortezazadeh et al. [91]. Future climate model data can come from either GCMs or RCMs, ideally RCM data should be used when performing an analysis at a local scale (see Section 1.1.4). Urban Physics Models (UPMs) simulations require the following weather parameters to accurately model building energy consumption due to the outdoor climate: dry bulb temperature, pressure, radiation, and wind speed. However, availability is the limiting factor for RCM and GCM data acquisition. The Government of Canada offers downscaled data from the Coupled Model Intercomparison Project Phase 5 (CMIP5); however it only offers mean, daily maximum and minimum temperatures, and total precipitation. The National American CORDEX Program offers downscaled data from the CMIP projects with a substantial number of climate variables but not all. The Geophysical Fluid Dynamics Lab coupled model Earth System Model (GFDL-ESM2M) is used by Hosseini et al. [65]. This analysis uses daily RCM data from the Canadian Regional Climate Model (CanRCM4) (also used by Mortezazadeh et al. [91]), which is driven by the CanESM2 global climate model [112]. The specifics of the downloaded data can be found in Table 2.5. Climate model data is downloaded from 2007-2020 for the validation period and 2021-2100 for the future period. The validation period was used to validate the downscaling method. This thesis does not discuss the details regarding the validation activity.

Weather Parameter	Spatial/Temporal Resolution	Climate Scenario
Near Surface Air Temperature, ta [K]	0.22°, Daily	RCP 4.5, RCP 8.5 [W m^{-2}]
Surface Pressure, pa [Pa]	0.22°, Daily	RCP 4.5, RCP 8.5 [W m^{-2}]
Surface Downwelling Longwave Radiation, $rlds$ [W m^{-2}]	0.22°, Daily	RCP 4.5, RCP 8.5 [W m^{-2}]
Surface Downwelling Shortwave Radiation, $rsds$ [W m^{-2}]	0.22°, Daily	RCP 4.5, RCP 8.5 [W m^{-2}]
Daily-Mean Near-Surface Wind Speed, $sfcWind$ [m s^{-1}]	0.22°, Daily	RCP 4.5, RCP 8.5 [W m^{-2}]

Table 2.5: Weather variables obtained from CanRCM4 [49]

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2.2.3 Process

The process for the downscaling approach can be demonstrated in Figure 2.4. Detailed explanations are provided in the next sub section, while the brief process overview can be given as:

- Download climate model files for the historical, validation, and future periods. Extract data from a coordinate nearest to the rural forcing cite.
- Download ERA5 reanalyzed data for the historical and validation periods.
- Use Quantile-Quantile (QQ) method for initial climate model bias correction.

- Match monthly climate model data to historical months using the Finkelstein-Schafer (FS) statistic and Weighted Sum (WS) approaches.
- Morph data to produce future weather files by correcting the mean and standard deviation of monthly records.

The output climate files from VWFG's downscaling process are used to force VCWG.

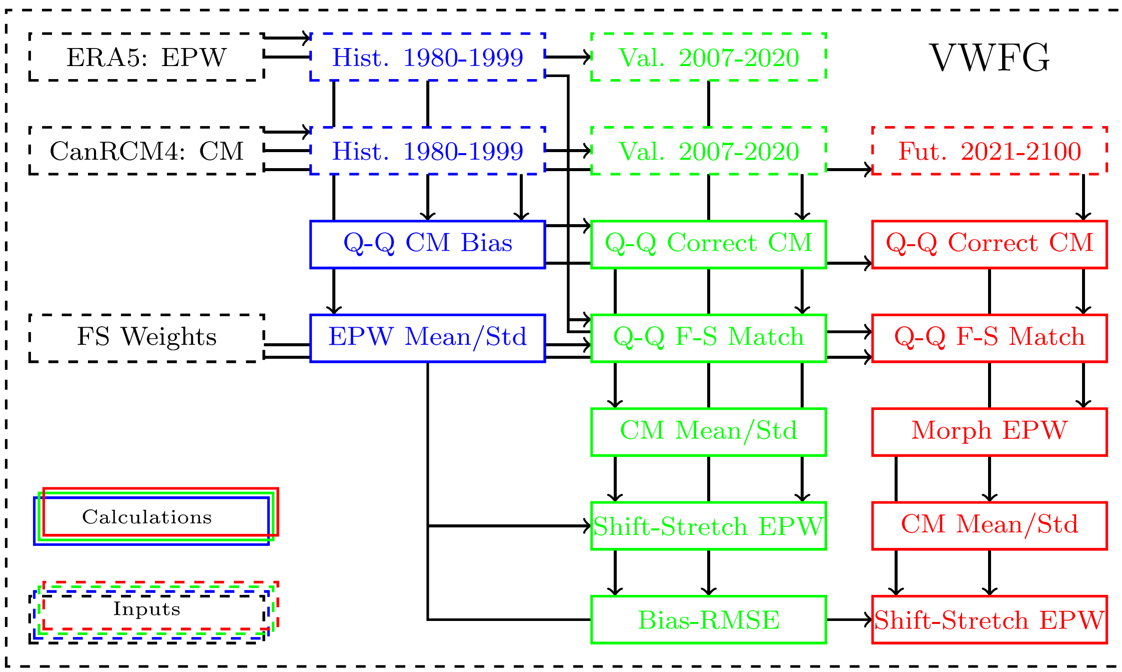


Figure 2.4: VWFG Process Diagram

2.2.4 Calculations

Climate model files from CanRCM4 contain 5 years of weather data at daily resolution for every grid cell in the RCM domain. Figure 2.5 shows the file structure. The dimensions of time indicates the total number of days, equal to 5 [yr] $\times$ 356 [day yr^{-1}] = 1825 [day]. The latitude and longitude dimensions are related to the domain spatial resolution. The columns of interest are the 'time', 'lon', 'lat', and 'variable'. From the datasets, a lat and lon closest to the rural sight is identified and the 'time' and 'variable' data are then extracted and placed into an EPW file.

```
odict_keys(['time', 'rlon', 'rlat', 'lon', 'lat', 'rotated_pole', 'tas'])
odict_keys(['time', 'rlon', 'rlat', 'lon', 'lat', 'rotated_pole', 'sfcWind'])
odict_keys(['time', 'rlon', 'rlat', 'lon', 'lat', 'rotated_pole', 'ps'])
odict_keys(['time', 'time_bnds', 'rlon', 'rlat', 'lon', 'lat', 'rotated_pole', 'rlds'])
odict_keys(['time', 'time_bnds', 'rlon', 'rlat', 'lon', 'lat', 'rotated_pole', 'rsds'])
Dimension of time: (1825,)
Dimension of latitude and longitude: (260, 310)
Dimension of weather variables: (1825, 260, 310)
```

Figure 2.5: CanRCM4 file structure

2.2.4.1 Quantile-Quantile Approach

The data output of climate models is inherently biased due to the low spatial resolution and simplified physical processes. Biases in dynamical downscaling can be reduced by adding more physical processes in the model and reducing the spatial and temporal resolutions, making the climate model more complex and computationally intensive. A simpler approach is to use the Quantile-Quantile method [5] for initial bias correction of the climate model data. For each weather variable during the historical period (1980-1999), a daily average is taken for each validation year. A Cumulative Distribution Function (CDF) is created for EPW files sorting daily averaged values of weather variables for each month of all historical years. This step is repeated for climate model historical years. The number of quantiles in the CDF is determined by the number of days in the month. Bias correction takes place for each month using Equation 2.8, where the historical EPW data is subtracted from the historical climate model data. This bias is then applied to the future climate model CDF data to complete the bias correction process. The bias is defined by

$$B(i) = \frac{1}{N}\sum_{j=1}^{N}(X_{CM,i,j} - X_{EPW,i,j}), \tag{2.8}$$

where i represents the quantile, j represents the historical year, N is the total number of historical years (20), $X_{CM,i,j}$ is the climate model quantile value for a given month, and $X_{EPW,i,j}$ is the EPW historical quantile for a given month. Once the future climate data has been bias corrected, the matching process can begin.

2.2.4.2 Finkelstein-Schafer Method and Weighted Sum

A CDF is created for each month and each year during the historical period for EPW data. The same CDF is created for the future period of climate model data. Downscaling occurs when a historical EPW CDF can be matched with a future climate model CDF for all weather parameters (i.e. temperature, pressure, wind speed, radiation). To do this the Finkelstein-Schafer (FS) method is used to find the closest match. From Equation 2.9 the absolute difference between the future climate model CDF and all possible historical EPW CDFs is taken for all weather parameters.

$$FS_X = (1/n)\sum_{i=1}^{n}|X_{CM,i} - X_{EPW,i}|, \tag{2.9}$$

where i is a given quantile, n is the number of quantiles, i.e. days (28, 30, or 31), $X_{CM,i}$ is the quantile value for the bias corrected climate model CDF for an given month and year, and $X_{EPW,i}$ is the quantile value for the historical EPW CDF for a given month and year. This step is repeated for all weather parameters.

Once the FS statistics have been determined, the best possible match can be found considering all weather parameters together. This is achieved by applying weights to each parameter that reflect each parameter's impact on building energy consumption. Weights are taken from a weight analysis performed by Hosseini et al. [64, 65] in Montreal (to represent Toronto in our study) and Vancouver. The weights can be found in Table 2.10 and 2.13 for Vancouver and Toronto, respectively.

Equation 2.10 is used to calculate the Weighted Sum (WS) factor between a future CM CDF and all possible historical EPW CDFs. The historical EPW CDF with the minimum WS is chosen as the best matching month.

$$\begin{aligned} WS &= \sum w_p FS_p \\ &= w_T FS_T + w_P FS_P + w_R FS_R + w_S FS_S, \end{aligned} \tag{2.10}$$

where p represents the weather parameter (temperature [K], pressure [Pa], radiation flux [W m^{-2}], and wind speed [m s^{-1}]), w_p is the weighting factor for each parameter, and FS_p is the FS statistic for each parameter.

2.2.4.3 Morphing Method

Once a matching record (month and year) has been determined, further statistical corrections are performed using the morphing method. This involves adjusting the monthly mean and standard deviation of the historical record to match those of the future record. The climate model data is used to stretch and shift the hourly EPW data. Using the mean and standard deviation to shift and stretch the EPW data. Equation 2.11 shows the adjusted EPW data after the combined shifting and stretching:

$$X_{EPW_{SS}} = \overline{X}_{CM} + (X_{EPW} - \overline{X}_{EPW}) \frac{S_{CM}}{S_{EPW}}, \tag{2.11}$$

where $\bar{X}_{CM}$ is the average daily climate model values, X_{EPW} is the EPW values, $\bar{X}_{EPW}$ is the averaged daily EPW values, S_{CM} is the standard deviation in the daily climate model values, and S_{EPW} is the standard deviation in the daily EPW values.

2.3 GHG Analysis

The CO_2e emissions analysis considers carbon emissions from grid electricity and burning of natural gas for space cooling and heating, respectively. The analysis also considers carbon captured by trees. However, this analysis does not consider Canada's Carbon Tax. Canada's Carbon tax pricing standards were developed by the federal government in 2019 [57], the carbon tax puts prices on CO_2e emissions associated with fossil fuel pollution [58]. Provinces have the option to implement federal standard prices or create their own. If provinces choose to implement their own pricing system, it must meet or exceed the proposed federal government standards [57]. Canada recently published more stringent standards in 2021 [57]. The Carbon tax system in Canada is in its infancy, changing to meet global warming needs and provincial needs. Due to the uncertainty in the future structure of Canada's carbon tax system, it was not included in this research.

Trees have the ability to store carbon dioxide via photosynthesis. The Environmental Protection Agency (EPA) has estimated that coniferous and deciduous trees can store 10.52 and 17.24 [kg CO_2e], respectively, in their first 10 years [38]. For simplicity, an average value of 13.88 [kg CO_2e] of these values was used for the GHG analysis. Equation 2.12 shows the total CO_2e emissions savings from vegetation.

VCWG outputs annual gas and electricity demands, see Sections C.2.1 and C.2.2. These values were then used in the Equations 2.12, 2.13, and 2.15, to calculate the total CO_2e emissions savings.

$$VegCO_{2_{Sav}} = N_{\text{Tree}} \times \left(\frac{13.88}{10}\right) \times N, \tag{2.12}$$

where N_{Tree} [Tree] is the number of additional trees and N [year] is number of years, equal to 20 for this study.

While The majority of grid electricity used in Canada is green energy, all grid electricity has an associated CO_2e emissions. To calculate CO_2e emissions from electricity, an Electric Emissions

Intensity Factor (EEIF) is used to quantify the amount of CO_2e emissions from the electricity used. Vancouver and Toronto have EEIF of 0.027 [22] and 0.04 [kg CO_2e kW-hr^{-1}], respectively. BC mainly uses hydroelectric power which has a lower emissions intensity. Equation 2.13 shows the total CO_2e emissions savings from grid electricity.

$$ElecCO_{2_{Sav}} = [(TECD_b + TEDD) - (TECD_s + TEDD - TEP_{PV})] \times A_H \times N \times EEI, \tag{2.13}$$

where $TECD_b$ [kW-hr m^{-2}] is the total electricity consumption for cooling of the base system, $TEDD$ [kW-hr m^{-2}] is the total domestic electricity demand, $TECD_s$ [kW-hr m^{-2}] is the total electricity consumption for cooling for the retrofit system, TEP_{PV} [kW-hr m^{-2}] is the total electricity produced by the PV panels, A_H [m^2] is the area of the house, and EEI [kg CO_2e kW-hr^{-1}] is the CO_2e emissions from grid electricity production.

Natural gas is mostly composed of methane (CH_4), when it is burned it releases GHG emissions. Equation 2.14 shows the conversion of (CH_4) to CO_2e emissions, which is then used to calculate CO_2e emissions savings associated with natural gas consumption for the residential building

$$GasCO_{2_{Sav}} = (TGCH_b - TGCH_s) \times A_H \times N \times \rho_{CH_4} \times \frac{MW_{CO_2}}{MW_{CH_4}}, \tag{2.14}$$

where $TGCH_b$ [m^3 m^{-2}] is the total gas consumption for heating for the base system, and $TGCH_s$ [m^3 m^{-2}] is the total gas consumption for heating for the retrofit system.

Equation 2.15 shows the total CO_2e emissions savings

$$TCO_{2_{Sav}} = VegCO_{2_{Sav}} + GasCO_{2_{Sav}} + ElecCO_{2_{Sav}}, \tag{2.15}$$

where $VegCO_{2_{Sav}}$ [kg CO_2e] is the total CO_2e emissions savings associated with planting trees, $GasCO_{2_{Sav}}$ [kg CO_2e] is the total CO_2e emissions savings associated with natural gas savings, and

$ElecCO_{2_{Sav}}$ [kg CO_2e] is the total CO_2e emissions savings associated with electricity savings.

2.4 Economic Analysis

The cost of a retrofit is one of the most important considerations for a homeowner. If a retrofit item is expensive and do not offer any cost savings by the end of the retrofit period, it is less likely to be considered as a viable option. This research requires an economic analysis for a building in current and future climates. The United States Environmental Protection Agency (USEPA) has released Guidelines for Preparing Economic Analyses [121], which was used as a framework for this analysis along with the economic analysis in Aliabadi et al. [3]. Most of the mitigation strategies and heating/cooling systems have a lifespan of 20-25 years. With this in mind, the economic analysis is performed over 20 years. The analysis is framed to compare a base house, for which no retrofit is conducted, to a retrofitted house. Initial costs of renewable/alternative energy systems, the operational costs of the building, and government rebates are factored into the analysis.

2.4.1 Costs Considered

2.4.1.1 Gas and Electricity Costs

The economic analysis considers all the costs associated with the retrofit: initial investment costs, Operation and Maintenance (OM) costs, gas and electricity costs, and government rebates for qualifying retrofits. The analysis compares the cost of each retrofit system with the base house and then calculates the marginal annualized cost savings [%].

Initial electricity and gas prices were averaged historical values from [68, 103, 108] (electricity) and [95, 104] (gas), along with their inflation rates. Inflation and interest rates are medians of historical values from [15, 16]. Prices for acquisition and installation of retrofit items were taken from companies along with OM values. All values can be found in Table 2.6. Future costs were calculated by applying an inflation/interest rate to each cost.

2.4.1.2 Retrofit Costs

Increasing vegetation by adding trees is relatively inexpensive, depending on where a homeowner lives, it can even be free. In this analysis, the cost of tree planting is obtained from a local business in Toronto [81], which includes the cost of the tree and planting. It was assumed that the homeowner would pay for lawn cleaning service (OM) during the fall, for which the price was also obtained from a business in Toronto [41].

R-4 spray insulation was chosen because of its easy application. The cost of insulation came from an insulation company [32] and is per unit of R-value [m^2 K W^{-1}] added, which is already per wall area [m^{-2}]. There is no OM cost associated with increasing insulation.

Prior to sealing air-leakage points to reduce infiltration/exfiltration an air blower test must be conducted. The cost of an air blower test and sealing leakage points are obtained form a report written by Proskiw Engineering Ltd. [107]. It was assumed that this test was conducted twice during the 20-year period; this cost was accounted for at the initial time of installation, to simplify the analysis. A Government rebate was also considered [54].

Cool roof pricing depends on the type of material used. In this case a liquid applied coating was chosen with an albedo of 0.6 [-] from [37] corresponding to a cost of \$8 [m^{-2}]. This material was chosen because it can be easily applied by the homeowner. There will be an annual OM cost of \$75 to clean the roof to maintain an albedo of 0.6 [-]. It was assumed that a second coating would be added after the first ten years. Again to simplify the analysis, all costs were factor in at the initial time of the installation.

As beneficial as PV systems can be, they were historically expensive (about \$115 [W^{-1}]) [69], which made them uneconomical for residential buildings. Since the mid 1970s, PV systems have been decreasing in price (in 2020 US PV system price was less than \$10 [W^{-1}]) due to government incentives, access to materials, and market competition [17, 69]. Even with the decrease in PV system cost, prices are still high and may not be economical in the short or long term depending on climate zone, future climate conditions, and system size. The initial cost of the system was taken from a previous analysis completed by Aliabadi et al. [3]. The OM cost was assumed based on the price of the PV system. The Government of Canada offers rebates for renewable energy retrofits [54], which was considered in this analysis. For simplicity, the rebate amount did not change as a function of PV system cost.

Description	Variables	Value	Source
PV System Price	P_{PV} [\$ m^{-2}]	377	[3]
Cool Roof Price	P_{CR} [\$ m^{-2}]	8×2	[37]
Insulation Price	P_{Ins} [\$ m^{-2}]	32.29	[32]
Air Tightness Price	P_{AirT} [\$]	1500×2	[107]
Tree Price	P_{Tree} [\$ Tree^{-1}]	200	[81]
PV Operation and Maintenance	OM_{PV} [\$ m^{-2}]	$0.01 \times P_{PV}$	[3]
Cool Roof Operation and Maintenance	OM_{CR} [\$]	75	Assumed
Tree Operation and Maintenance	OM_{Tree} [\$ Tree^{-1}]	130	[41]
Base System Operation and Maintenance	OM_B [\$ m^{-2}]	1	Assumed
Base System Initial Cost	C_B [\$]	5	Assumed
Electricity Price	P_E Vancouver [\$ kW-hr^{-1}]	0.092	[68, 108]
Gas Price	P_G Vancouver [\$ m^{-3}]	0.314	[95]
Electricity Price Inflation	j_E Vancouver [-]	0.030	[68, 108]
Gas Price Inflation	j_G Vancouver [-]	0.036	[95]
Electricity Price	P_E Toronto [\$ kW-hr^{-1}]	0.130	[103]
Gas Price	P_G Toronto [\$ m^{-3}]	0.160	[104]
Electricity Price Inflation	j_E Toronto [-]	0.032	[103]
Gas Price Inflation	j_G Toronto [-]	0.104	[104]
Inflation Rate	j [-]	0.018	[15]
Nominal Interest Rate	i_n [-]	0.041	[16]
Salvage Factor for Base System	F_{SB} [-]	0.03	Assumed
Salvage Factor for System	F_S [-]	0.05	Assumed
Rebate for PV	ITC_{PV} [\$]	3000	[54]
Rebate for Insulation	ITC_{Ins} [\$ m^{-2}]	8.60	[54]
Rebate for Air Tightness	ITC_{AirT} [\$]	550	[54]
Number of Analysis Years	N	20	-

Table 2.6: Economic analysis parameters

2.4.2 Economic Calculation Approach

The present and future value of cash flows must be considered to determine annual cost savings. We will need to first determine the Present Worth Factor (PWF), which is the present value of future cash flows, and then determine the equal amount of annual payments that need to be made over the 20 year period, which is the Capital Recovery Factor (CRF) (see Figure 2.6). CRF is calculated as

$$CRF(i,N) = \frac{1}{1-(1+i)^{-N}}, \tag{2.16}$$

where i is the effective interest rate and N is the number of years. Effective interest rate is

$$i = \frac{i_n - j}{1+j}, \tag{2.17}$$

where i_n is the nominal interest rate and j is the inflation rate. PWF is calculated as

$$PWF(i,k) = \frac{1}{(1+i)^k}, \tag{2.18}$$

where k is the year.

The annualized cost of the retrofit system is

$$C_A = C_l + C_G + C_E + C_{OM} - C_S, \tag{2.19}$$

where C_l [$] is the annualized initial investment for the system, C_G [$] is the annualized cost of gas, C_E [$] is the annualized cost of electricity, C_{OM} [$] is the annualized operation and maintenance cost, and C_S [$] is the annualized salvage revenue. Annualized initial base system cost is

$$C_{IB} = C_B \times CRF(i,N) \times A_H, \tag{2.20}$$

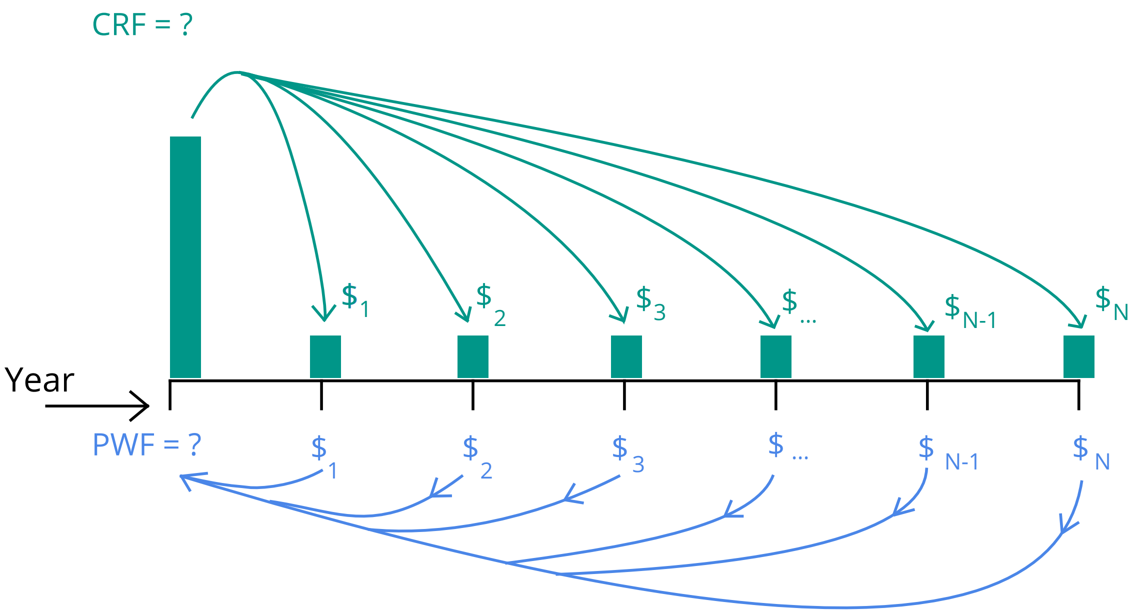


Figure 2.6: Present Value of future cash flows from PWF over N years that are then equally distributed annually over N years from CRF.

where C_B [\$ m^{-2}] is the initial marginal base system cost and A_H is the area of the house [m^2]. Annualized system initial investment is

$$C_I = (A_{PV} \times P_{PV} + A_{CR} \times P_{CR} + N_{Tree} \times P_{Tree} + A_{wall} \times P_{Ins} + P_{AirT} \\ - (ITC_{PV} + ITC_{AirT} + ITC_{Ins} \times A_{wall})) \times CRF(i, N), \quad (2.21)$$

where A_{PV} [m^2] and P_{PV} [\$ m^{-2}] are the area and price of the PV system, A_{CR} [m^2] and P_{CR} [\$ m^{-2}] are the area and price of the cool roof, N_{Tree} and P_{Tree} [\$ tree^{-1}] are the number of trees added and price of adding trees, A_{wall} is the area of all four walls [m^2], P_{ins} is the insulation price [\$m^{-2}], P_{AirT} [\$] is the price for decreasing infiltration. Annualized gas consumption cost is

$$C_G = \left(\sum_{k=1}^{N} G_h \times P_G \times (1 + j_G)^k \times PWF(i, k) \times A_H \right) CRF(i, N), \quad (2.22)$$

where G_h [m^3 m^{-2}] is the annual gas consumption for heating, P_G [\$ m^{-3}] is the price of gas, and j_G is the inflation rate of gas price. Annualized cost of electricity consumption for the base system is

$$C_{EB} = \left(\sum_{k=1}^{N} (E_c + E_d) \times P_E \times (1 + j_E)^k \times PWF(i, k) \times A_H \right) CRF(i, N), \tag{2.23}$$

where E_c [kW-hr m^{-2}] is the annual electricity consumption for cooling, E_d [kW-hr m^{-2}] is the annual electricity consumption for domestic use, P$_E$ [\$ kW-hr^{-1}] is the price of electricity, and j_E [-] is the inflation rate of electricity price. Annualized cost of electricity consumption for the retrofit system is

$$C_E = \left(\sum_{k=1}^{N} (E_c + E_d - E_{PV}) \times P_E \times (1 + j_E)^k \times PWF(i, k) \times A_H \right) CRF(i, N), \tag{2.24}$$

where E_{PV} [kW-hr m^{-2}] is the electricity produced by the PV system. Annualized operation and maintenance cost of the retrofit system is

$$C_{OM} = A_{PV} \times OM_{PV} + A_{CR} \times OM_{CR} + Tree \times OM_{\text{Tree}}, \tag{2.25}$$

where OM_{PV} [\$ m^{-2}] is the operation and maintenance cost of the PV system, OM_{CR} [\$ m^{-2}] is the operation and maintenance cost of the cool roof, and OM_{Tree} [\$ tree^{-1}] is the operation and maintenance cost of adding trees. Annualized revenue by salvaging materials for the base system is

$$C_{SB} = F_{SB} \times C_{IB} \times PWF(i, N) \times CRF(i, N), \tag{2.26}$$

where F_{SB} [-] is the salvage factor for the base system. Annualized revenue by salvaging materials for the retrofitted system is

$$C_S = F_S \times C_I \times PWF(i, N) \times CRF(i, N), \tag{2.27}$$

where F_S [-] is the salvage factor for the renewable system.

2.5 Case Studies

This research considers building energy consumption of a typical residential building in two climate zones with and without mitigation efforts. It will investigate the effects of building energy consumption in the current and future climates. Climate zones 4 and 5, both, experience warm and cold weather, with climate zone 5 having more extreme temperature variations. Climate zones further north were not considered in this analysis, but they should be investigated in the future.

Vancouver and Toronto were chosen to represent Climate zones 4 and 5, respectively. To compare retrofit strategies between Climate zones, a standard neighborhood type must be determined. Vancouver and Toronto are large cities in Canada with a wide range of neighborhood types from rural to high-rise settings. If the analysis were to include a less populated Climate zone, for example climate zone 7, there would only be rural and low-rise residential neighborhood types. This analysis considers a neighborhood type that can be found in all Canadian climate zones for comparison in future studies. Choosing an appropriate urban neighborhood type poses challenges because there are no standard for different rural or urban areas [100, 116]. Stewart and Oke [117, 118] have developed a Local Climate Zone (LCZ) classification system based on building and land cover type (see Table 2.7). An open-low-rise neighborhood type with scattered trees was chosen (LCZ6_B) because most climate zones have low-density urban areas with low-rise residential buildings and space for surrounding vegetation.

Building Type	Land Cover Type
Compact high-rise	Dense trees
Compact mid-rise	scattered trees
Compact low-rise	Bush, shrub
Open high-rise	Low plants e.g. grass
Open mid-rise	Bare rock or paved
Open low-rise	Base soil or sand
Lightweight low-rise	Water
Large low-rise	
Sparely built	
Heavy industry	

Table 2.7: An overview of LCZ building and land cover types from [117]

The neighborhood location relative to any bodies of water must be considered. Large bodies of water can impact climate data if the dominant wind direction comes from the direction of the water bodies. The Windy application was used to determine the wind directions for each city. Apart from the rural and urban location, a spatial range is required for ERA5 data download. The spatial range must be large to assure there is available data to download but consideration must be given to reduce the amount of water bodies within the spatial range.

NEBC and ASHRAE codes/standards were used in VCWG to ensure the buildings were within code. This analysis considers emsissivities, albedos, thermal resistance, building ventilation and infiltration/exfiltration, solar heat gain, glazing ratio, and furnace efficiency. Values for Vancouver and Toronto can be found in Tables 2.8 and 2.11, respectively.

The mitigation strategies chosen were: added vegetation, increased insulation, decreased infiltration/exfiltration, added a cool roof, and added a photovoltaic system. Added vegetation and increased insulation are discussed below relative to each climate zone. Requirements for infiltration, a cool roof, and a PV system are the same for climate zones 4 and 5 and do not need to be discussed further.

2.5.1 Vancouver

2.5.1.1 Neighborhood and Building Parameters

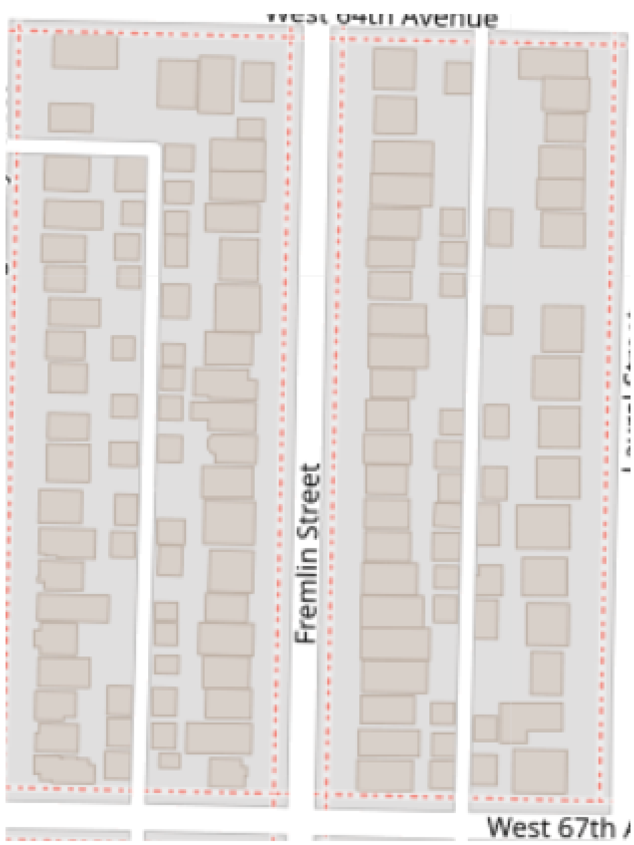
Vancouver is a coastal city with the Strait of Georgia to the west, which leads into the Pacific Ocean. Figure 2.7 shows the dominant wind direction is from the East. A rural site from the dominant wind direction that is 10 km away from the city edge near Golden Ears Provincial Park was chosen. The coordinates for the rural site can be found in Table 2.8.

(a) Vancouver wind direction

Figure 2.7: Vancouver's wind rose

Using Google maps an LCZ6_B residential neighbourhood on Fremlin Street in Vancouver was chosen. A street view of a two story building and an aerial view of the neighborhood can be seen in Figure 2.8. The building and neighborhood morphometric parameters were measured using Google maps. An average of the building measurements was taken to create a representative building; final measurement values can be found in Table 2.8. From the street view of Figure 2.8, there is a house with front green space, an impervious surface (sidewalk), more green space, and finally another impervious surface (road). Even with the sidewalk and road, this neighbourhood has a lot of green space, enough to add extra vegetation.

(a) Vancouver neighbourhood street view



(b) Vancouver neighborhood

Figure 2.8: Vancouver open low-rise neighborhood; obtained from Google maps

British Columbia is a Coastal forest region (see Section 1.2.1) where the dominant tree species are western red cedar, western hemlock, sitka spruce, and douglas-fir [53, 80, 113]. Using Canada's Plant Hardiness Map, the distribution for western hemlock was found under RCP 4.5 and RCP 8.5 [W m^{-2}]. Since there is a distribution range for western hemlock (see Figures 1.5 and A.1), this tree can be modelled under the current and future climates for all years.

All of the mentioned tree species are coniferous with long thin needle leaves and a triangular shape. VCWG performs monthly analysis, where the tree profile can change depending on the season. The LAD [m^2 m^{-3}] profiles for a representative tree in Vancouver is shown in Figure 2.9 for a single month of every season (January, April, July, October). The LAD [m^2 m^{-3}] value will be the smallest at the top of the tree and increases as the profile reaches closer to the ground, this gives an appropriate coniferous tree profile. As the seasons change the tree will never loose all of its leaves but it will shed, decreasing the LAD profile. Leaf width has an impact on transpiration rate, the chosen leaf width is 0.0016 [m] and was an average of dominant tree species from [80]. Transpiration rate is modelled in VCWG by the bowen ratio which establishes a relationship between sensible and latent heat fluxes from the leaves. the bowen ratio for Vancouver can be found in Table 2.8.

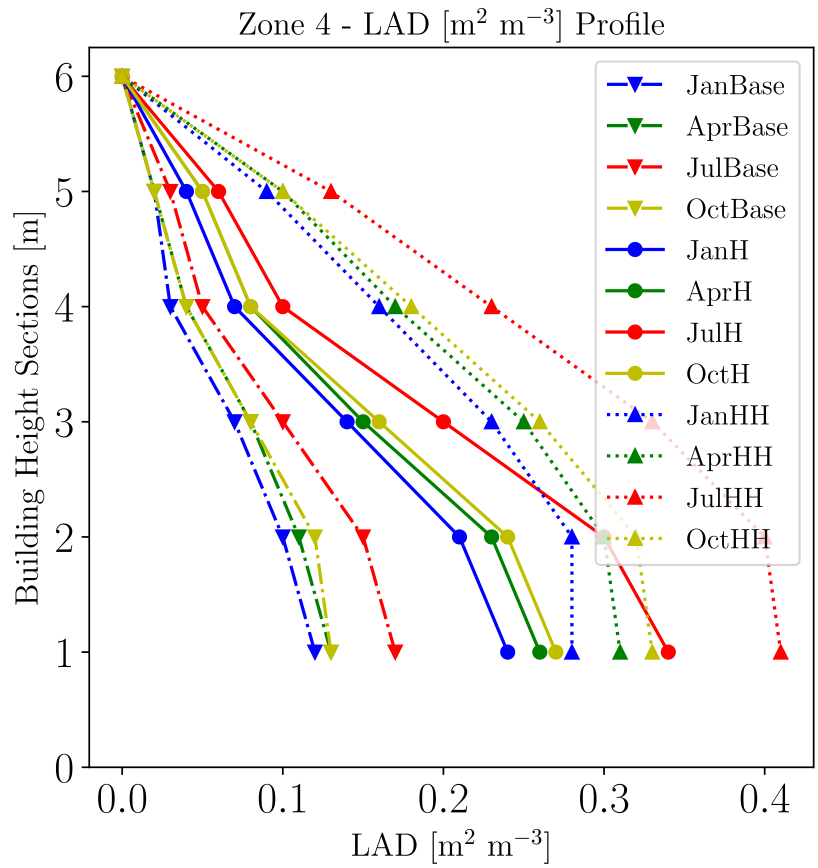


Figure 2.9: LAD [m^2 m^{-3}] profile for Base, High (H), and Very High (HH) vegetation during the months of January, April, July, and October for Vancouver

Climate zone 4 has the lowest R-value (highest U-value) code requirements in Canada as a result of its moderate climate. R-value (U-value) code requirement increases (decreases) with colder temperature but as discussed in Section 1.4.1. Increasing R-value (decreasing U-value) could reduce heat loss/gain via conductive heat transfer. The R-value increase of 4 [m^2 K W^{-1}] is implemented to show the potential savings if resistance was increased, not to show the optimal increase in different climate zones. The NEBC does not report a code for R-value but it does report code for thermal U-value. R-value is inversely proportional to U-value, $U = 1/R$. This was used to calculate R-value.

Current base values can be found in Table 2.8 and retrofit values can be found in Table 2.9.

Table 2.8: Zone 4 Parameters

Parameter	**Value**	**Source**
LAI [m^2 m^{-2}]	Appendix B	From ERA5 file
LAD [m^2 m^{-3}]	Figure 2.9	$LAI = \sum LAD \Delta z$
h_{obs} (rural average obstacle height) [m]	2	[3, 89]
$Z_{0_{rur}}$ (aerodynamic roughness length) [m]	0.2	$Z_{0_{rur}} = \frac{h_{\text{obs}}}{10}$
$Z_{T_{rur}}$ (thermodynamic roughness length) [m]	0.02	$Z_{T_{rur}}$ = 0.1 $Z_{0_{rur}}$
Building height, H [m]	6	VCWG 2-story building
Fraction of building dimensions and distance, C_{bw} [-]	0.53	($\frac{bx}{Wx}$ or $\frac{by}{Wy}$)
Canyon direction from true north clockwise positive, θ_{can} [°]	0	Google maps
Building width, $bx = by$ [m]	16	Google maps
Width from house to house, W [m]	30	Google maps ($Wy = Wx$), ($W_{\text{veg}} + W_{\text{road}}$)
Width of the road, W_{road} [m]	5	Google maps
Width of public vegetation, W_{veg} [m]	12.5×2	Google maps
Ground veg. cover fraction, δ_v [-]	0.9	δ_s = $\frac{W_{veg}}{W_{veg}+W_{road}}$

(Continued)

Parameter	Value	Source
Month where vegetation starts to evaporate, vegStart	Jan (1)	Coniferous
Month where vegetation ends evaporation, vegEnd	Jan (1)	Coniferous
Tree height, H_{tree} [m]	3.6	$H_{\text{tree}} = 0.6 \times H$
Tree crown radius, C_r [m]	1.8	-
Distance of tree to trunk wall, d_{wall} [m]	5	City of Vancouver tree code
Bowen ratio (rural and/or trees) [-]	0.7	[105]
View factor [-]	-	Completed in Python RayTracing
Wall emissivity, ϵ_{wall} [-]	0.91	ASHRAE Fundamentals Handbook 2001 Table 3, [39] Table 2.1
Roof emissivity, ϵ_{roof} [-]	0.95	ASHRAE Fundamentals Handbook 2001 Table 3, [39] Table 2.1
Road emissivity, ϵ_{road} [-]	0.95	ASHRAE Fundamentals Handbook 2001 Table 3, [39] Table 2.1
Vegetation emissivity, ϵ_{veg} [-]	0.96	[39] Table 2.1

(Continued)

Parameter	Value	Source
Rural emissivity, ϵ_{rur} [-]	0.95	ASHRAE Fundamentals Handbook 2001 Table 3, VCWG
Bare ground emissivity, ϵ_{bare} [-]	0.96	[39] Table 2.1
Wall albedo, α_{wall} [-]	0.225	[39] Table 2.1
Roof albedo, α_{roof} [-]	0.125	[39] Table 2.1
Road albedo, α_{road} [-]	0.125	[39] Table 2.1
Vegetation albedo, α_{veg} [-]	0.225	[39] Table 2.1
Rural albedo, α_{rur} [-]	0.135	VCWG
Bare ground albedo, α_{bare} [-]	0.135	[39] Table 2.1
Solar Heat Gain Coefficient, SHGC [-]	0.4	ASHRAE 90.1-2019 Table 5.5-4, [66]
U_{wall} value [W m^{-2} K^{-1}]	0.315	[98] Table 3.2.2.2
U_{roof} value [W m^{-2} K^{-1}]	0.193	[98] Table 3.2.2.2
U_{floor} value [W m^{-2} K^{-1}]	0.227	[98] Table 3.2.2.2
$U_{\mathrm{floorGround}}$ value [W m^{-2} K^{-1}]	0.757 (at 1.2m)	[98] Table 3.2.3.1
$U_{\mathrm{All.fen}}$ value [W m^{-2} K^{-1}]	2.1	[98] Table 3.2.2.3
Ventilation rate [L s^{-1} m^{-2}]	0.3	ANSI/ASHRAE Standard 62.1 2019 Table 6.1

(Continued)

Parameter	**Value**	**Source**
Infiltration rate [L s^{-1} m^{-2}]	2.03	ASHRAE 90.1-2019 Sentence C3.5.5.3
Infiltration rate [ACH]	1.218	Unit converted
Glazing ratio [-]	0.4×0.8	[98] Table A-3.2.1.4 (taking 80$\%$)
COP_{min} [-]	3.0	[98] Table 5.2.12.1
Thermal efficiency [$\%$]	95	[48]
Long and Lat (rural) [Degrees]	49.281620, -122.581826	Google maps
Long and Lat (urban) [Degrees]	49.212288, -123.127356	Google maps
Lat (N) [Degrees]	49.403227	Google maps
Long (E) [Degrees]	-122.369919	Google maps
Lat (S) [Degrees]	49.078886	Google maps
Long (W) [Degrees]	-123.228776	Google maps
Time shift (GMT) [hr]	-8	-

Retrofit Item	Base	Retrofit 1	Retrofit 2
Cool Roof Albedo [-] (Base, High, -)	0.125	0.6	-
Infiltration [ACH] (Base, InfL, InfLL)	1.218	0.7	0.4
Insulation [m^2 K W^{-1}] (Base, RvalH, -)	3.175	7.175	-
Vegetation [tree] (Base, VegH, VegHH)	1	2	3
Photovoltaic Coverage [%] (Base, PVH, PVHH)	0	0.35	0.69

Table 2.9: Base and retrofit values for Vancouver

2.5.1.2 Downscaling Data

The downscaling methodology can be found in Section 2.2. Hosseini et al. [64, 65] developed a machine learning algorithm to determine which weather variables are most influential on building energy demand. The weighting factors used in Equation 2.10 can be found in Table 2.10 and come from Hosseini et al. [64]. The results of that study showed that temperature had the largest impact on building energy demand followed by pressure. Radiation flux and wind speed had similarly low weightings. Climate model data is downloaded from [49] and a coordinate close to the rural site is extracted using VWFG. The latitude and longitude coordinates are: 48.39475, -117.94991.

Month	Temperature	Pressure	Radiation	Wind Spreed
Jan	0.786	0.138	0.046	0.030
Feb	0.825	0.117	0.028	0.030
Mar	0.641	0.243	0.069	0.047
Apr	0.595	0.254	0.073	0.078
May	0.694	0.206	0.056	0.044
Jun	0.535	0.394	0.035	0.036
Jul	0.429	0.490	0.039	0.042
Aug	0.530	0.405	0.040	0.025
Sep	0.443	0.434	0.073	0.050
Oct	0.718	0.194	0.058	0.030
Nov	0.806	0.128	0.047	0.019
Dec	0.862	0.098	0.022	0.018

Table 2.10: Weather variable weightings from Hosseini et al. [64] for Vancouver

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Once the initial bias is corrected the minimum weighted sum, Equation 2.10, can be used to find a matching historical month to a future month. Figure 2.10 shows an example of a matched month to December 2009 (validation period) under RCP 4.5 [W m^{-2}]. The matching month was January 1998. Temperature had a close match due to its high weighting. Pressure and radiation also have close matches but it can be seen that wind speed was not matched as well. This could be due to two reasons, the first being the low weighting attributed to wind speed. The second reason maybe due the climate model's over estimation of wind speed due to ocean effects. This analysis as conducted for RCP 8.5 [W m^{-2}], the quantile-quantile matching figures can be found in Appendix B.2. The increased GHG emissions made it more difficult for VWFG to find a close historical month to match to a future month. Performing a second bias correction by stretching and shifting the hourly EPW data based on the corrected climate model data can further reduce the bias.

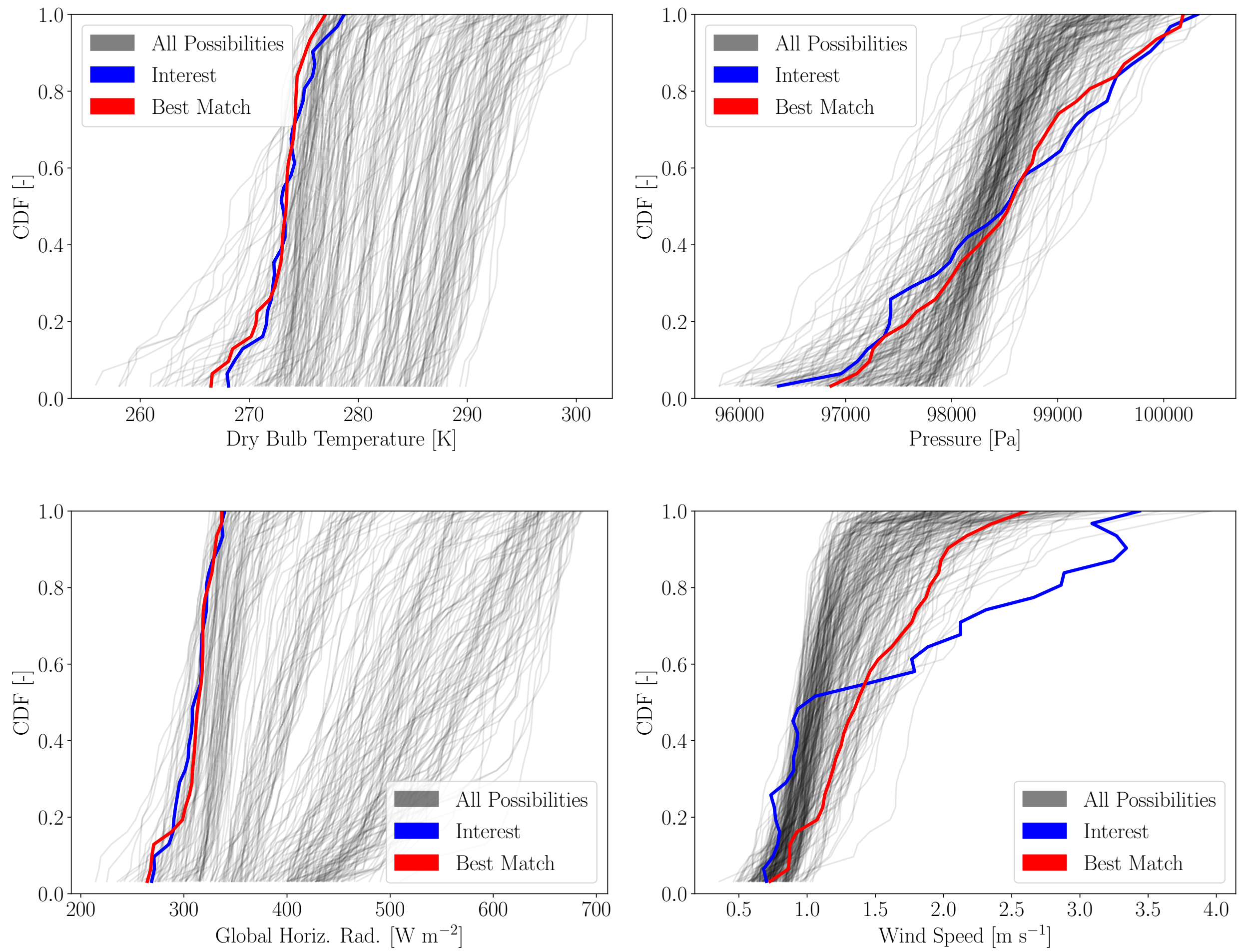


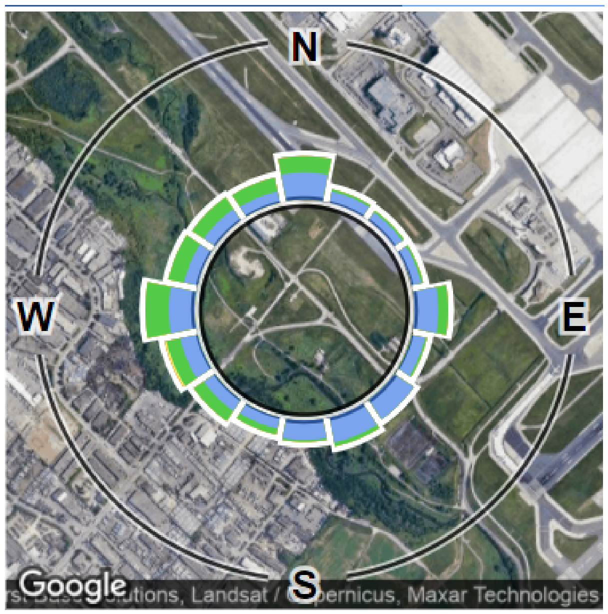
Figure 2.10: Matching a historical month to December 2009 for each weather variable under RCP 4.5 [W m^{-2}] for Vancouver. Matching month and year and month: January 1988

2.5.2 Toronto

2.5.2.1 Neighborhood and Building Parameters

Toronto is north of Lake Ontario, which can have an affect on the climate data, wind direction must be checked. Figure 2.11 shows the dominant wind direction is from the west and north. The chosen rural site is roughly 20 km away from the city's edge in the north-west direction. The coordinates for the rural site, urban site, and boundary can be found in Table 2.11.

Using Google maps an LCZ6_B residential neighborhood on Cherry Post Crescent in Toronto was chosen. A street view of a two-story building and an aerial view of the neighborhood can be seen in Figure 2.12. The building and neighborhood morphometric parameters were measured using Google maps. An average of the building measurements was taken to create a representative building; final measurement values can be found in Table 2.11.



(a) Toronto wind direction

Figure 2.11: Toronto's wind rose

Southwestern Ontario has a Carolinian forest region (see Section 1.2.1) where the dominant tree species are beech, maple, black walnut, hickory, and oak [53, 80, 113]. Using Canada's Plant Hardiness Map, the distribution for the trees was found under RCP 4.5 and RCP 8.5 [W m^{-2}]. Since there is a distribution range for red maple (see Figures 1.6 and A.2), this tree can be modelled under the current and future climates for all years.

All of the mentioned tree species are deciduous with large flat leaves that shed seasonally. The LAD profile for a representative tree in Toronto is shown in Figure 2.13. Deciduous trees have a spherical shape; therefore the LAD profile is symmetrical around the horizontal axis. VCWG has an option for the start and end months of evapotranspiration, corresponding to when there are leaves on the tree. The LAD profile is considered starting in the spring (April) and ending in the fall (October). Leaf width for Toronto is 0.14 [m] and was an average of dominant tree species from [80]. Transpiration rate is modelled by the bowen ratio. The bowen ratio for Toronto can be found in Table 2.8.

Climate zone 5 has a larger temperature fluctuation compared to climate zone 4, with almost double the number of freezing days. For this reason, thermal resistance code increases to prevent heat loss during the winter.

(a) Toronto neighbourhood street view

(b) Toronto neighborhood

Figure 2.12: Toronto open low-rise neighborhood; obtained from Google maps

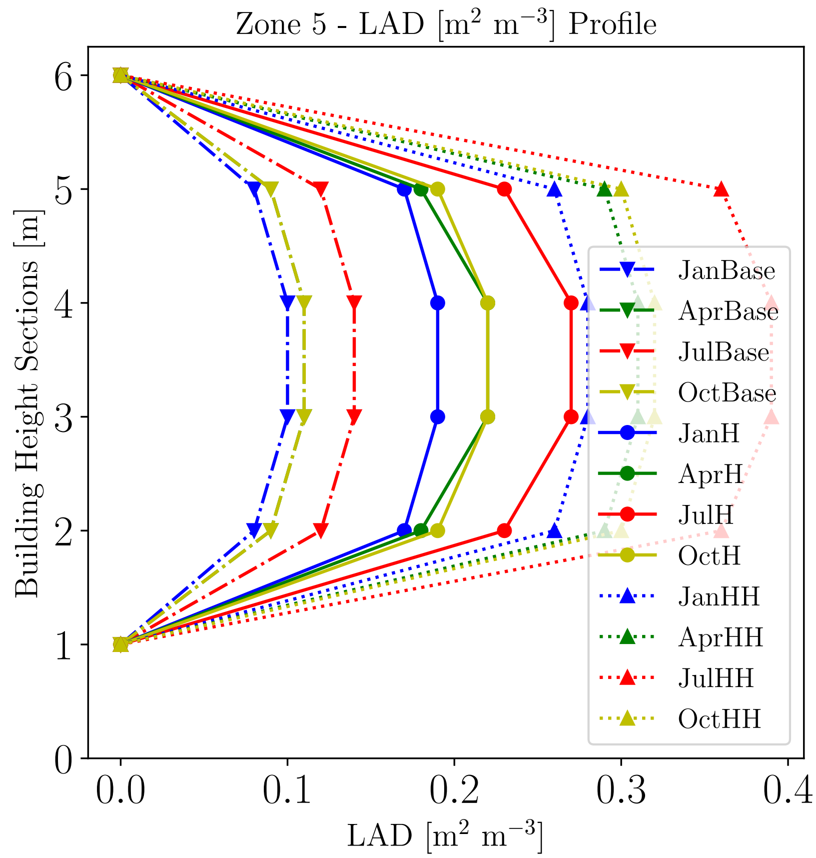


Figure 2.13: LAD [m^2 m^{-3}] profile for Base, High, and Very High vegetation during the months of January, April, July, and October for Toronto

Table 2.11: Zone 5 Parameters

Parameter	**Value**	**Source**
LAI [m^2 m^{-2}]	Appendix B	From ERA5 file
LAD [m^2 m^{-3}]	Figure 2.13	$LAI = \sum LAD\Delta z$
h_{obs} (rural average obstacle height) [m]	2	[3, 89]
$Z_{0_{rur}}$ (aerodynamic roughness length) [m]	0.2	$Z_{0_{rur}} = \frac{h_{\text{obs}}}{10}$
$Z_{T_{rur}}$ (thermodynamic roughness length) [m]	0.02	$Z_{T_{rur}}$ = 0.1 $Z_{0_{rur}}$
Building height, H [m]	6	VCWG 2-story building
Fraction of building dimensions and distance, C_{bw} [-]	0.467	($\frac{bx}{Wx}$ or $\frac{by}{Wy}$)
Canyon direction from true north clockwise positive, θ_{can} [°]	-5	Google maps
Building width, $bx = by$ [m]	14	Google maps
Width from house to house, W [m]	30	Google maps ($Wy = Wx$), ($W_{\text{veg}} + W_{\text{road}}$)
Width of the road, W_{road} [m]	10	Google maps
Width of public vegetation, W_{veg} [m]	9×2	Google maps
Ground veg cover fraction, δ_s [-]	0.78	δ_s = $\frac{W_{veg}}{W_{\text{veg}}+W_{\text{road}}}$

(Continued)

Parameter	Value	Source
Month where vegetation starts to evaporate, vegStart	April (4)	Carolina (Deciduous)
Month where vegetation ends evaporation, vegEnd	October (10)	Carolina (Deciduous)
Tree height, H_{tree} [m]	3.6	$H_{\text{tree}} = 0.6 \times H$
Tree crown radius, C_r [m]	1.8	-
Distance of tree to trunk wall, d_{wall} [m]	5	City of Toronto tree code
Bowen ratio (rural and/or trees) [-]	0.5	[105]
View factor [-]	-	Completed in Python RayTracing
Wall emissivity, ϵ_{wall} [-]	0.91	ASHRAE Fundamentals Handbook 2001 Table 3, [39] Table 2.1
Roof emissivity, ϵ_{roof} [-]	0.95	ASHRAE Fundamentals Handbook 2001 Table 3, [39] Table 2.1
Road emissivity, ϵ_{road} [-]	0.95	ASHRAE Fundamentals Handbook 2001 Table 3, [39] Table 2.1
Vegetation emissivity, ϵ_{veg} [-]	0.96	[39] Table 2.1

(Continued)

Parameter	Value	Source
Rural emissivity, ϵ_{rur} [-]	0.95	ASHRAE Fundamentals Handbook 2001 Table 3, VCWG
Bare ground emissivity, ϵ_{bare} [-]	0.96	[39] Table 2.1
Wall albedo, α_{wall} [-]	0.225	[39] Table 2.1
Roof albedo, α_{roof} [-]	0.125	[39] Table 2.1
Road albedo, α_{road} [-]	0.125	[39] Table 2.1
Vegetation albedo, α_{veg} [-]	0.225	[39] Table 2.1
Rural albedo, α_{rur} [-]	0.135	VCWG
Bare ground albedo, α_{bare} [-]	0.135	[39] Table 2.1
Solar Heat Gain Coefficient, SHGC [-]	0.4	ASHRAE 90.1-2019 Table 5.5-5, [66]
U_{wall} value [W m^{-2} K^{-1}]	0.278	[98] Table 3.2.2.2
U_{roof} value [W m^{-2} K^{-1}]	0.156	[98] Table 3.2.2.2
U_{floor} value [W m^{-2} K^{-1}]	0.183	[98] Table 3.2.2.2
$U_{\text{floorGround}}$ value [W m^{-2} K^{-1}]	0.757 (at 1.2m)	[98] Table 3.2.3.1
$U_{\text{All fen.}}$ value [W m^{-2} K^{-1}]	1.9	[98] Table 3.2.2.3
Ventilation rate [L s^{-1} m^{-2}]	0.3	ANSI/ASHRAE Standard 62.1 2019 Table 6.1

(Continued)

Parameter	Value	Source
Infiltration rate [L s^{-1} m^{-2}]	2.03	ASHRAE 90.1-2019 Sentence C3.5.5.3
Infiltration rate [ACH]	1.218	Unit converted
Glazing ratio [-]	0.4×0.8	[98] Table A-3.2.1.4 (taking 80$\%$)
COP_{min} [-]	3.0	[98] Table 5.2.12.1
Thermal efficiency [$\%$]	95	[48]
Lat and Long (rural) [Degrees]	43.649889, -80.121909	Google maps
Lat and Long (urban) [Degrees]	43.632580, -79.581630	Google maps
Lat (N) [Degrees]	44.087626	Google maps
Long (E) [Degrees]	-78.185403	Google maps
Lat (S) [Degrees]	43.575661	Google maps
Long (W) [Degrees]	-81.024785	Google maps
Time shift (GMT) [hr]	-5	-

Retrofit Item	Base	Retrofit 1	Retrofit 2
Cool Roof Albedo [-] (Base, High, -)	0.125	0. 6	-
Infiltration [ACH] (Base, InfL, InfLL)	1.218	0.7	0.4
Insulation [m^2 K W^{-1}] (Base, RvalH)	3.597	7.597	-
Vegetation [tree] (Base, VegH, VegHH)	1	2	3
Photovoltaic Coverage [%] (Base, PVH, PVHH)	0	0.35	0.69

Table 2.12: Base and retrofit values for Toronto

2.5.2.2 Downscaling Data

The weighting factors used in Equation 2.10 can be found in Table 2.13. Climate model data is downloaded from [49] and a coordinate close to the rural site is extracted using VWFG. The latitude and longitude coordinates are: 41.67868, -76.67624.

Month	Temperature	Pressure	Radiation	Wind Spreed
Jan	0.773	0.086	0.078	0.063
Feb	0.912	0.036	0.027	0.026
Mar	0.891	0.041	0.036	0.032
Apr	0.884	0.043	0.038	0.036
May	0.869	0.052	0.043	0.036
Jun	0.887	0.048	0.037	0.028
Jul	0.830	0.064	0.057	0.048
Aug	0.868	0.057	0.045	0.030
Sep	0.829	0.068	0.054	0.048
Oct	0.831	0.060	0.056	0.053
Nov	0.905	0.039	0.031	0.025
Dec	0.922	0.027	0.026	0.026

Table 2.13: Weather variable weightings from Hosseini et al. [65] for Toronto

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Figure 2.14 shows an example of a matched month to December 2009 (validation period) under RCP 4.5 [W m^{-2}]. The matching month was December 1992. Similar to the Vancouver case, Toronto had a close match for temperature followed by radiation and pressure. Although wind speed had a poorer match it can be considered a suitable match. Comparing the wind speed matches of Toronto and Vancouver, Toronto had a better fitting match which can be attributed to a lack of ocean effects. This analysis as conducted for RCP 8.5 [W m^{-2}], the quantile-quantile matching figures can be found in Appendix B.2. Again, we see a poorer matching performance under RCP 8.5 [W m^{-2}] conditions for the same reason stated above.

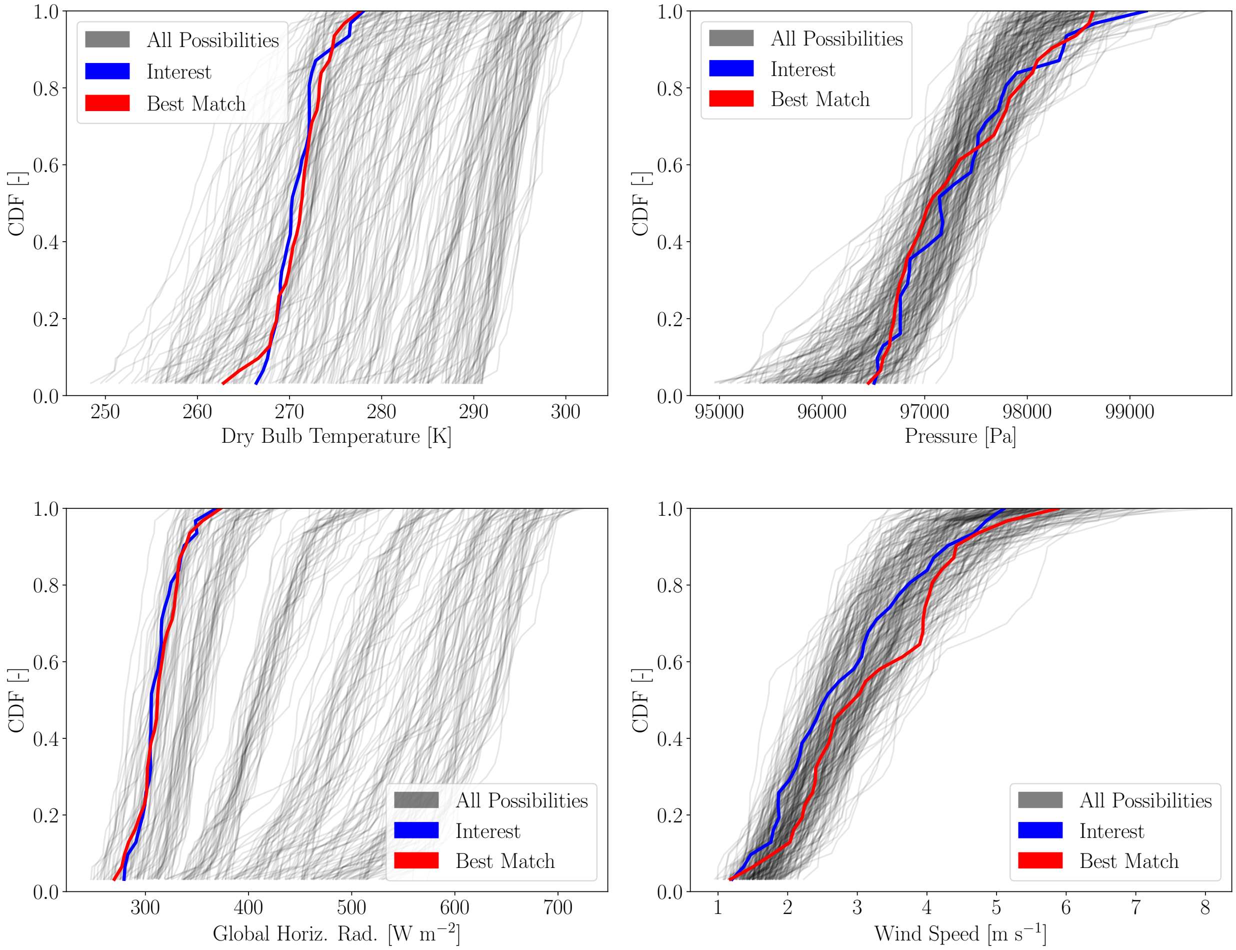

Figure 2.14: Matching a historical month to December 2009 for each weather variable under RCP 4.5 [W m^{-2}] for Toronto. Matching month and year: December 1992

Chapter 3

Results and Discussion

This research investigated the potential cost and CO_2e emissions savings from implementing mitigation measures in Vancouver and Toronto. Climate model data from CanRCM4 for two future climate scenarios (RCP 4.5 and RCP 8.5 [W m^{-2}]) from 2021 to 2100 was downscaled using historical and observed/reanalyzed data (see Section 2.2 for downscaling details). The Vertical City Weather Generator (VCWG), developed by Moradi et al. [89] and Aliabadi et al. [3], was used as an Urban Physics Model (UPM) to model the annual gas and electricity consumption used for heating and cooling with/without mitigation measures. Sections 3.1 and 3.2 will discuss 1) annual electricity consumption, 2) annual gas consumption, 3) CO_2e emissions analysis, and 4) economic analysis results for Vancouver and Toronto, respectively. The results will include values for the 2020 and 2100 analysis period in the text only, while the figures include the intermediate decades, with a discussion of the overall trend from all analysis periods. Section 3.2.6 will discuss the results in greater detail. All the numerical results discussed can be found in Appendix C.1.

It should be noted that the climate model data shows an overall warming trend, except for a period of cooling in 2080s, which is reflected in the analysis. There also appears to be a large increase in temperature for 2100 given the RCP 8.5 [W m^{-2}] scenario from the climate model data. Data from 2099 was considered in-place of 2100 but there was no change in the increased temperature.

3.1 Results - Vancouver

3.1.1 Electricity Consumption

For the base case in Vancouver for the 2020s analysis period, the annual electricity consumption was 18.9 [kW-hr m^{-2}]. Under climate scenario RCP 4.5 [W m^{-2}], annual electricity consumption has a gradual increase, except for 2060s, which appears to have a cooler year in Vancouver (see Figure 3.1). Gradual warming is to be expected due to global warming from 2020 to 2100 but it can also be expected that individual decades experience warmer or colder seasons. Under RCP 8.5 [W m^{-2}] annual electricity consumption is slightly greater than that under RCP 4.5 [W m^{-2}], which is to be expected. However, there is a large jump from 2080s to 2100s for reasons mentioned above (see Figure 3.2). During the 2100s analysis period, electricity demand increases to 22.2 [kW-hr m^{-2}] and 55.5 [kW-hr m^{-2}] under RCP 4.5 [W m^{-2}] and RCP 8.5 [W m^{-2}], respectively.

With the addition of trees, annual electricity consumption has the potential to decrease by 1.2 [kW-hr m^{-2}] and 2.2 [kW-hr m^{-2}] for VegH and VegHH, respectively, during 2020s. For the analysis periods until 2100s, an increase in trees provides a decrease in annual electricity consumption, with the largest electricity decrease in 2100s. In the 2100s analysis, the addition of trees could decrease annual electricity consumption by 1.3 [kW-hr m^{-2}] and 2.3 [kW-hr m^{-2}] for VegH and VegHH, respectively, under RCP 4.5 [W m^{-2}]. Under RCP 8.5 [W m^{-2}], the annual electricity consumption decreased by 1.6 [kW-hr m^{-2}] and 2.9 [kW-hr m^{-2}] for VegH and VegHH, respectively.

Increasing insulation decreased annual electricity consumption by 0.9 [kW-hr m^{-2}]. The extra insulation was able to decrease thermal energy loss by conduction through the walls. For every decade until 2100s this trend holds. For the 2100s analysis, insulation could decrease electricity by

1.1 [kW-hr m^{-2}] and 1.6 [kW-hr m^{-2}] under RCP 4.5 [W m^{-2}] and RCP 8.5 [W m^{-2}], respectively.

Decreasing infiltration/exfiltration increased annual electricity consumption by 3.7 [kW-hr m^{-2}] and 7.0 [kW-hr m^{-2}] for InfL and InfLL, respectively, in 2020s. For all decades under RCP 4.5 [W m^{-2}] annual electricity consumption increased with a decrease in infiltration/exfiltration. During the 2100s analysis under RCP 4.5 [W m^{-2}], infiltration/exfiltration change could increase annual electricity consumption by 3.8 [kW-hr m^{-2}] and 7.4 [kW-hr m^{-2}] for InfL and InfLL, respectively. Under RCP 8.5 [W m^{-2}] increased infiltration/exfiltration could cause an increase in annual electricity consumption for all decades except for 2100s. This is due to the increased cooling load and the required air conditioning electricity consumption.

Adding a cool roof to the building was able to reduce annual electricity consumption by 0.6 [kW-hr m^{-2}] during the 2020s analysis. A cool roof produced electricity savings for all year under both RCP scenarios. During the 2100 analysis, a cool roof could decrease electricity by 0.7 [kW-hr m^{-2}] and 3.3 [kW-hr m^{-2}] under RCP 4.5 and RCP 8.5 [W m^{-2}], respectively.

The addition of a PV system does not change the annual electricity consumption. Vancouver electricity production can be found in Appendix C.2.1.

The combination case is based off the economic analysis, which is discussed in Section 3.1.4. Each analysis period has the potential to have a different combination of retrofits, the combinations can be found in Table 3.1. In the 2020s analysis the combination case increased annual electricity consumption by 5.4 [kW-hr m^{-2}]. All combination cases, except for RCP 8.5 [W m^{-2}] in 2100s, had increased annual electricity consumption due to added cooling demand and air conditioning need. In the 2100s analysis under RCP 4.5 [W m^{-2}] annual electricity consumption increased by 5.8 [kW-hr m^{-2}]. Under RCP 8.5 [W m^{-2}] the mitigation strategies were able to reduce annual electricity consumption by 2.8 [kW-hr m^{-2}].

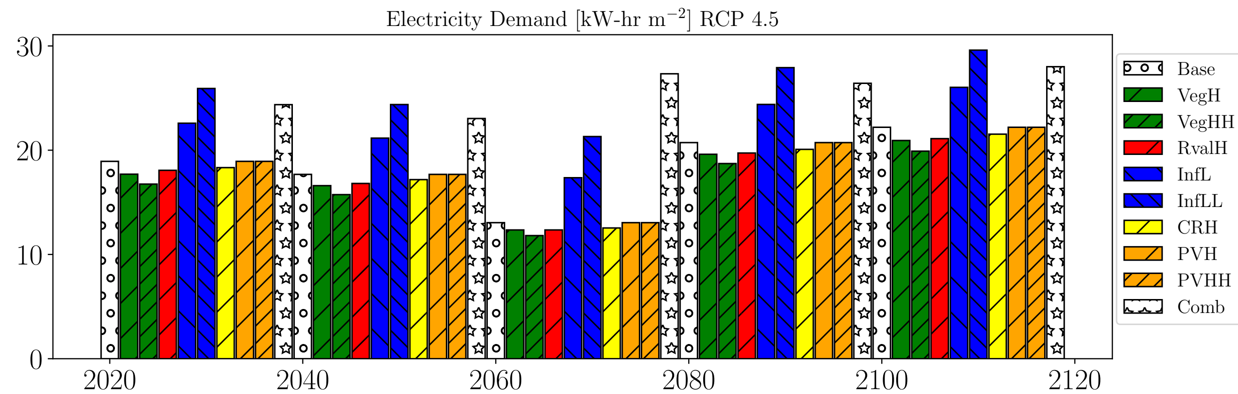

Figure 3.1: Annualized electricity Demand [kW-hr m^{-2}] for individual and combination cases for all decades under RCP 4.5 [W m^{-2}] over 20 year periods in Vancouver.

The trends discussed under RCP 4.5 [W m^{-2}] scenario for each mitigation effort are the same under RCP 8.5 [W m^{-2}]. The difference between the results for each scenario is the demand intensity. There is a clearer increase from 2020s to 2080s; from 2080s to 2100s, the demand decreases following the climate model data, and then there is a drastic increase in demand in 2100s under RCP 8.5 [W m^{-2}] (see Figure 3.2).

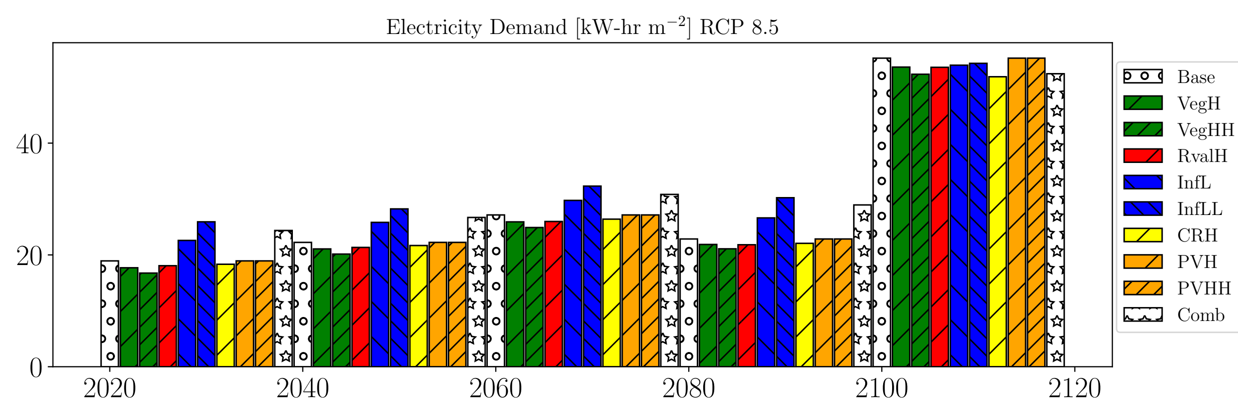

Figure 3.2: Annualized electricity demand [kW-hr m^{-2}] for individual and combination cases for all decades under RCP 8.5 [W m^{-2}] over 20 year periods in Vancouver.

3.1.2 Gas Consumption

During the 2020s analysis, base annual gas consumption was 25.4 [m^3 m^{-2}]. By 2100s the base annual gas consumption decreased to 16.3 [m^3 m^{-2}]. Under RCP 4.5 [W m^{-2}] (see Figure 3.3), for all cases annual gas consumption has a steady decrease with an increase in temperature until 2100s where there is a levelling off. This trend is expected based on RCP 4.5 [W m^{-2}] conditions. Under RCP 8.5 [W m^{-2}] (see Figure 3.4), for all cases annual gas consumption has a steady decrease until 2100s. This is expected based on RCP 8.5 [W m^{-2}] increasing emissions.

During the 2020s analysis increasing vegetation increased annual gas consumption by 1.2 [m^3 m^{-2}] and 2.2 [m^3 m^{-2}] for VegH and VegHH, respectively. Under both RCP 4.5 and RCP 8.5 [W m^{-2}] annual gas consumption increased for each analysis year with the increase of vegetation. During the 2100s analysis period under RCP 4.5 [W m^{-2}] annual gas consumption increased by 1.3 [m^3 m^{-2}] and 2.3 [m^3 m^{-2}] for VegH and VegHH, respectively. Under RCP 8.5 [W m^{-2}] annual gas consumption increased by 1.6 [m^3 m^{-2}] and 2.9 [m^3 m^{-2}] for VegH and VegHH, respectively.

Increasing insulation was able to decrease annual gas consumption by 0.9 [m^3 m^{-2}] during the 2020s analysis. Under both RCP 4.5 and RCP 8.5 [W m^{-2}] annual gas consumption decreased for each analysis year with the increase of insulation. During the 2100s analysis period annual gas consumption decreased by 1.2 [m^3 m^{-2}] and 1.6 [m^3 m^{-2}] for RCP 4.5 and RCP 8.5 [W m^{-2}], respectively.

Decreasing infiltration/exfiltration had the largest reduction in annual gas consumption, 9.9 and 15.3 [m^3 m^{-2}] for InfL and InfLL, respectively, in the 2020s analysis. Annual gas consumption decrease in every period for both RCP 4.5 and RCP 8.5 [W m^{-2}]. In the 2100s analysis under RCP 4.5 [W m^{-2}] annual gas consumption decreased by 7.2 [m^3 m^{-2}] and 10.9 [m^3 m^{-2}] for InfL and InfLL, respectively. Under RCP 8.5 [W m^{-2}] annual gas consumption decreased by 5.0 [m^3 m^{-2}] and 7.5 [m^3 m^{-2}] for InfL and InfLL, respectively.

The addition of a cool roof increased annual gas consumption by 0.2 [m^3 m^{-2}] in the 2020s analysis. All subsequent periods produce an increase in annual gas consumption for both RCP 4.5 and RCP 8.5 [W m^{-2}], except one. The 2100s analysis under RCP 8.5 [W m^{-2}] decreased annual gas consumption by 1.1 [m^3 m^{-2}]. Under RCP 4.5 [W m^{-2}] in the 2100s analysis produced an increase in annual gas consumption of 0.2 [m^3 m^{-2}].

PV systems have no affect on annual gas consumption, the electricity generated is firstly used by the air conditioning unit to offset grid electricity and then used by household appliances. Heating demand is met using natural gas, not electricity in this analysis.

The combination case has the second highest reduction in annual gas consumption for both RCP 4.5 and RCP 8.5 [W m^{-2}]. The combinations can be found in Table 3.1. Annual gas consumption decreased by 15.2 [m^3 m^{-2}] in 2020s. All years for both RCP scenarios had a decrease of annual gas consumption between 7 [m^3 m^{-2}] and 16 [m^3 m^{-2}].

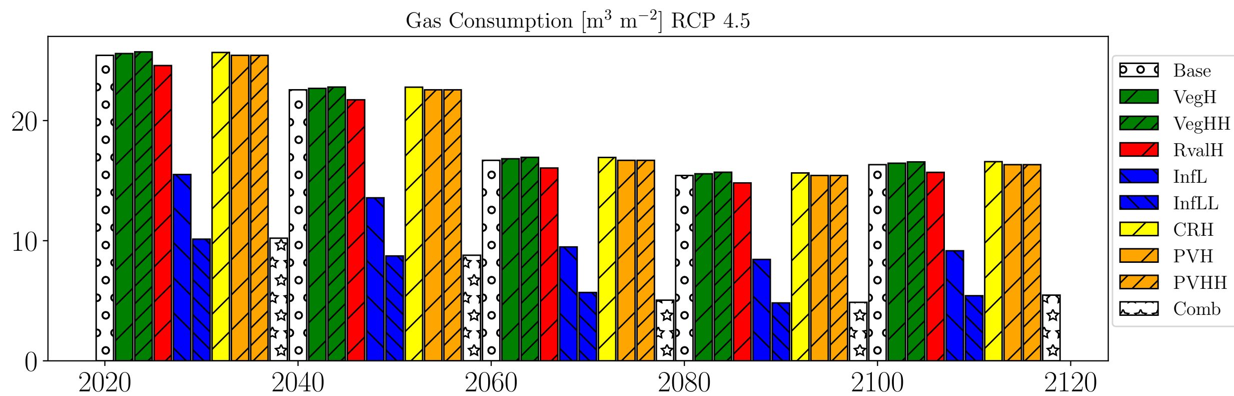

Figure 3.3: Annual gas Consumption [m^3 m^{-2}] for individual and combination cases for all decades under RCP 4.5 [W m^{-2}] over 20 year periods in Vancouver.

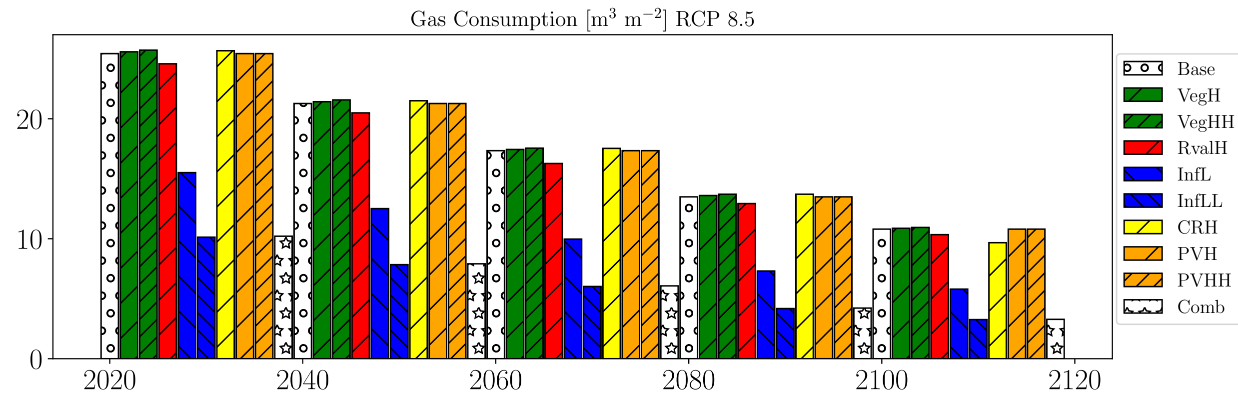

Figure 3.4: Annualized gas consumption [m^3 m^{-2}] for individual and combination cases for all decades under RCP 8.5 [W m^{-2}] over 20 year periods in Vancouver.

3.1.3 CO_2e Analysis

A carbon dioxide analysis was performed for each mitigation strategy by monitoring annual gas and electricity consumption. Carbon uptake from tree planting was also considered. From Figures 3.5 and 3.6, there is a steady decrease in CO_2e emissions savings for RCP 4.5 [W m^{-2}] and RCP 8.5 [W m^{-2}]. This corresponds to the decrease in annual gas consumption.

During the 2020s analysis, increased vegetation lead to an increase of 1.2 [Tonnes] and 2.4 [Tonnes] of CO_2e emissions for VegH and VegHH cases, respectively. For all decades an increase in vegetation increased CO_2e emissions. In the 2100s analysis under RCP 4.5 [W m^{-2}] the addition of trees increased CO_2e emissions by 0.9 [Tonnes] and 1.8 [Tonnes] for VegH and VegHH cases, respectively. Under RCP 8.5 [W m^{-2}] the addition of trees will increase CO_2e emissions by 0.4 [Tonnes] and 0.9 [Tonnes] for VegH and VegHH, respectively.

Increasing insulation was able to save 8.1 [Tonnes] in CO_2e emissions during the 2020s analysis. All decades under both RCP scenarios were able to produce CO_2e emissions savings. During the 2100s analysis, increased insulation was able to save 6.2 [Tonnes] and 4.5 [Tonnes] in CO_2e emissions for RCPs 4.5 and 8.5 [W m^{-2}], respectively.

Infiltration/exfiltration produced CO_2e emissions savings of 92.8 [Tonnes] and 142.9 [Tonnes] for InfL and InfLL cases, respectively during the 2020s analysis. Decreasing infiltration had the largest CO_2e emissions savings. During all decades reduction of infiltration/exfiltration produced CO_2e emissions savings for both RCP 4.5 [W m^{-2}] and RCP 8.5 [W m^{-2}]. During the 2100s analysis under RCP 4.5 [W m^{-2}] reducing infiltration/exfiltration could produce CO_2e emissions savings of 66.9 [Tonnes] and 101.6 [Tonnes] for InfL and InfLL cases, respectively. Under RCP 8.5 [W m^{-2}] reducing infiltration/exfiltration could produce CO_2e emissions savings of 47.2 [Tonnes] and 71.0 [Tonnes] for InfL and InfLL cases, respectively.

Adding a cool roof increases CO_2e emissions by 2.2 [Tonnes] during the 2020s analysis. This increase in emissions resulted from the increase in annual gas consumption for heating. For all decades under both RCP 4.5 and RCP 8.5 [W m^{-2}], CO_2e emissions increased. In the 2100s analysis a cool roof could increase CO_2e emissions by 2.3 [Tonnes] and 1.3 [Tonnes] under RCP 4.5 and RCP 8.5 [W m^{-2}], respectively.

The PV systems produced CO_2e emissions savings of 4.7 [Tonnes] and 9.3 [Tonnes] in 2020s for PVH and PVHH cases, respectively. For all decades under both RCP scenarios a PV system was able to produce CO_2e emissions savings. In the 2100s analysis under RCP 4.5 [W m^{-2}] a PV system could save 4.8 [Tonnes] and 9.4 [Tonnes] for PVH and PVHH cases, respectively. Under RCP 8.5 [W m^{-2}] CO_2e emissions savings could be 4.7 [Tonnes] and 9.3 [Tonnes] for PVH and PVHH cases, respectively.

The combination cases produced the second highest CO_2e emissions savings. In the 2020s analysis the combination case (see Table 3.2) was able to save 142.4 [Tonnes] of CO_2e emissions. In 2100s under RCP 4.5 [W m^{-2}], the combination case was able to save 101.4 [Tonnes] of CO_2e emissions. Under RCP 8.5 [W m^{-2}] the combination case was able to save 71.1 [Tonnes] of CO_2e emissions. Each combination case for all decades was able to produce CO_2e emissions savings for both RCP scenarios.

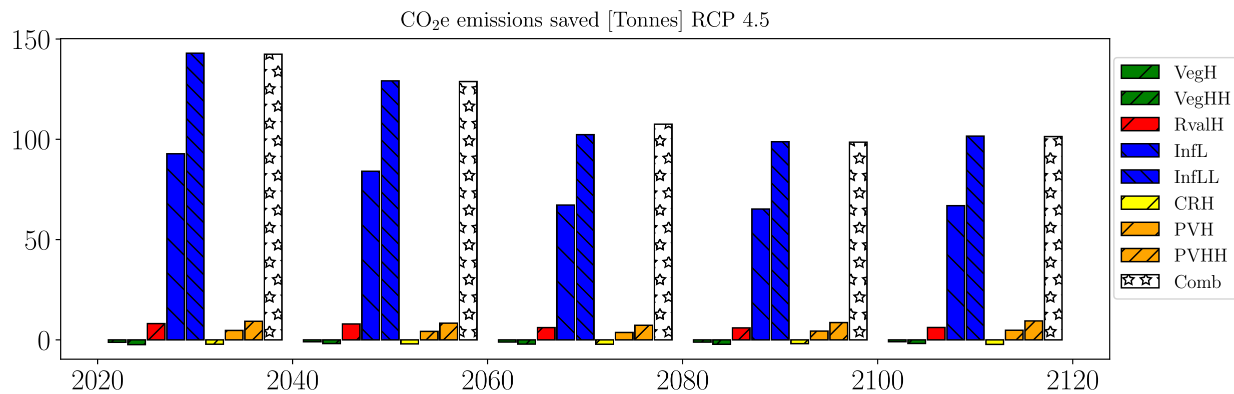

Figure 3.5: CO_2e emissions savings [Tonnes] for individual and combination cases for all decades under RCP 4.5 [W m^{-2}] over 20 year periods in Vancouver.

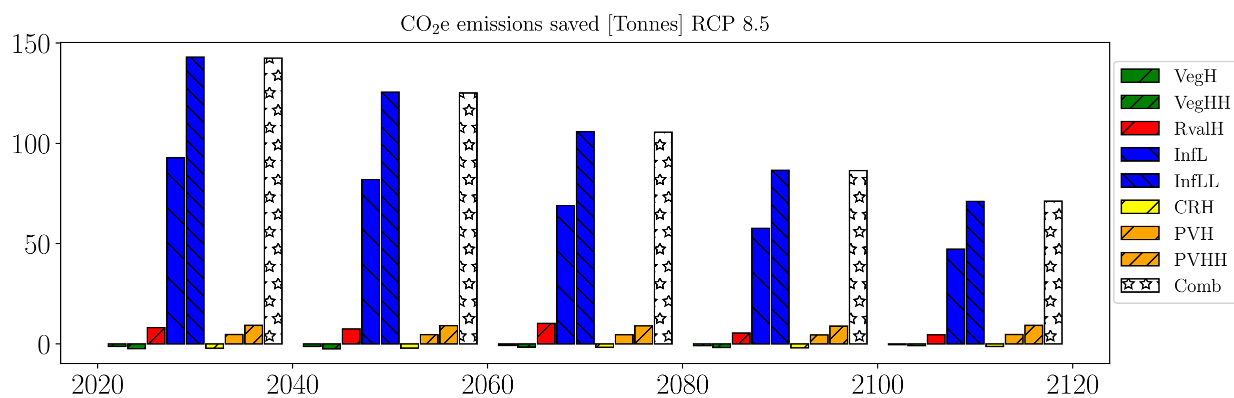

Figure 3.6: CO_2e emissions savings [Tonnes] for individual and combination cases for all decades under RCP 8.5 [W m^{-2}] over 20 year periods in Vancouver.

3.1.4 Cost Analysis

An Economic analysis was conducted over a 20 year period considering: product cost, operation and maintenance cost, gas and electricity cost, inflation rate, interest rate, and rebates. The mitigation items that produced positive cost savings were modelled together to produce a combined case. Pricing values used in the analysis can be found in Table 2.6. A description of the economic analysis method used can be found in Section 2.4. Figures 3.7 and 3.8 show the cost savings (or cost increase) for each retrofit and the combination retrofits under RCP 4.5 and RCP 8.5 [W m^{-2}], respectively.

The addition of one tree was able to produce annual cost savings of 1.5% in the 2020s analysis period. The addition of a second tree resulted in an increased homeowner cost of 0.9%. For all decades under both RCP scenarios an increase of one tree was able to produce cost savings, while adding two trees resulted in an increased homeowner cost. The addition of one tree in 2100s under both RCP 4.5 and RCP 8.5 [W m^{-2}] produced cost savings of 1.83 %. The addition of two trees increased cost by 0.9% and 0.7% under RCP 4.5 and RCP 8.5 [W m^{-2}], respectively.

Increasing insulation resulted in a 3.2% increase in cost over the 20 year analysis starting in 2020s. This trend is true for all decades and both RCP scenarios. In 2100s under RCP 4.5 and RCP 8.5 [W m^{-2}] increased insulation would increase costs by 4.1% and 4.2%, respectively.

The greatest cost savings potential for individual retrofits came from decreasing infiltration/exfiltration. For the 2020s analysis, decreasing infiltration/exfiltration produced cost savings of 20.5% and 28.5% in 2020s for InfL and InfLL cases, respectively. Decreasing infiltration/exfiltration consistently produced the largest and second largest cost saving for all decades under both RCP scenarios. For the 2100s analysis under RCP 4.5 [W m^{-2}], decreasing infiltration/exfiltration was able to save 18.3% and 24.3% for InfL and InfLL, respectively. Under RCP 8.5 [W m^{-2}], cost savings were 12.9% and 16.2% for InfL and InfLL, respectively.

The addition of a cool roof increased annual homeowner cost by 1.9% at the end of the 20 year analysis beginning in 2020s. For the 2100s analysis under RCP 4.5 and RCP 8.5 [W m^{-2}], costs increased by 2.2% and 1.9%, respectively. all decades for both RCP scenarios saw an increase in cost with the addition of a cool roof.

The electricity production from a PV system was not able to offset grid electricity consumption to produce cost savings. In the 2020s analysis, a PV system could increase annual costs by 2.0% and 10.2% for PVH and PVHH cases, respectively. For the 2100s analysis period under RCP 4.5 [W m^{-2}], annual costs increased by 2.0% and 11.2% for PVH and PVHH cases, respectively. Under RCP 8.5 [W m^{-2}] costs increased by 2.2% and 11.2% for PVH and PVHH cases, respectively.

For all decades under both RCP scenarios, a PV system was not able to produce cost savings.

Combination cases were chosen based on cost savings from individual retrofits for each year under both RCP scenarios, they can be found in Table 3.1. Under RCP 4.5 and RCP 8.5 [W m^{-2}], the combinations for 2020s, 2040s, 2060s, 2080s, and 2100s included an increase of one tree (VegH), and infiltration/exfiltration of 0.4 [ACH] (InfLL). Cost saving during the 2020s analysis was 26.3%. During the 2100s analysis, cost savings were 21.8% and 13.9% for RCP 4.5 and RCP 8.5 [W m^{-2}], respectively.

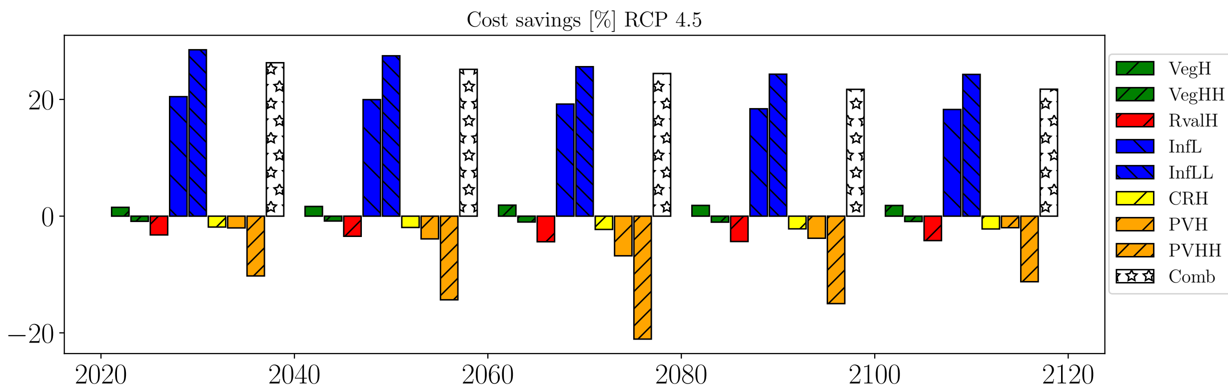

Figure 3.7: Annualized cost savings [%] for individual and combination cases for all decades under RCP 4.5 [W m^{-2}] over 20 year periods in Vancouver.

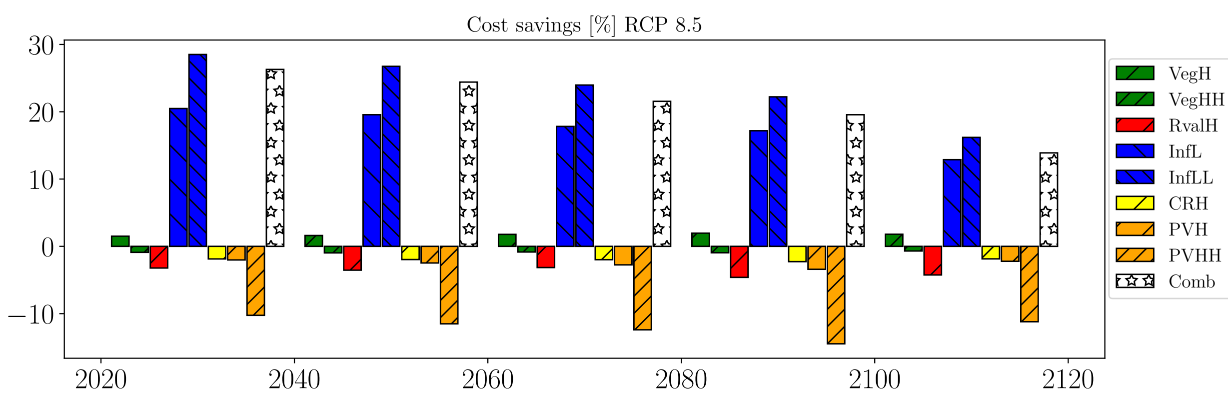

Figure 3.8: Annualized cost savings [%] for individual and combination cases for all decades under RCP 8.5 [W m^{-2}] over 20 year periods in Vancouver.

Year	RCP 4.5 [W m^{-2}]	RCP 8.5 [W m^{-2}]
2020s	VegH-InfLL	VegH-InfLL
2040s	VegH-InfLL	VegH-InfLL
2060s	VegH-InfLL	VegH-InfLL
2080s	VegH-InfLL	VegH-InfLL
2100s	VegH-InfLL	VegH-InfLL

Table 3.1: Combination of mitigation strategies for Vancouver based on economic analysis

3.2 Results - Toronto

3.2.1 Electricity Consumption

For the base case in Toronto in 2020s, the annual electricity consumption was 27.95 [kW-hr m^{-2}]. Under climate scenarios RCP 4.5 and RCP 8.5 [W m^{-2}], annual electricity consumption has a gradual increase which is to be expected with global warming (see figure 3.9 and 3.9). However, under RCP 8.5 [W m^{-2}] there is a greater demand. By 2100s, electricity demand increases to 54.63 [kW-hr m^{-2}], while under RCP 4.5 [W m^{-2}] electricity demand is 44.12 [kW-hr m^{-2}].

With the addition of trees, annual electricity consumption has the potential to decrease by 1.6 [kW-hr m^{-2}] and 2.9 [kW-hr m^{-2}] for VegH and VegHH cases, respectively in 2020s. For every decade, increase in trees provides a decrease in electricity consumption. Adding trees will increase the shading on buildings and cause evapotranspiration, which decrease the cooling load in the warm seasons. In 2100s, the addition of trees could decrease annual electricity consumption by 1.6 [kW-hr m^{-2}] and 1.9 [kW-hr m^{-2}] for VegH and VegHH cases, respectively, under RCP 4.5 [W m^{-2}]. Under RCP 8.5 [W m^{-2}], the annual electricity consumption decreased by 1.9 [kW-hr m^{-2}] and 3.3 [kW-hr m^{-2}] for VegH and VegHH cases, respectively.

Increasing insulation decreased annual electricity consumption by 0.6 [kW-hr m^{-2}] in 2020s.

The extra insulation was able to decrease thermal energy loss/gain by conduction through the walls. For every decade until 2100s this trend holds. In 2100s, insulation could decrease electricity by 0.8 [kW-hr m^{-2}] and 1.2 [kW-hr m^{-2}] under RCP 4.5 and RCP 8.5 [W m^{-2}], respectively.

Decreasing infiltration/exfiltration increased annual electricity consumption by 4.7 [kW-hr m^{-2}] and 8.5 [kW-hr m^{-2}] for InfL and InfLL cases, respectively in 2020s. Annual electricity consumption increased for all decades and both climate scenarios. In 2100s under RCP 4.5 [W m^{-2}] infiltration/exfiltration could increase the annual electricity consumption by 1.5 [kW-hr m^{-2}] and 3.3 [kW-hr m^{-2}] for InfL and InfLL cases, respectively. Under RCP 8.5 [W m^{-2}] infiltration/exfiltration could increase annual electricity consumption by 0.4 [kW-hr m^{-2}] and 1.3 [kW-hr m^{-2}] for InfL and InfLL cases, respectively.

Adding a cool roof to the building was able to reduce annual electricity consumption by 0.6 [kW-hr m^{-2}] in 2020s. This is mainly due to reducing the cooling load in the warm seasons. During the days with high solar radiation intensity, the increased albedo was able to reflect a higher percentage of solar radiation. Annual electricity consumption decreased for all decades. In 2100s a cool roof could decrease electricity by 0.7 [kW-hr m^{-2}] and 0.8 [kW-hr m^{-2}] under RCP 4.5 [W m^{-2}] and RCP 8.5 [W m^{-2}], respectively.

The addition of a PV system does not change the annual electricity consumption, in Figure 3.9 there is no change between the base case, PVH, and PVHH cases. Toronto's electricity production can be found in Appendix C.2.2. The effects of electricity production are discussed in Section 3.2.6.

The combination retrofits are chosen based off the economic analysis, which is discussed in Section 3.1.4. Each decade has the potential to have a different combination of retrofits, the combinations can be found in Table 3.2. In 2020s the combination case increased annual electricity consumption by 6.6 [kW-hr m^{-2}]. All combination cases, except for RCP 8.5 [W m^{-2}] in 2100s had increased annual electricity consumption.

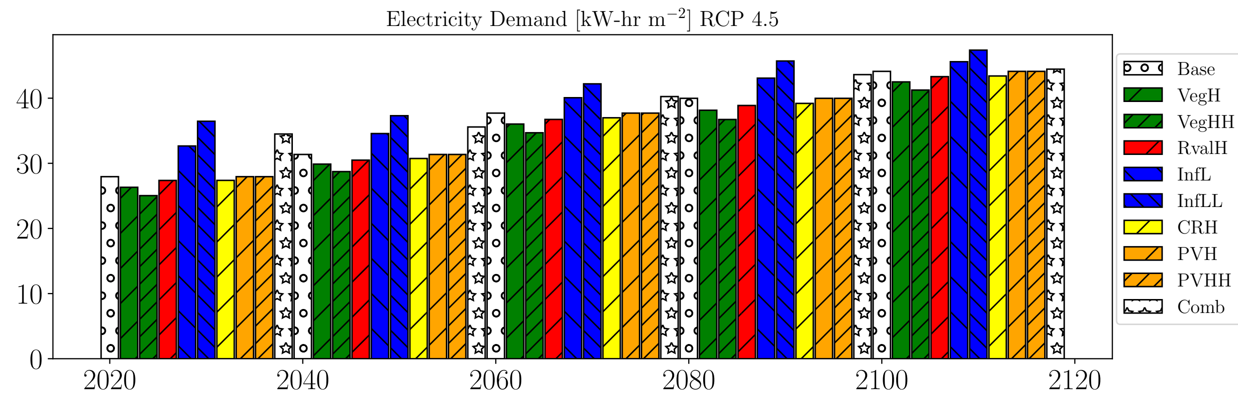

Figure 3.9: Annualized electricity demand [kW-hr m^{-2}] for individual and combination cases for all decades under RCP 4.5 [W m^{-2}] over 20 year periods in Toronto.

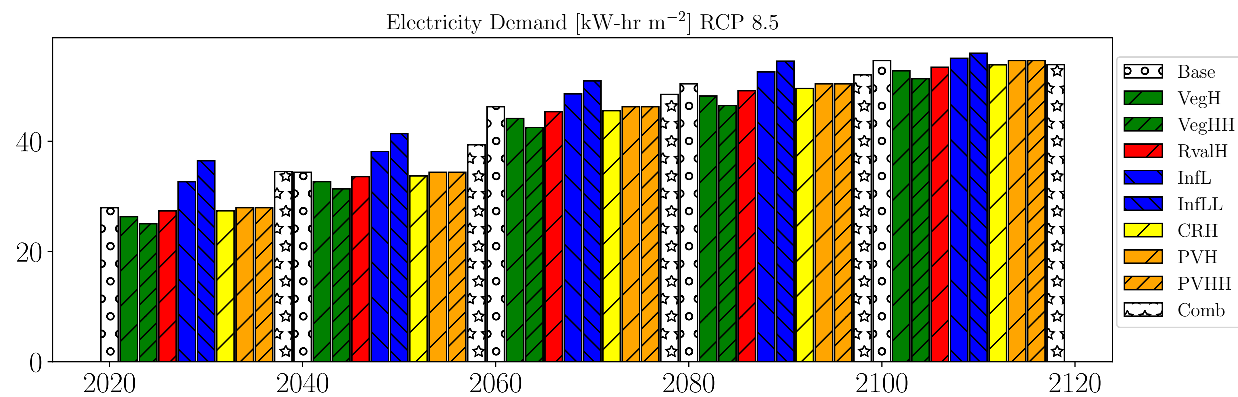

Figure 3.10: Annualized electricity demand [kW-hr m^{-2}] for individual and combination cases for all decades under RCP 8.5 [W m^{-2}] over 20 year periods in Toronto.

3.2.2 Gas Consumption

In 2020s the base annual gas consumption is 26.2 [m^3 m^{-3}]. Under RCP 8.5 [W m^{-2}], annual gas consumption has a gradual decrease and by 2100s annual gas consumption decreases to 20 [m^3 m^{-3}] (see Figure 3.12). Under RCP 4.5 [W m^{-2}], annual gas consumption increases slightly, but by 2100s, annual gas consumption has decreased to 25.1 [m^3 m^{-3}] (see Figure 3.11).

In 2020s increasing vegetation increased annual gas consumption by 0.2 [m^3 m^{-2}] and 0.4 [m^3 m^{-2}] for VegH and VegHH cases, respectively. Under both RCP 4.5 [W m^{-2}] and RCP 8.5

[W m^{-2}] annual gas consumption increased for each year. In 2100s under RCP 4.5 [W m^{-2}] annual gas consumption increased by 0.2 [m^3 m^{-2}] and 0.4 [m^3 m^{-2}] for VegH and VegHH cases, respectively. In 2100s under RCP 8.5 [W m^{-2}] annual gas consumption increased by 0.2 [m^3 m^{-2}] and 0.3 [m^3 m^{-2}] for VegH and VegHH cases, respectively.

Increasing insulation in the walls decreased annual gas consumption by 0.9 [m^3 m^{-2}] in 2020s. Under both RCP 4.5 and RCP 8.5 [W m^{-2}] annual gas consumption decreased for all decades.

Decreasing infiltration/exfiltration had the largest reduction in annual gas consumption, 9.6 and 14.9 [m^3 m^{-2}] for InfL and InfLL cases, respectively, in 2020s. Annual gas consumption decreased in every decade for both RCP 4.5 [W m^{-2}] and RCP 8.5 [W m^{-2}]. In 2100s under RCP 4.5 [W m^{-2}] annual gas consumption decreased by 7.5 [m^3 m^{-2}] and 11.6 [m^3 m^{-2}] for InfL and InfLL cases, respectively. In 2100s under RCP 8.5 [W m^{-2}] annual gas consumption decreased by 9.3 [m^3 m^{-2}] and 14.3 [m^3 m^{-2}] for InfL and InfLL cases, respectively.

The addition of a cool roof increased annual gas consumption by 0.2 [m^3 m^{-2}] in 2020s. This is due to increased heating demand in the cold seasons (absorption of solar radiation by cool roofs is reduced). All decades produce an increase in annual gas consumption for both RCP 4.5 and RCP 8.5 [W m^{-2}]. In 2100s annual gas consumption increased by 0.1 [m^3 m^{-2}] and 0.2 [m^3 m^{-2}] under RCP 4.5 and RCP 8.4 [W m^{-2}], respectively.

The combination case has the second highest reduction in annual gas consumption for both RCP 4.5 and RCP 8.5 [W m^{-2}], following the InfLL case. The combination can be found in Table 3.2. Annual gas consumption decreased by 14.7 [m^3 m^{-2}] in 2020s. All decades for both RCP scenarios had a decrease of annual gas consumption between 11 [m^3 m^{-2}] and 16 [m^3 m^{-2}].

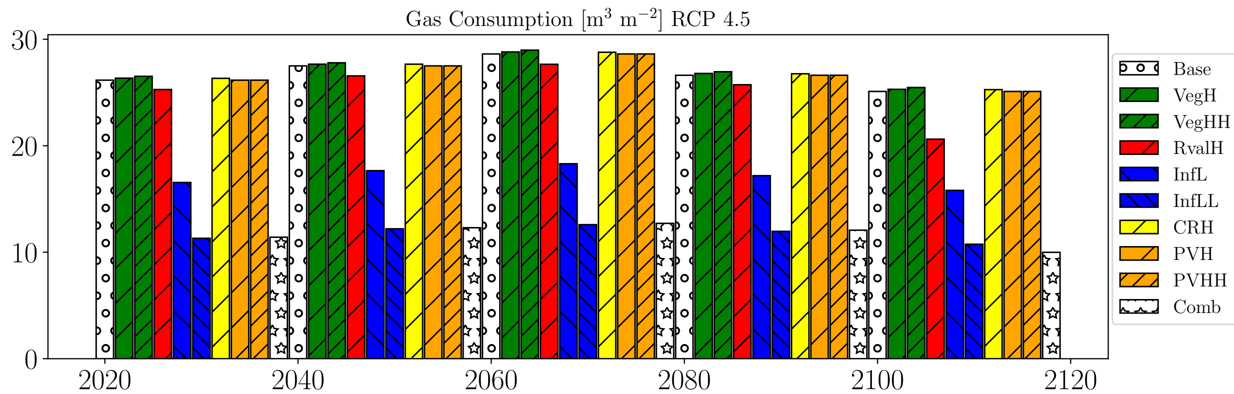

Figure 3.11: Annualized gas Consumption [m^3 m^{-2}] for individual and combination cases for all decades under RCP 4.5 [W m^{-2}] over a 20 year period in Toronto.

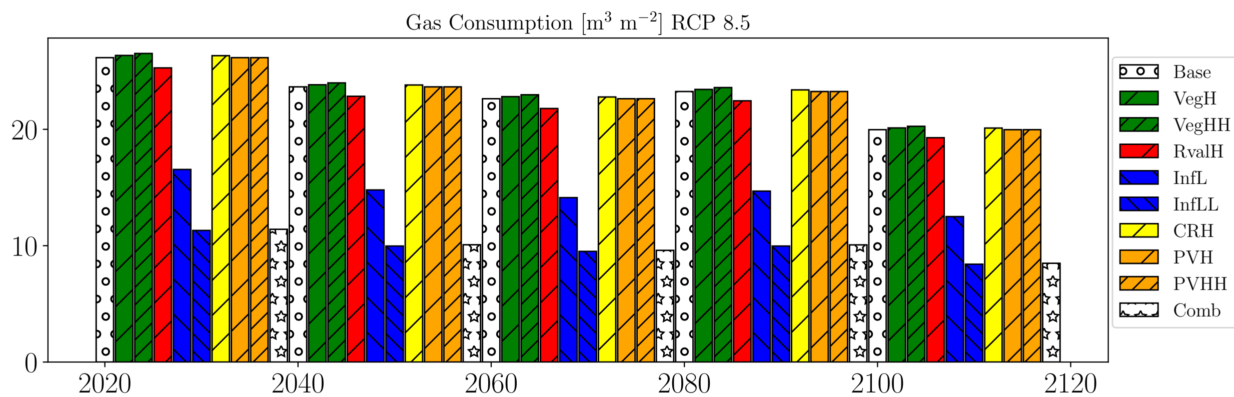

Figure 3.12: Annualized gas consumption [m^3 m^{-2}] for individual and combination cases for all decades under RCP 8.5 [W m^{-2}] over 20 year periods in Toronto.

3.2.3 CO_2e Analysis

CO_2e emissions follows the same trend as gas consumption due to the emissions factor of gas. From Figures 3.14, there is a steady decrease in CO_2e emissions savings under RCP 8.5 [W m^{-2}]. From Figure 3.13 there is little change in CO_2e emissions under RCP 4.5 [W m^{-2}].

When vegetation was added, CO_2e emissions increased by 1.1 [Tonnes] and 2.1 [Tonnes] for VegH and VegHH cases, respectively in 2020s. For all decades an increase in vegetation increased CO_2e emissions. In 2100s under RCP 4.5 [W m^{-2}] the addition of trees will increase CO_2e emissions by 1.1 [Tonnes] and 2.2 [Tonnes] for VegH and VegHH cases, respectively. Under RCP 8.5 [W m^{-2}] the addition of trees will increase CO_2e emissions by 0.8 [Tonnes] and 1.5 [Tonnes] for VegH and VegHH cases, respectively.

Increasing insulation was able to save 6.43 [Tonnes] of CO_2e emissions in 2020. These savings came from the decrease in annual gas and electricity consumption. All decades under both RCP scenarios were able to reduce between 5 [Tonnes] and 7.5 [Tonnes] of CO_2e emissions, with the exception of 2100s under RCP 4.5 [W m^{-2}]. This year was able to save 32.4 [Tonnes] of CO_2e emissions. This outlying point is discussed in Section 3.2.6.

Reducing infiltration/exfiltration produced CO_2e emissions savings of 68.5 [Tonnes] and 105.6 [Tonnes] for InfL and InfLL cases, respectively, in 2020s. During all decades reducing infiltration/exfiltration produced savings for both RCP 4.5 and RCP 8.5 [W m^{-2}]. By 2100s under RCP 4.5 [W m^{-2}] reducing infiltration/exfiltration could produce CO_2e emissions savings of 66.7 [Tonnes] and 102.8 [Tonnes] for InfL and InfLL cases, respectively. By 2100s under RCP 8.5 [W m^{-2}] reducing infiltration/exfiltration could produce CO_2e emissions savings of 53.7 [Tonnes] and 83.0 [Tonnes] for InfL and InfLL cases, respectively.

Adding a cool roof increases CO_2e emissions by 1.1 [Tonnes] in 2020s. Under RCP 4.5 [W m^{-2}] the magnitude of CO_2e emissions increase is relativity stable. For all decades under both RCP 4.5 [W m^{-2}] and RCP 8.5 [W m^{-2}] tje CO_2e emissions increased. In 2100s a cool roof could increase CO_2e emissions by 0.1 [Tonnes] and 0.9 [Tonnes] under RCP 4.5 and RCP 8.5 [W m^{-2}], respectively.

The PV systems produced CO_2e emissions savings of 6.1 [Tonnes] and 12.1 [Tonnes] in 2020s by offsetting the need for grid electricity. For all decades under both RCP scenarios a PV system was able to produce CO_2e emissions savings. In 2100s a PV system could save 6.2 [Tonnes] and 12.2 [Tonnes] under for PVH and PVHH cases, respectively. Under RCP 4.5 [W m^{-2}] CO_2e emissions savings could be 6.0 [Tonnes] and 11.7 [Tonnes] for PVH and PVHH cases, respectively.

The combination cases produced the second highest CO_2e emissions savings. In 2020s, the combination case (see Table 3.2) was able to save 117.3 [Tonnes] of CO_2e emissions. In 2100s under RCP 4.5 [W m^{-2}], the combination case was able to save 121 [Tonnes] of CO_2e emissions. Under RCP 8.5 [W m^{-2}] the combination case was able to save 94.5 [Tonnes] of CO_2e emissions. Each combination case for all decades was able to produce CO_2e emissions savings for both RCP scenarios.

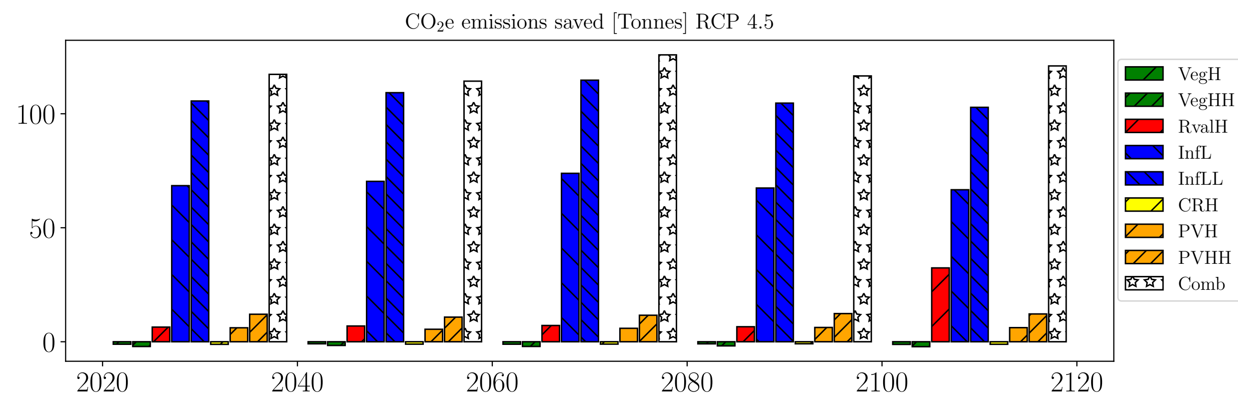

Figure 3.13: CO_2e emissions savings [Tonnes] for individual and combination cases for all decades under RCP 4.5 [W m^{-2}] over 20 year periods in Toronto.

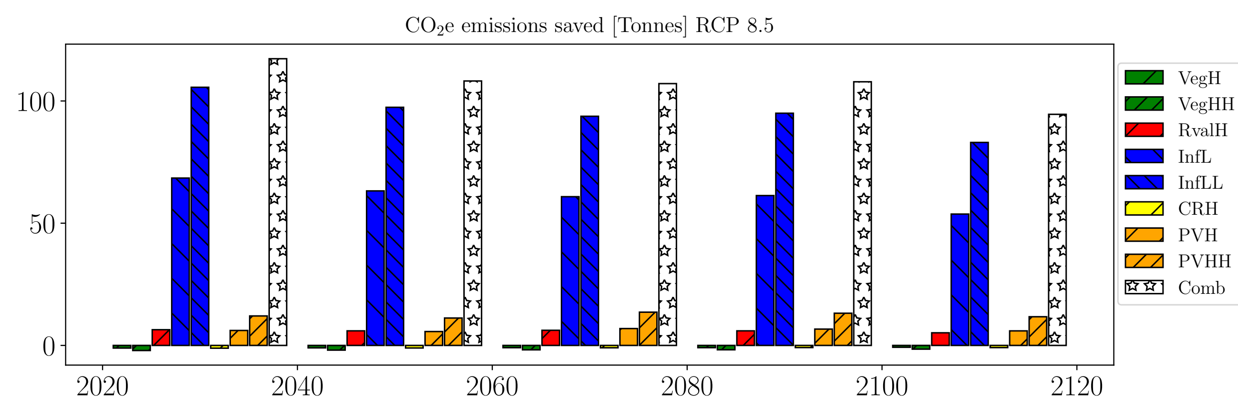

Figure 3.14: CO_2e emissions savings [Tonnes] for individual and combination cases for all decades under RCP 8.5 [W m^{-2}] over 20 year periods in Toronto.

3.2.4 Cost Analysis

The costs considered for the economic analysis are the same for Toronto as they were for Vancouver and can be found in Table 2.6. The mitigation items that produced positive cost savings were modelled together to produce a combined case for each decade under both RCP scenarios. Figures 3.15 and 3.16 show the cost savings (or cost increase) for each retrofit and the combination retrofits under RCP 4.5 [W m^{-2}] and RCP 8.5 [W m^{-2}], respectively. Results are discussed below.

The addition of one tree was able to produce annual cost savings of 0.3% starting in 2020. The addition of a second tree resulted in an increased homeowner cost of 2.1%. For all decades under both RCP scenarios an increase of one tree was able to produce cost savings, while adding two trees resulted in an increased homeowner cost. The addition of one tree in 2100s under both RCP 4.5 and RCP 8.5 [W m^{-2}] produced cost savings of 0.3%, while the addition of a second tree resulted in a 1.9% increase in cost.

Surprisingly, increasing insulation resulted in a 3.4% increase in cost over the 20 year analysis in 2020s. This trend is true for all decades and both RCP scenarios, with one exception. In 2100s under RCP 4.5 [W m^{-2}] increased insulation was able to produce cost savings of 1.6%. The reasoning for this is the same as the outlying point in CO_2e emissions savings and will be discussed in the following section.

The greatest cost savings potential for individual retrofits came from decreasing infiltration/exfiltration. For the 2020s analysis, decreasing infiltration/exfiltration produced cost savings of 15.6% and 21.7% for InfL and InfLL cases, respectively. Decreasing infiltration/exfiltration consistently produced the largest and second largest cost saving for all decades under both RCP scenarios. For the 2100s analysis under RCP 4.5 [W m^{-2}], decreasing infiltration/exfiltration was able to save 14.1% and 19.6% for InfL and InfLL cases, respectively. Under RCP 8.5 [W m^{-2}], cost savings were 11.9% and 16.1% for InfL and InfLL cases, respectively.

The addition of a cool roof increased homeowner cost by 1.6% at the end of the 20 year analysis in 2020s. For the 2100s analysis under RCP 4.5 and RCP 8.5 [W m^{-2}], costs increased by 1.5%. All decades for both RCP scenarios saw an increase in cost with the addition of a cool roof.

The electricity production from a PV system was able to offset grid electricity consumption to produce cost savings. In 2020s, a PV system could produce cost savings of 7% and 9% for PVH and PVHH cases, respectively. For the 2100s analysis period under RCP 4.5 [W m^{-2}], cost savings were 7% and 8% for PVH and PVHH cases, respectively. Under RCP 8.5 [W m^{-2}] cost savings were 6% and 7% for PVH and PVHH cases, respectively. For all decades under both RCP scenarios, a PV system was able to produce cost savings.

Combination cases were chosen based on cost savings from individual retrofits for each year under both RCP scenarios; they can be found in Table 3.2. Under RCP 4.5 [W m^{-2}], the combinations for 2020s, 2060s, 2080s, and 2100s included an increase of one tree (VegH), infiltration/exfiltration of 0.4 [ACH] (InfLL), and high PV coverage of 69% for half the roof (PVHH). The combination case for RCP 4.5 [W m^{-2}] 2040s was an increase of one tree (VegH), infiltration/exfiltration of 0.4 [ACH] (InfLL), and low PV coverage of 35% for half the roof (PVH). Under RCP 8.5 [W m^{-2}], the combinations for all decades were the same, which included an increase of one tree, infiltration/exfiltration of 0.4 [ACH], and high PV coverage of 69% for half the roof.

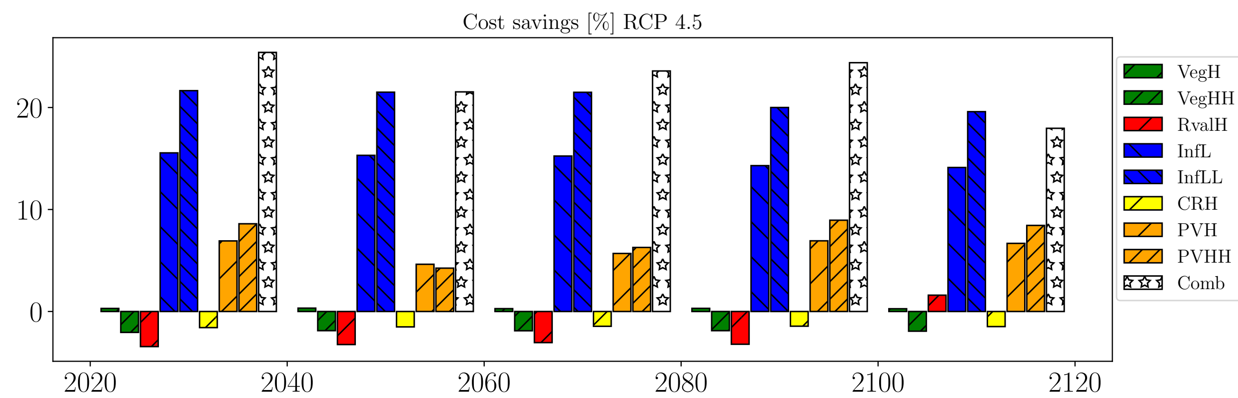

Figure 3.15: Annualized cost savings [%] for individual and combination cases for all decades under RCP 4.5 [W m^{-2}] over 20 year periods in Toronto.

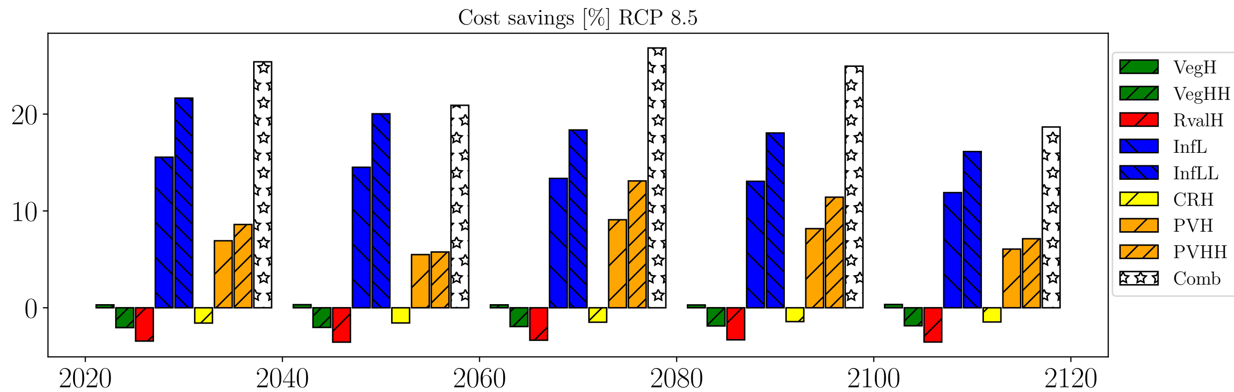

Figure 3.16: Annualized cost savings [%] for individual and combination cases for all decades under RCP 8.5 [W m^{-2}] over 20 year periods in Toronto.

Year	RCP 4.5 [W m^{-2}]	RCP 8.5 [W m^{-2}]
2020s	VegH-InLL-PVHH	VegH-InLL-PVHH
2040s	VegH-InLL-PVH	VegH-InLL-PVHH
2060s	VegH-InLL-PVHH	VegH-InLL-PVHH
2080s	VegH-InLL-PVHH	VegH-InLL-PVHH
2100s	VegH-InLL-PVHH	VegH-InLL-PVHH

Table 3.2: Combination of mitigation strategies for Toronto based on economic analysis

3.2.5 Comparison Between Climate Zones

As seen in the previous sections, mitigation efforts that were most cost effective and reduced CO_2e emissions were similar between climate zones. The differences can be seen in the savings magnitude that each mitigation effort were able to produce, within each climate zone. This section will briefly discuss the difference in cost savings for Vancouver and Toronto when infiltration/exfiltration is decreased, a PV system is added, and when an extra tree is added. This section will also discuss the difference in CO_2e emissions saving for Vancouver and Toronto, when infiltration/exfiltration is decrease and a PV system is added. It will not discuss CO_2e emissions savings differences for the addition of trees because there were no CO_2e emissions savings.

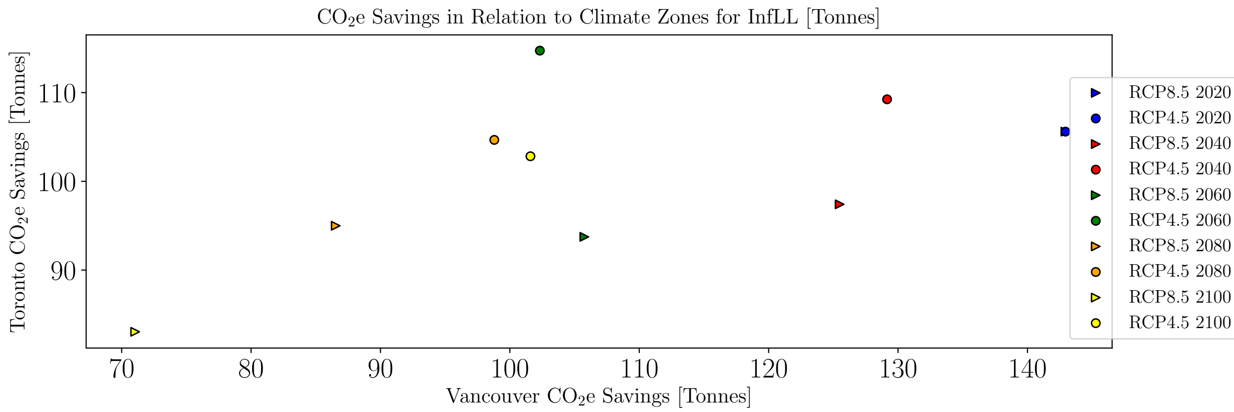

Figure 3.17: Comparison of CO_2e emissions savings [Tonnes] associated with decreasing infiltration/exfiltration between Vancouver and Toronto.

Infiltration had the best overall performance in providing cost savings and reducing CO_2e emissions for both Vancouver and Toronto. Between the two climate zones, decreasing air leakage was generally more beneficial in Vancouver than in Toronto. Figure 3.17 and 3.18 show Vancouver savings on the x-axis and Toronto savings on the y-axis for a given year under both RCP scenarios. For all years except 2060 and 2080 under RCP 4.5 [W m^{-2}], Vancouver has greater CO_2e emissions savings because of the reduction in gas consumption. Vancouver also had the largest cost savings for all years and both RCP scenarios, this was due to the cheap price in electricity and the reduction in gas consumption. Natural gas in Vancouver is almost twice as expensive than in Toronto, leading to a higher overall cost savings for Vancouver.

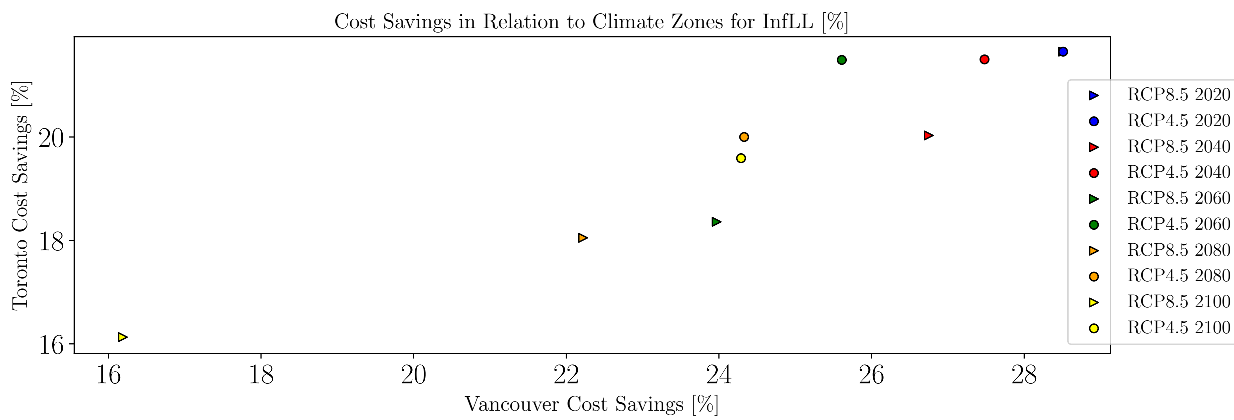

Figure 3.18: Comparison of cost savings [$] associated with decreasing infiltration/exfiltration between Vancouver and Toronto.

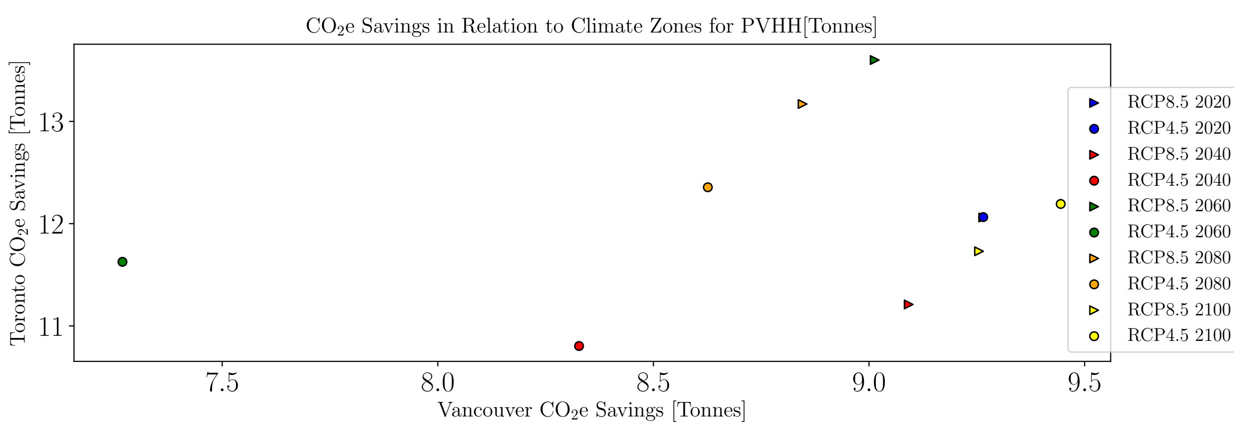

Figure 3.19: Comparison of CO_2e emissions savings [Tonnes] associated with the addition of a high coverage PV system between Vancouver and Toronto.

Figures 3.19 and 3.20 show the performance of a high PV system in Vancouver and Toronto. A high PV system is more beneficial in Toronto than in Vancouver for all years and both RCP scenarios. In Toronto, both the price of electricity and the Electricity Emissions Intensity Factor are much higher compared to Vancouver. The ability of a PV system to offset grid electricity has a larger benefit in this case. A PV system in Vancouver was not cost effective due to the cheap price in electricity, this is shown in Figure 3.20 where there are negative savings.

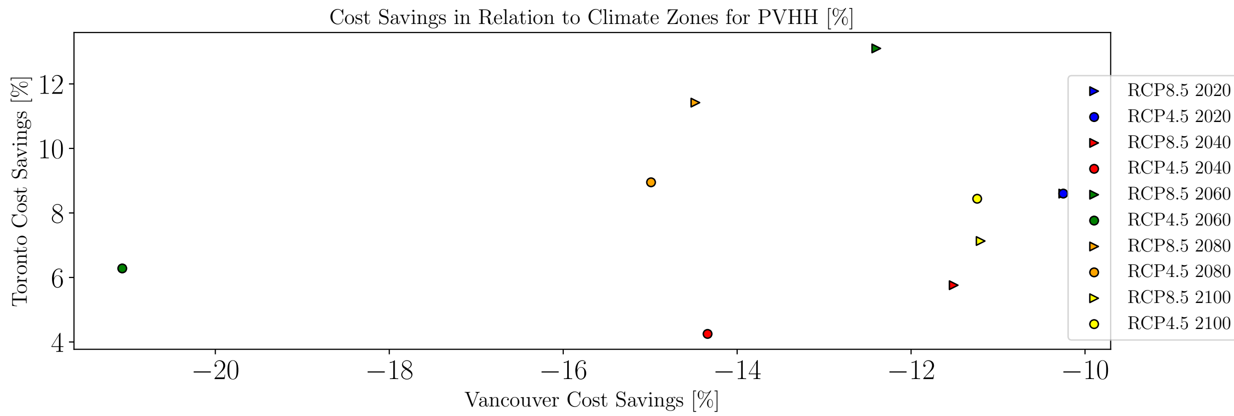

Figure 3.20: Comparison of cost savings [$] associated with the addition of a high coverage PV system between Vancouver and Toronto.

Finally, looking at Figure 3.21 there are larger cost savings for all years under both RCP scenarios with the addition of a tree in Vancouver. This is due to the added shading effect and Vancouver's milder climate. Trees in Vancouver are coniferous, they do not loose their leaves during the change in season; this leads to a longer duration of shading which would be beneficial during the shoulder seasons. Vancouver also has a milder climate, which would lengthen the cooling season and need for shading compared to Toronto.

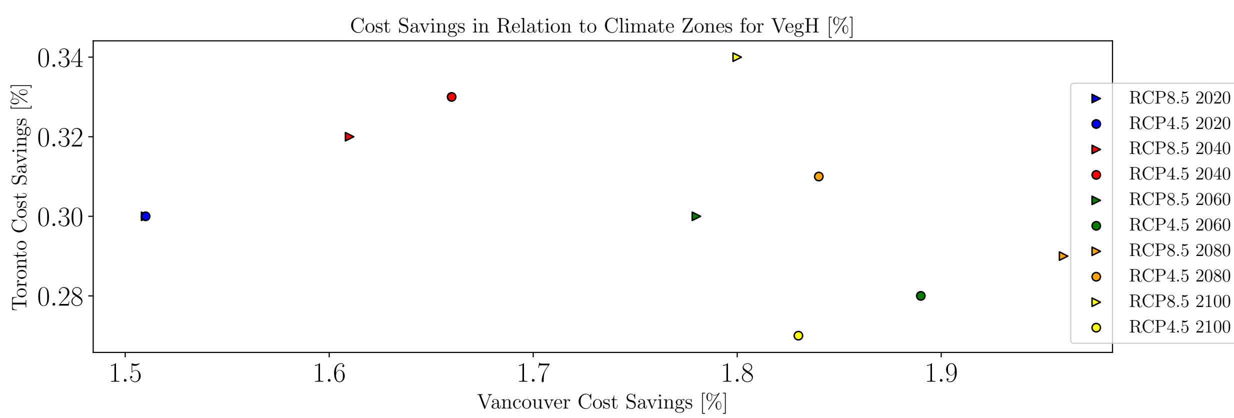

Figure 3.21: Comparison of cost savings [$] associated with the addition of a tree between Vancouver and Toronto.

These differences show that mitigation efforts have differing effects between climate zones due to economics, vegetation, and regional climate.

3.2.6 Discussion

A base house that meets Canadian Code was simulated using an urban physics model called VCWG. The model outputs annual gas and electricity consumption of the base houses in climate zones 4 and 5, for Vancouver and Toronto, respectively. The house was then modelled with the following mitigation measures: increased vegetation, increased thermal resistance, decreased infiltration/exfiltration, added a cool roof, and added photovoltaic panels. Two climate zones were studied to determine if there are mitigation efforts that can be applied regardless of climate zone. Using the annual gas and electricity consumption, a 20-year economic and CO_2e emissions analysis was performed from 2020s to 2100s under two future climate change scenarios, RCP 4.5 and RCP 8.5 [W m^{-2}].

Electricity consumption in Vancouver increases from 2020s to 2100s under both RCP scenarios, with a larger increase under the RCP 8.5 [W m^{-2}] condition. This is to be expected with the increase in temperature. However, increasing temperature trends over a century does not mean that every decade sees an increase in temperature, individual decades may experience colder temperatures. This is seen in 2060s under RCP 4.5 [W m^{-2}]. Cooler temperatures in the summer lead to a decrease in electricity consumption. During RCP 8.5 [W m^{-2}] in 2100s there is a large increase in electricity consumption. VWFG downscaled CM data for 2100s and 2099s, both years produced larger electricity demands. This could be due to the climate model data over-predicting climate factors that increase electricity consumption such as temperature. Coastal regions, like Vancouver, could have oceanic factors that impact the climate model outputs. In Toronto for both RCP 4.5 [W m^{-2}] and RCP 8.5 [W m^{-2}], electricity consumption has a gradual increase. Electricity consumption under RCP 8.5 [W m^{-2}] is always larger than under RCP 4.5 [W m^{-2}], this is to be expected since RCP 8.5 [W m^{-2}] is a more extreme climate change scenario for cooling load.

Gas consumption in Vancouver under both RCP scenarios has a gradual decrease, this is to be expected due to climate change and reduced heating load. In Toronto under RCP 4.5 [W m^{-2}] gas consumption is relatively stable but does show a declining trend under RCP 8.5 [W m^{-2}]. Vancouver experiences moderate winters with about half as many freezing days as Toronto. The warming effects would be more noticeable in Vancouver compared to Toronto, which explains why there is a more noticeable decrease in gas consumption. Gas consumption is larger under RCP 4.5 [W m^{-2}] than RCP 8.5 [W m^{-2}] for all decades except 2060s. This can be due to climate model predictions for cooler temperatures in Vancouver and warmer temperatures in Toronto for a particular decade.

An decadal analysis showed that mitigation strategies can be beneficial during one seasons (heating or cooling) but not for the other. This was observed with increased vegetation, decreased infiltration/exfiltration, and the addition of a cool roof. Increasing vegetation decreased electricity consumption but increased gas consumption. Increasing vegetation was beneficial in the cooling season because of the decrease in electricity consumption (due to shading and evapotranspiration toward the reduction of cooling load); but in the heating season gas consumption increased (due to prevention of solar radiation absorption toward heat gain and reduction of heating load).

Decreasing infiltration/exfiltration increased electricity consumption but decreased gas consumption. Sealing leakage points reduces airflow between the indoor and outdoor environment. During the day the building naturally stores thermal energy, which is then naturally released at a later time (usually a few hours later). If there is a reduction in airflow the cooler outdoor air will not replace the hotter indoor air and the air conditioning unit will need to work harder to reach the desired set-point temperature. This is particularly true during shoulder seasons (spring and fall), when daily temperatures tend to fluctuate more. This can be resolved by opening windows to increase natural airflow; however natural ventilation was not modelled in this research.

Adding a cool roof decreased electricity consumption but increased gas consumption. During the heating season, the building could store thermal energy from solar radiation, which would be used to meet the heating demand. However, with an increased albedo more solar radiation is reflected, reducing the amount of thermal energy that can be stored in the building. This lead to an increase in gas consumption. From this analysis one can say that a cool roof and added vegetation would be beneficial to a homeowner in tropical or sub-tropical climates, whereas decreasing infiltration/exfiltration is more beneficial for cold climates.

The changes in gas and electricity consumption have a direct influence on CO_2e emissions. Canada generally uses clean electricity for space cooling because of natural resources availability, i.e. hydro power. This is especially true in British Columbia. On the other hand, space heating is not as clean. Canada dominantly uses natural gas. Even though the natural gas used is one of the cleanest, the grid electricity CO_2e emissions factor is much lower compared to natural gas CO_2e emissions factor. Therefore the mitigation strategies that are able to either 1) reduce gas consumption or 2) reduce electricity consumption without increasing gas consumption have the highest CO_2e emissions savings. For individual cases, reducing infiltration/exfiltration had the largest decrease in gas consumption and therefore had the largest CO_2e emissions savings in Toronto and Vancouver under both RCP scenarios. Unfortunately, the addition of trees increased CO_2e emissions. A trees ability to store carbon was not enough to offset carbon emissions from the increased gas consumption. Increasing insulation in the walls decreased gas and electricity consumption. Gas and electricity consumption decreased because there was a reduction in thermal energy loss/gain by conductive heat transfer through the walls. The hot/cold air that the furnace/AC produced was not lost. This lead to CO_2e emissions savings in both Vancouver and Toronto under RCP 4.5 and RCP 8.5 [W m^{-2}] scenarios. A PV system produced electricity that was used to offset grid electricity, this lead to CO_2e emissions savings. A cool roof did not produce any CO_2e emissions or cost savings due to the increased gas consumption in Toronto and Vancouver under both RCP scenarios. Perhaps if a more advanced cool roof technology were used that could change albedo seasonally, there would be savings. Combination cases in Vancouver account for the second largest CO_2e emissions savings, followed by the reduction of infiltration/exfiltration. The addition of a tree reduced CO_2e emissions savings as a result of the increase in gas consumption. In Toronto, combination cases accounted for the largest CO_2e emissions savings. The combination of reducing infiltration/exfiltration and adding photovoltaic panels was beneficial.

The changes in gas and electricity consumption also have a direct influence on cost savings, along with product cost, operation and maintenance, and government rebates. One tree had a low product cost and was able to reduce electricity consumption, both of these economic factors were able to offset the cost of increased gas consumption. The addition of two trees is not as cost effective. The low cost of the product and reduced cost associated with a reduction in electricity was not enough to offset the increase cost associated with increased gas consumption for either RCP scenario in Vancouver and Toronto. Reducing infiltration/exfiltration had the largest cost savings for both Vancouver and Toronto. The large amount of cost savings comes primarily from savings in gas consumption and the low cost of an air blower test. Increasing insulation was able to reduce gas and electricity consumption and therefore reduce the homeowner cost. However, the initial cost of adding an extra layer of insulation was too expensive to be offset by the savings associated with decreased gas and electricity consumption. Perhaps if a homeowner were able to find a less expensive company there would be cost savings. The addition of a cool roof was not economical in either Vancouver or Toronto under RCP 4.5 and RCP 8.5 [W m^{-2}]. This was due to the increase costs associated with an increase in gas and electricity consumption. The addition of a PV system that covered 69% of half the roof was cost effective in Toronto for every analysis decade and RCP scenario except for RCP 4.5 [W m^{-2}] in 2040s. It was more cost effective to use a PV system that covered 35% of half the roof for that decade. This may be due to the climate model data predicting a cloudier or cooler year. In Vancouver a PV system was not cost effective for every decade under both RCP scenarios for two main reasons. The first is due to the low cost of electricity in BC and the second is due to the climate in Vancouver. Most of the electricity used is produced in BC by hydroelectric plants, which is relatively inexpensive. Vancouver also has a cloudy climate which reduces direction solar radiation. Looking at 1.8, we see that BC has a lower annual PV potential [kWh kWp^{-1}]. These findings are similar to findings from the Government of Canada [46].

These results are based largely off of future economic assumptions, which adds a large element of uncertainty. With Canada's plan to involve residential buildings in grid electricity generation, there maybe economic incentives that outweigh the cost of PV systems in Vancouver. Product costs for insulation and cool roofs could decrease, making them profitable. Even with this level of uncertainty, these results can show homeowners and policy makers which mitigation strategies have the potential to reduce gas, electricity, CO_2e emissions, and cost. Homeowners can choose to implement all or just one strategy. Policy makers can decide which mitigation strategy would benefit from monitory incentives.

Chapter 4

Conclusion and Future Work

4.1 Conclusions

This analysis calculated gas/electricity consumption, greenhouse gas emissions, and operating costs for a single family low-rise residential house in two climate zones of Canada. The objective was to investigate mitigation measures for reduction of energy use, emissions, and costs, for the house in current and future climates. The mitigation strategies investigated were: increasing vegetation, increasing thermal resistance, decreasing infiltration/exfiltration, adding a cool roof, and adding photovoltaic panels. Simulations of the energy consumption were conducted using the Vertical City Weather Generator (VCWG) software. The forcing conditions for the future climate were produced using the Vatic Weather File Generator (VWFG). These two software platforms have been developed by the Atmospheric Innovations Research (AIR) lab and utilized for this research.

Vancouver and Toronto, belong to climate zones 4 and 5, and the residential house was considered in neighborhoods of these cities. Future climate conditions are associated with Representative Concentration Pathways (RCP) 4.5 and 8.5 [W m^{-2}]. A cost and CO_2e emissions analyses were conducted to determine which mitigation efforts would be most beneficial in a given climate zone.

The mitigation efforts that had the greatest cost savings were combined to further investigate cost and CO_2e emissions savings. The results of this analysis showed that building retrofits are not 'one-size fits all' in terms of climate zones, CO_2e savings, and cost. With some mitigation strategies a homeowner must decide which is more important: CO_2e savings or cost savings.

For Vancouver, decreasing infiltration/exfiltration can yield a major decrease in gas consumption, 15.3 [m^3 m^{-2}] in 2020s under RCP 4.5 [W m^{-2}]. This can decrease CO_2e emissions by 142.9 [Tonnes] over a 20 year period and produce cost savings of 28.5%. However, other mitigation efforts, such as increasing insulation, can produce CO_2e emissions savings of 8.1 [Tonnes] (in 2020s under RCP 4.5 [W m^{-2}]) but increase homeowner cost by 3.2%. If cost is of major concern, a homeowner should focus on sealing air leakage.

For Toronto, decreasing infiltration/exfiltration can yield a major decrease in gas consumption, 14.9 [m^3 m^{-2}] in 2020s under RCP 4.5 [W m^{-2}]. This can decrease CO_2e emissions by 105.6 [Tonnes] over a 20 year period and produce cost savings of 21.7%. However, other mitigation efforts, such as increasing insulation, can produce CO_2e emissions savings of 6.43 [Tonnes] (in 2020s under RCP 4.5 [W m^{-2}]) but increase homeowner cost by 3.4%. Again, if cost is of major concern, a homeowner should focus on sealing air leakage.

4.2 Future Work

4.2.1 Optimization and Mitigation Strategies

Performing an optimization analysis rather than considering scenario-based retrofits can improve our understanding of combination and sizing of mitigation strategies. For example an optimization analysis may reveal the best size for PV panels in Vancouver. In terms of a cool roof, an optimization approach may determine what albedo a roof should have in a cold climate. Aliabadi et al. [3] used a multi-objective optimization approach to calculate building energy consumption with a combination of retrofits. They used a gradient descent approach for optimization, which is computationally fast, but it cannot find a global minimum for the objective function. Bamdad et al. [13] used an ant colony optimization approach, which attempts to find a global minimum for the objective function; however this method is computationally intensive. Future work on coupling a simple optimization package with VCWG would allow for further studies.

Further, new mitigation strategies, such as utilizing air source heat pumps, ground source heat pumps, alternative glazing ratios, solar thermal energy, sensible and latent energy storage, and adaptive albedos, can be investigated. Advanced optimization techniques can particularly help with integrating diverse sources of renewable and alternative energy systems.

4.2.2 Diverse Climate Zones

This study focused on climate zones 4 and 5. However, these climate zones are very similar. Including more climate zones and a larger number of cities within each climate zone can help researchers understand what types of retrofits are suitable for each region. Investigating more cities would determine if climate zones classification is the best way to determine building codes. Perhaps investigating coastal versus inland cities might show differing results in the same climate zone. Further, factors driving the economic analysis could be different from one jurisdiction (city or country) to the next.

4.2.3 GHG and Economic Analysis Considerations

This analysis considered CO_2e emissions from natural gas combustion and grid electricity emissions, as well as the CO_2e uptake by trees. However, it does not consider the embodied emissions from the renewable energy products and mitigation efforts used. Perhaps we would see a reduction in CO_2e emissions savings when incorporating PV systems if the embodied emissions associated with PV production and transportation were considered.

The economic analysis considered the price of gas and electricity, material cost, operation and maintenance, and government rebates. This gives a general understanding for homeowner costs, but future work could consider the annual economic effects of Canada's carbon tax. This would be an important consideration when modelling a residential building under our current climate. The analysis already produces annual gas consumption values and there are guidelines for current carbon tax pricing. The complexity arises when considering carbon tax for future climate change scenarios because of the uncertainty of Canada's future carbon tax structure. Nevertheless, it is a financial consideration for homeowners and should therefore be considered in future work.

GHG emissions were only considered based on their impact on Climate Change, this research did not consider the health impacts of GHG emissions. Future research could consider indoor air quality and health effects of decreasing infiltration/exfiltration, considering how effective this mitigation effort was at reducing CO_2e emissions and producing cost savings.

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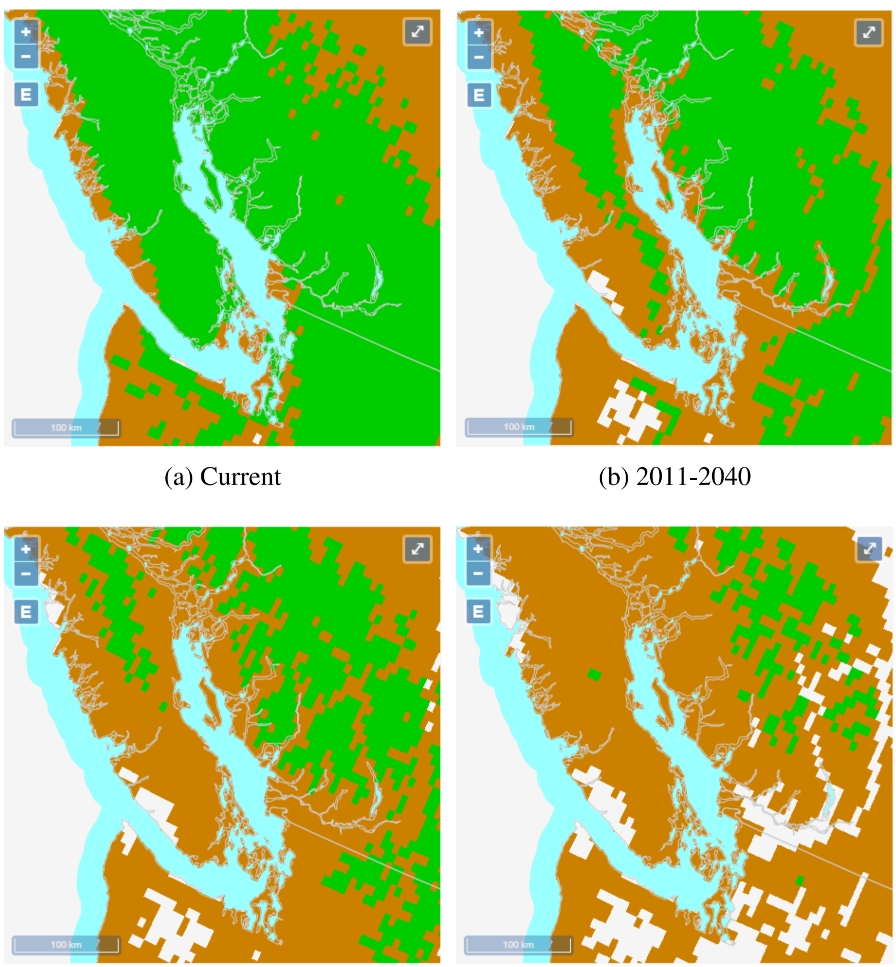
Appendix A

Chapter 1 Supplement

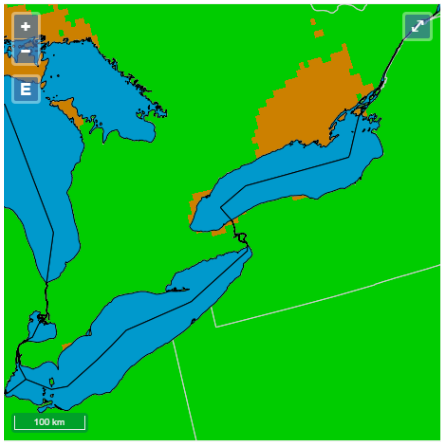
A.1 Climate Change Effects on Forests



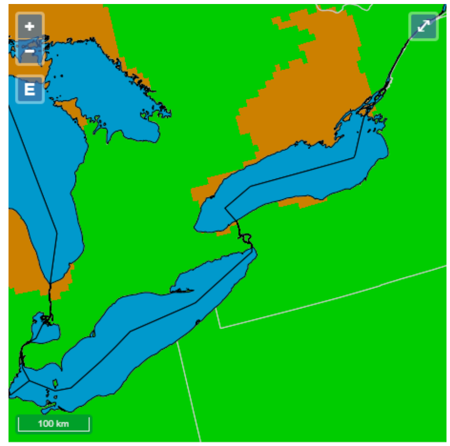
(a) Current (b) 2011-2040

(c) 2041-2070 (d) 2071-2100

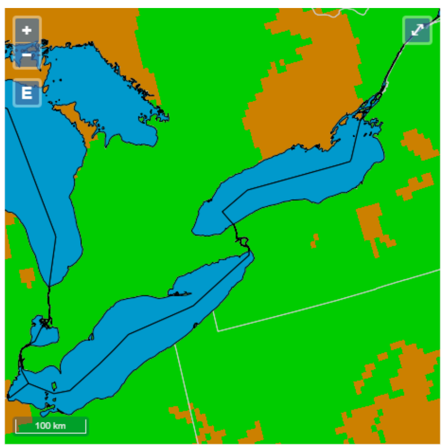
Figure A.1: Western hemlock distribution in Vancouver under RCP 8.5 [W m^{-2}] [99]



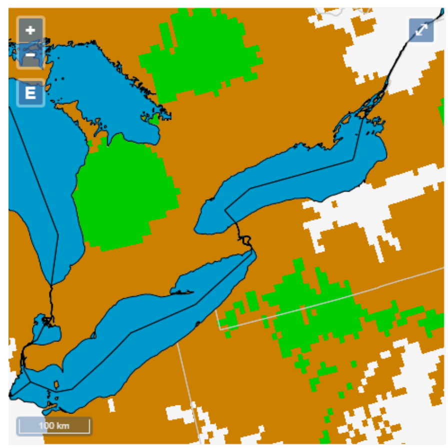
(a) Current



(b) 2011-2040



(c) 2041-2070



(d) 2071-2100

Figure A.2: Red maple distribution in Toronto under RCP 8.5 [W m^{-2}] [99]

A.2 ASHRAE Climate Zones

Zone	Range
0	$6000 < \text{CDD}10°\text{C}$
1	$5000 < \text{CDD}10°\text{C} \leq 6000$
2	$3500 < \text{CDD}10°\text{C} \leq 5000$
3	$\text{CDD}10°\text{C} < 3500$ and $\text{HDD}18°\text{C} \leq 2000$
4	$\text{CDD}10°\text{C} < 3500$ and $2000 < \text{HDD}18°\text{C} \leq 3000$
5	$\text{CDD}10°\text{C} < 3500$ and $3000 < \text{HDD}18°\text{C} \leq 4000$
6	$4000 < \text{HDD}18°\text{C} \leq 5000$
7	$5000 < \text{HDD}18°\text{C} \leq 7000$
8	$7000 < \text{HDD}18°\text{C}$

Table A.1: ASHRAE climate zone range definition for Cooling Degree Days (CDDs) and Heating Degree Days (HDDs) from ASHRAE Standard 90.1 Table Annex1-4 [7]

Appendix B

Chapter 2 Supplement

B.1 Vegetation

B.1.1 Vancouver LAI and LAD

Month	LAI [m^2 m^{-2}]	LAD Profile 0-6 [m^2 m^{-3}]
Jan	0.35	0, 0.12, 0.10, 0.07, 0.03, 0.02, 0
Feb	0.34	0, 0.12, 0.10, 0.07, 0.03, 0.02, 0
Mar	0.34	0, 0.12, 0.10, 0.07, 0.03, 0.02, 0
Apr	0.38	0, 0.13, 0.11, 0.08, 0.04, 0.02, 0
May	0.42	0, 0.14, 0.12, 0.08, 0.04, 0.02, 0
Jun	0.45	0, 0.15, 0.14, 0.09, 0.05, 0.03, 0
Jul	<u>0.50</u>	0, 0.17, 0.15, 0.10, 0.05, 0.03, 0
Aug	0.42	0, 0.14, 0.13, 0.08, 0.04, 0.03, 0
Sep	0.44	0, 0.15, 0.13, 0.09, 0.04, 0.03, 0
Oct	0.40	0, 0.13, 0.12, 0.08, 0.04, 0.02, 0
Nov	0.38	0, 0.13, 0.11, 0.08, 0.04, 0.02, 0
Dec	0.37	0, 0.12, 0.11, 0.07, 0.04, 0.02, 0

Table B.1: Vancouver: one tree.

Month	LAI [m^2 m^{-2}]	LAD Profile 0-6 [m^2 m^{-3}]
Jan	0.69	0, 0.24, 0.21, 0.14, 0.07, 0.04, 0
Feb	0.68	0, 0.23, 0.20, 0.14, 0.07, 0.04, 0
Mar	0.69	0, 0.23, 0.21, 0.14, 0.07, 0.04, 0
Apr	0.75	0, 0.26, 0.23, 0.15, 0.08, 0.05, 0
May	0.83	0, 0.28, 0.25, 0.17, 0.08, 0.05, 0
Jun	0.90	0, 0.31, 0.27, 0.18, 0.09, 0.05, 0
Jul	$\underline{1.00}$	0, 0.34, 0.30, 0.20, 0.10, 0.06, 0
Aug	0.84	0, 0.28, 0.25, 0.17, 0.08, 0.05, 0
Sep	0.88	0, 0.30, 0.27, 0.18, 0.09, 0.05, 0
Oct	0.79	0, 0.27, 0.24, 0.16, 0.08, 0.05, 0
Nov	0.75	0, 0.26, 0.23, 0.15, 0.08, 0.05, 0
Dec	0.73	0, 0.25, 0.22, 0.15, 0.07, 0.04, 0

Table B.2: Vancouver: two trees.

Month	LAI [m^2 m^{-2}]	LAD Profile 0-6 [m^2 m^{-3}]
Jan	1.04	0, 0.28, 0.28, 0.23, 0.16, 0.09, 0
Feb	1.02	0, 0.28, 0.27, 0.22, 0.16, 0.09, 0
Mar	1.03	0, 0.28, 0.28, 0.23, 0.16, 0.09, 0
Apr	1.13	0, 0.31, 0.30, 0.25, 0.17, 0.10, 0
May	1.25	0, 0.34, 0.33, 0.27, 0.19, 0.11, 0
Jun	1.36	0, 0.37, 0.36, 0.30, 0.21, 0.12, 0
Jul	$\underline{1.50}$	0, 0.41, 0.40, 0.33, 0.23, 0.13, 0
Aug	1.25	0, 0.34, 0.33, 0.28, 0.19, 0.11, 0
Sep	1.33	0, 0.36, 0.35, 0.29, 0.20, 0.11, 0
Oct	1.19	0, 0.33, 0.32, 0.26, 0.18, 0.10, 0
Nov	1.13	0, 0.31, 0.30, 0.25, 0.17, 0.10, 0
Dec	1.10	0, 0.30, 0.29, 0.24, 0.17, 0.09, 0

Table B.3: Vancouver: three trees.

B.1.2 Toronto LAI and LAD

Month	LAI [m^2 m^{-2}]	LAD Profile 0-6 [m^2 m^{-3}]
Jan	0.36	0, 0.08, 0.10, 0.10, 0.08, 0
Feb	0.36	0, 0.08, 0.10, 0.10, 0.08, 0
Mar	0.36	0, 0.08, 0.10, 0.10, 0.08, 0
Apr	0.40	0, 0.09, 0.11, 0.11, 0.09, 0
May	0.44	0, 0.10, 0.12, 0.12, 0.10, 0
Jun	0.49	0, 0.11, 0.13, 0.13, 0.11, 0
Jul	<u>0.50</u>	0, 0.12, 0.14, 0.14, 0.12, 0
Aug	0.50	0, 0.11, 0.13, 0.13, 0.11, 0
Sep	0.46	0, 0.11, 0.12, 0.12, 0.11, 0
Oct	0.41	0, 0.09, 0.11, 0.11, 0.09, 0
Nov	0.39	0, 0.09, 0.10, 0.10, 0.09, 0
Dec	0.37	0, 0.08, 0.10, 0.10, 0.08, 0

Table B.4: Toronto: one trees.

Month	LAI [m^2 m^{-2}]	LAD Profile 0-6 [m^2 m^{-3}]
Jan	0.72	0, 0.17, 0.19, 0.19, 0.17, 0
Feb	0.72	0, 0.17, 0.19, 0.19, 0.17, 0
Mar	0.72	0, 0.17, 0.19, 0.19, 0.17, 0
Apr	0.80	0, 0.18, 0.22, 0.22, 0.18, 0
May	0.89	0, 0.20, 0.24, 0.24, 0.20, 0
Jun	0.98	0, 0.22, 0.26, 0.26, 0.22, 0
Jul	<u>1.00</u>	0, 0.23, 0.27, 0.27, 0.23, 0
Aug	0.99	0, 0.23, 0.27, 0.27, 0.23, 0
Sep	0.92	0, 0.21, 0.25, 0.25, 0.21, 0
Oct	0.82	0, 0.19, 0.22, 0.22, 0.19, 0
Nov	0.78	0, 0.18, 0.21, 0.21, 0.18, 0
Dec	0.74	0, 0.17, 0.20, 0.20, 0.17, 0

Table B.5: Toronto: two trees.

Month	LAI [m^2 m^{-2}]	LAD Profile 0-6 [m^2 m^{-3}]
Jan	1.08	0, 0.26, 0.28, 0.28, 0.26, 0
Feb	1.08	0, 0.26, 0.28, 0.28, 0.26, 0
Mar	1.08	0, 0.26, 0.28, 0.28, 0.26, 0
Apr	1.20	0, 0.29, 0.31, 0.31, 0.29, 0
May	1.33	0, 0.32, 0.35, 0.35, 0.32, 0
Jun	1.46	0, 0.35, 0.38, 0.38, 0.35, 0
Jul	$\underline{1.50}$	0, 0.36, 0.39, 0.39, 0.36, 0
Aug	1.49	0, 0.36, 0.39, 0.39, 0.36, 0
Sep	1.38	0, 0.33, 0.36, 0.36, 0.33, 0
Oct	1.24	0, 0.30, 0.32, 0.32, 0.30, 0
Nov	1.16	0, 0.28, 0.30, 0.30, 0.28, 0
Dec	1.10	0, 0.27, 0.29, 0.29, 0.27, 0

Table B.6: Toronto: three trees.

B.2 VWFG Outputs

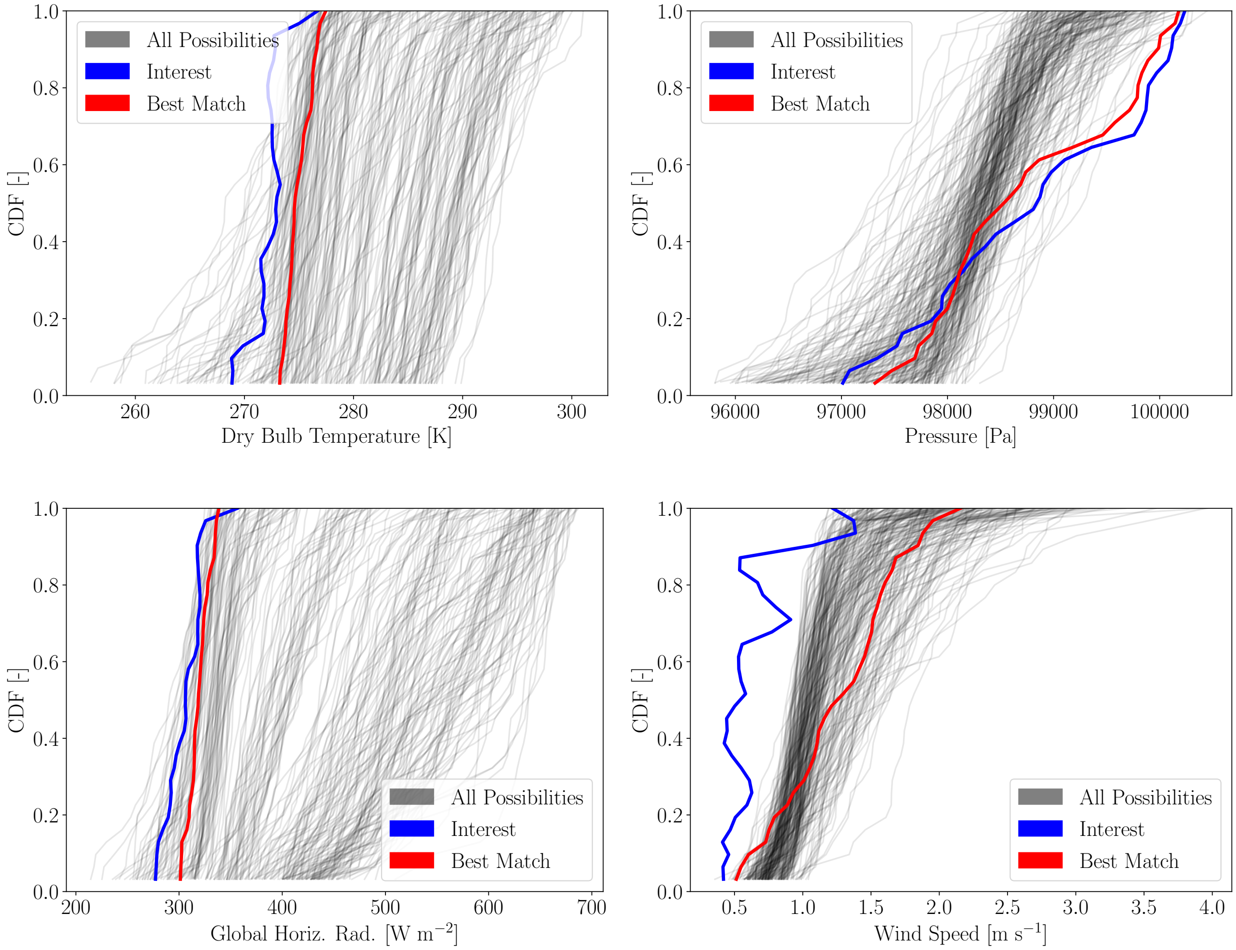


Figure B.1: Matching a historical month to December 2009 for each weather variable under RCP 8.5 [W m^{-2}] in Vancouver. Matching year and month: 1999 December

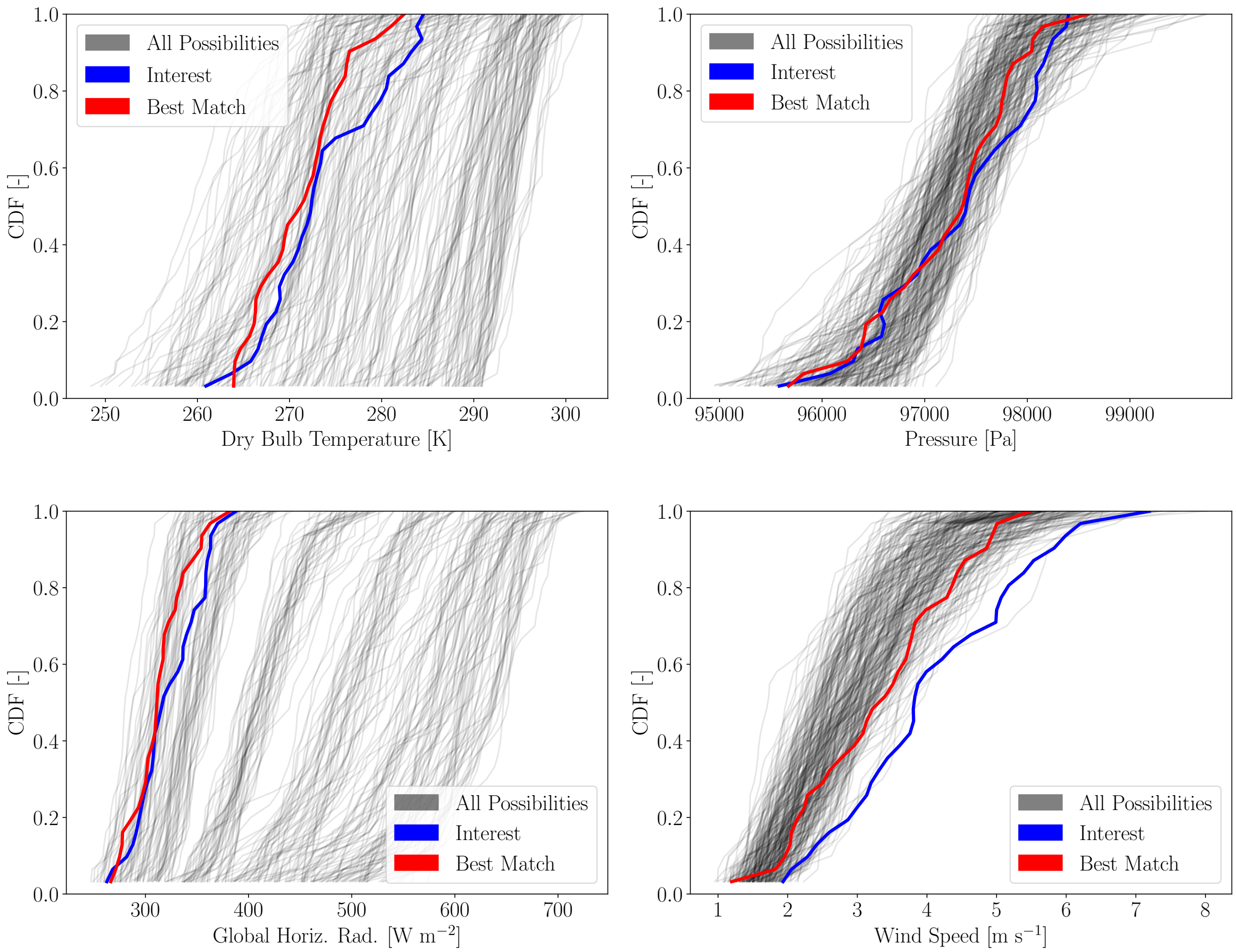


Figure B.2: Matching a historical month to December 2009 for each weather variable under RCP 8.5 [W m^{-2}] in Toronto. Matching year and month: 1999 December

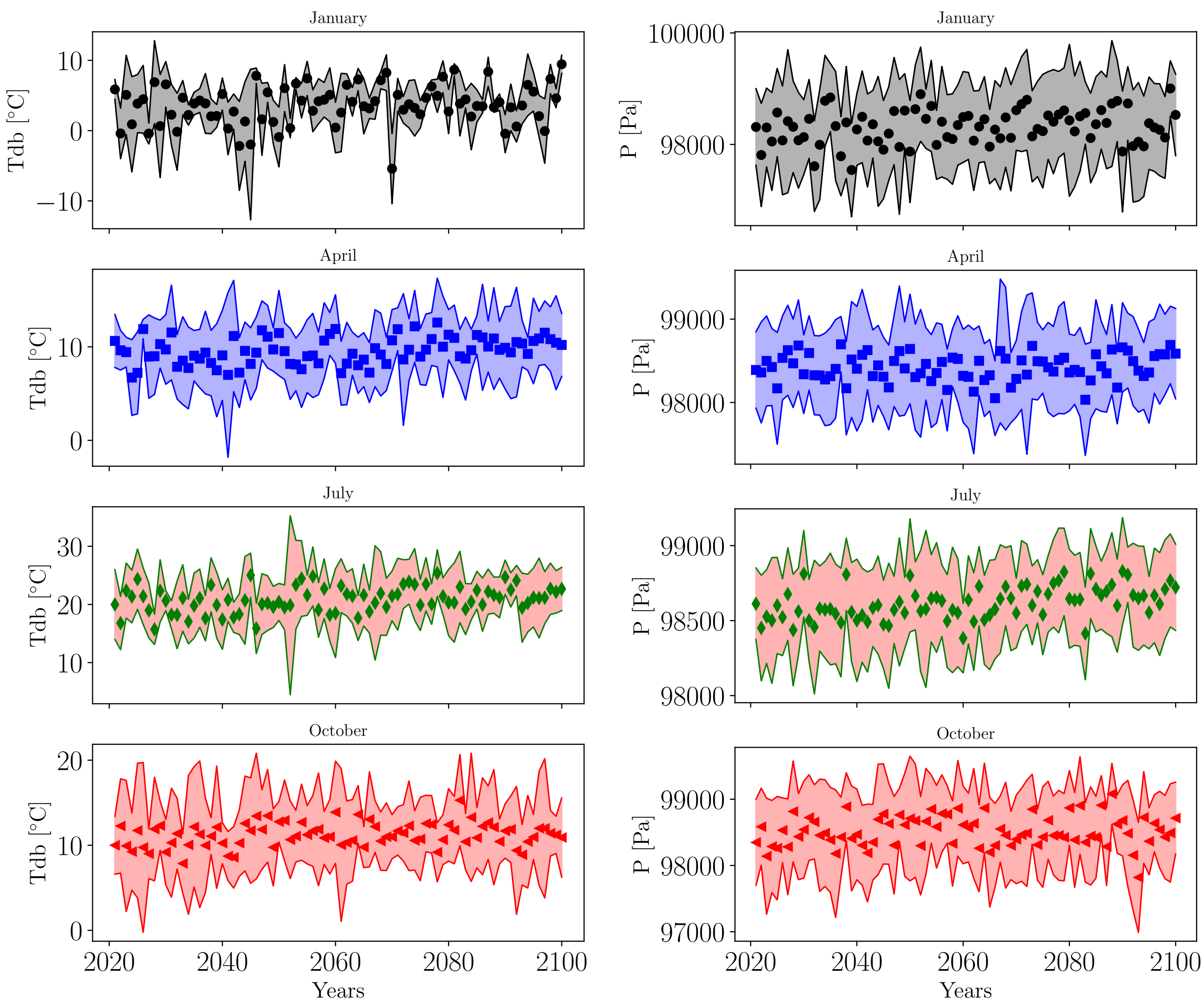


Figure B.3: Time series of matched and corrected historical month to December 2009 for temperature [°C] and pressure [Pa]. Matching year: 1988 Matching Month:January

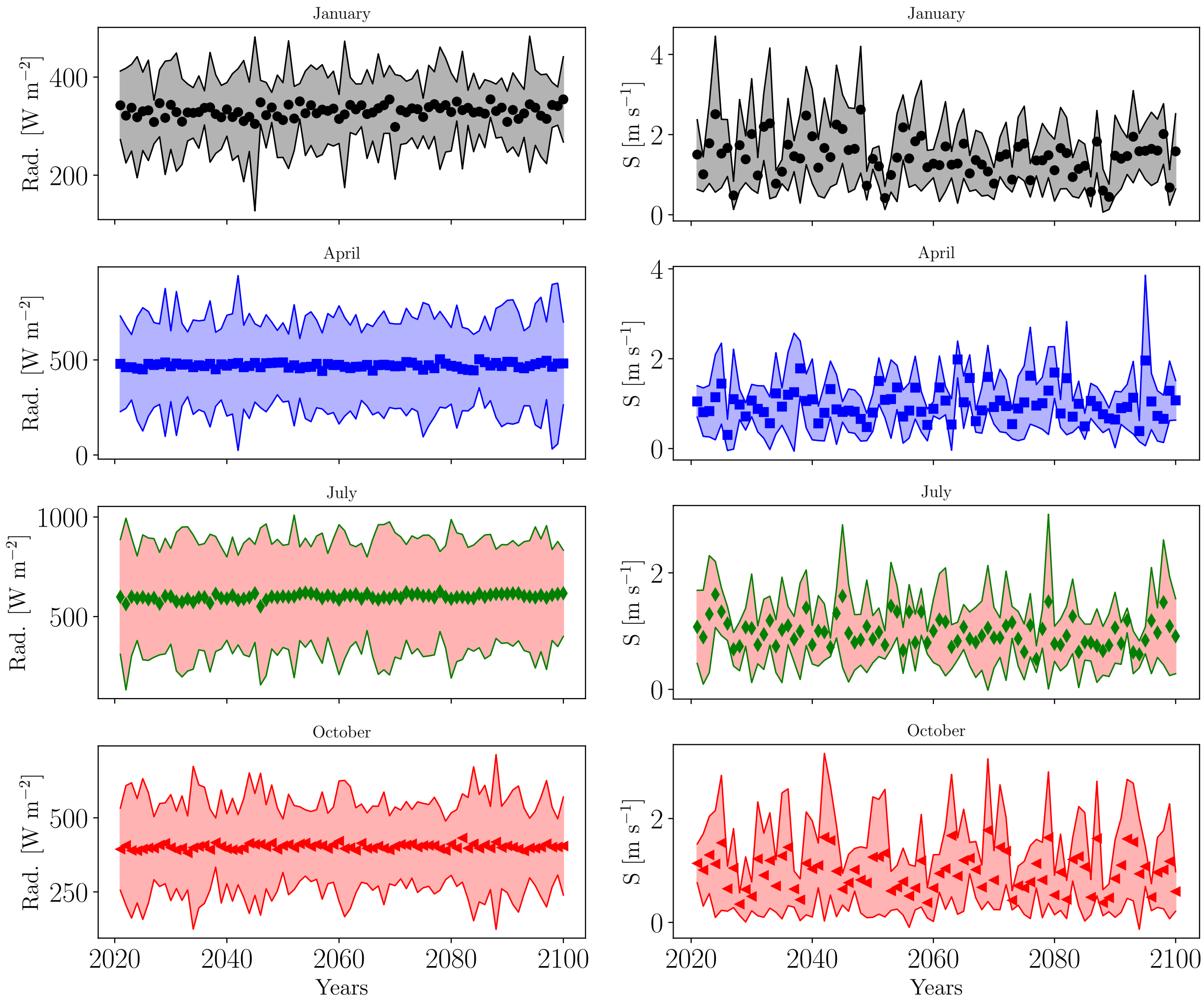


Figure B.4: Time series of matched and corrected historical month to December 2009 for radiation [W m^{-2}] and wind speed [m s^{-1}]. Matching year: 1988 Matching Month:January

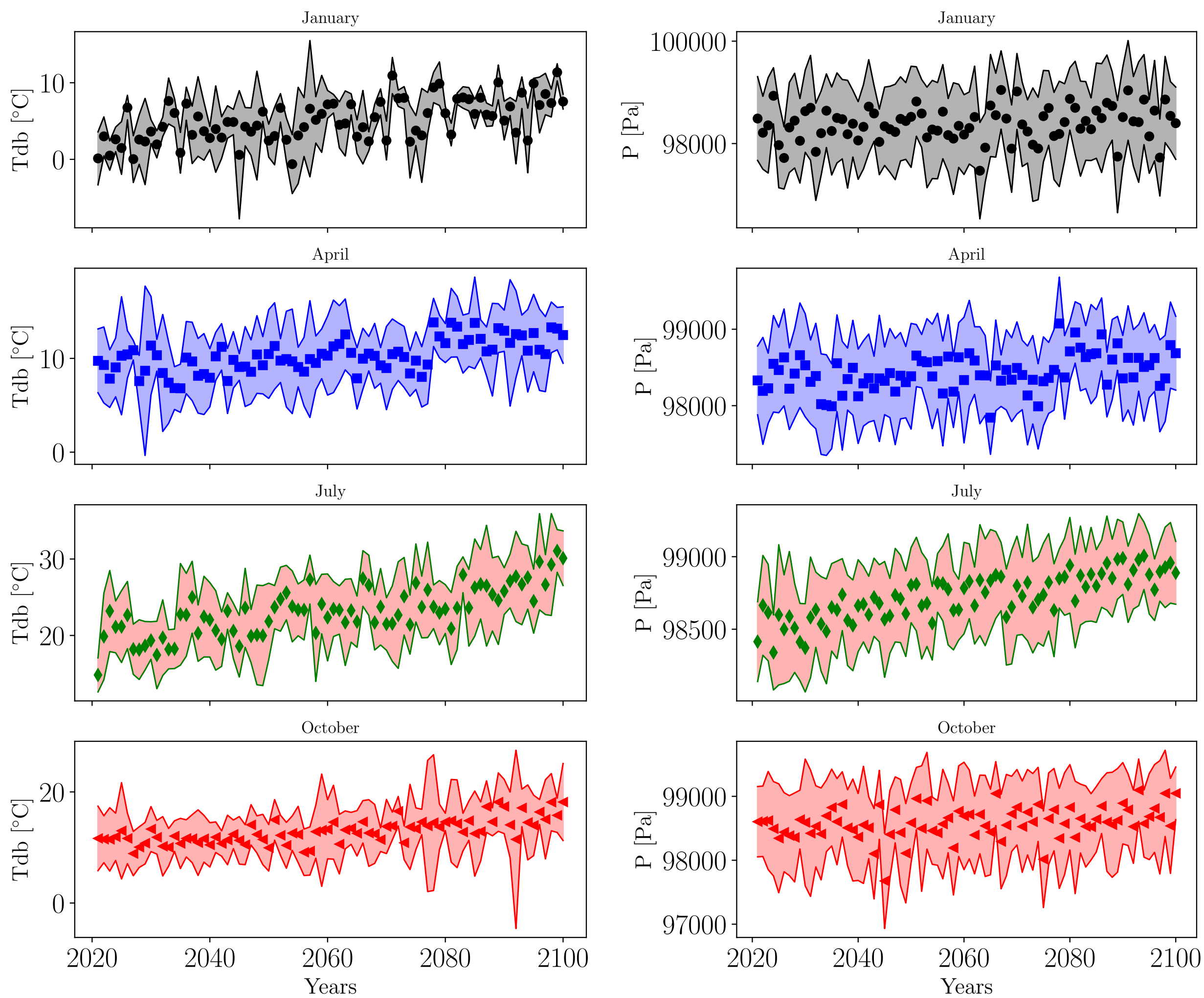


Figure B.5: Time series of matched and corrected historical month to December 2009 for temperature [°C] and pressure [Pa]. Matching year: 1999 Matching Month:December

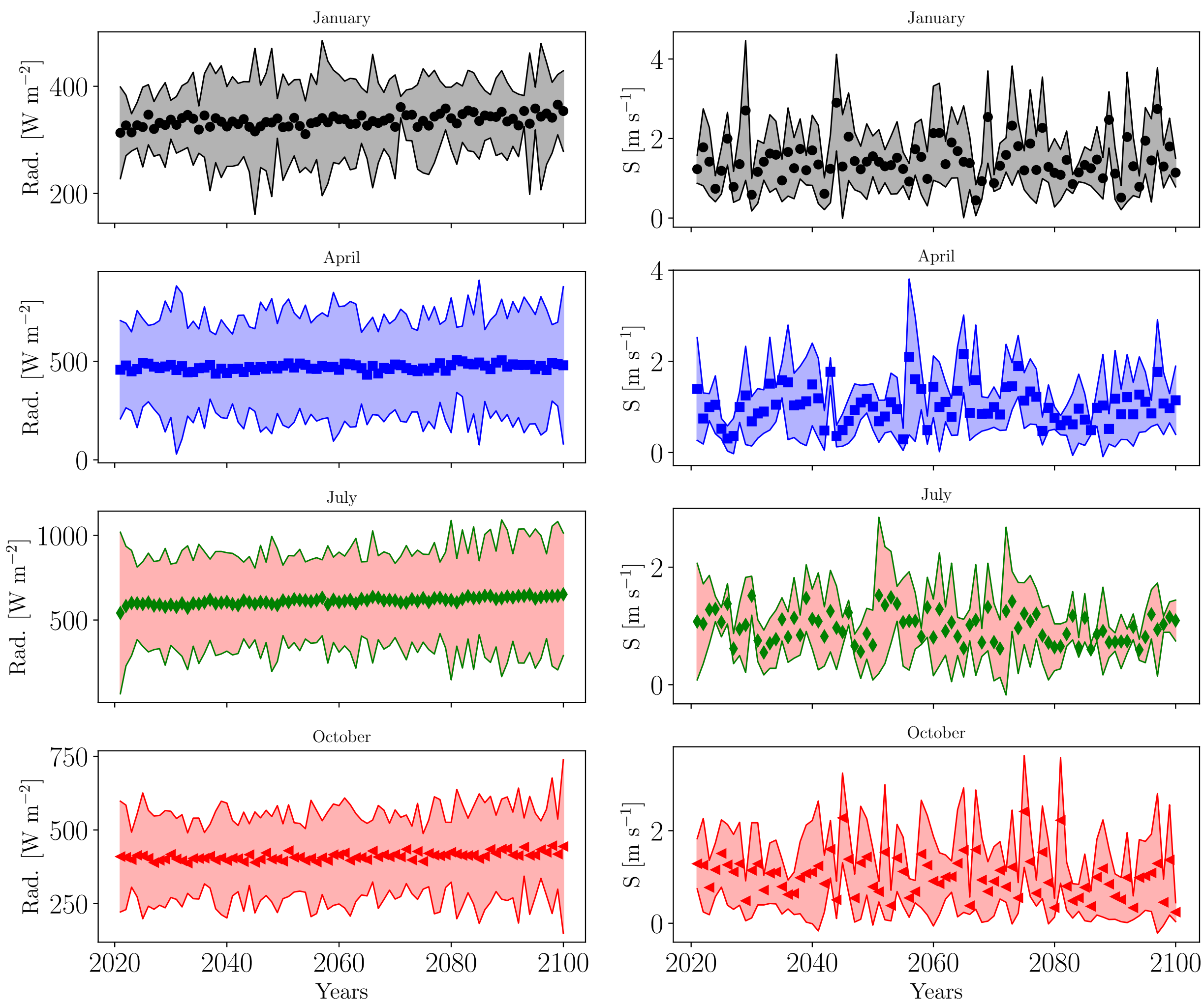


Figure B.6: Time series of matched and corrected historical month to December 2009 for radiation [W m^{-2}] and wind speed [m s^{-1}]. Matching year: 1999 Matching Month:December

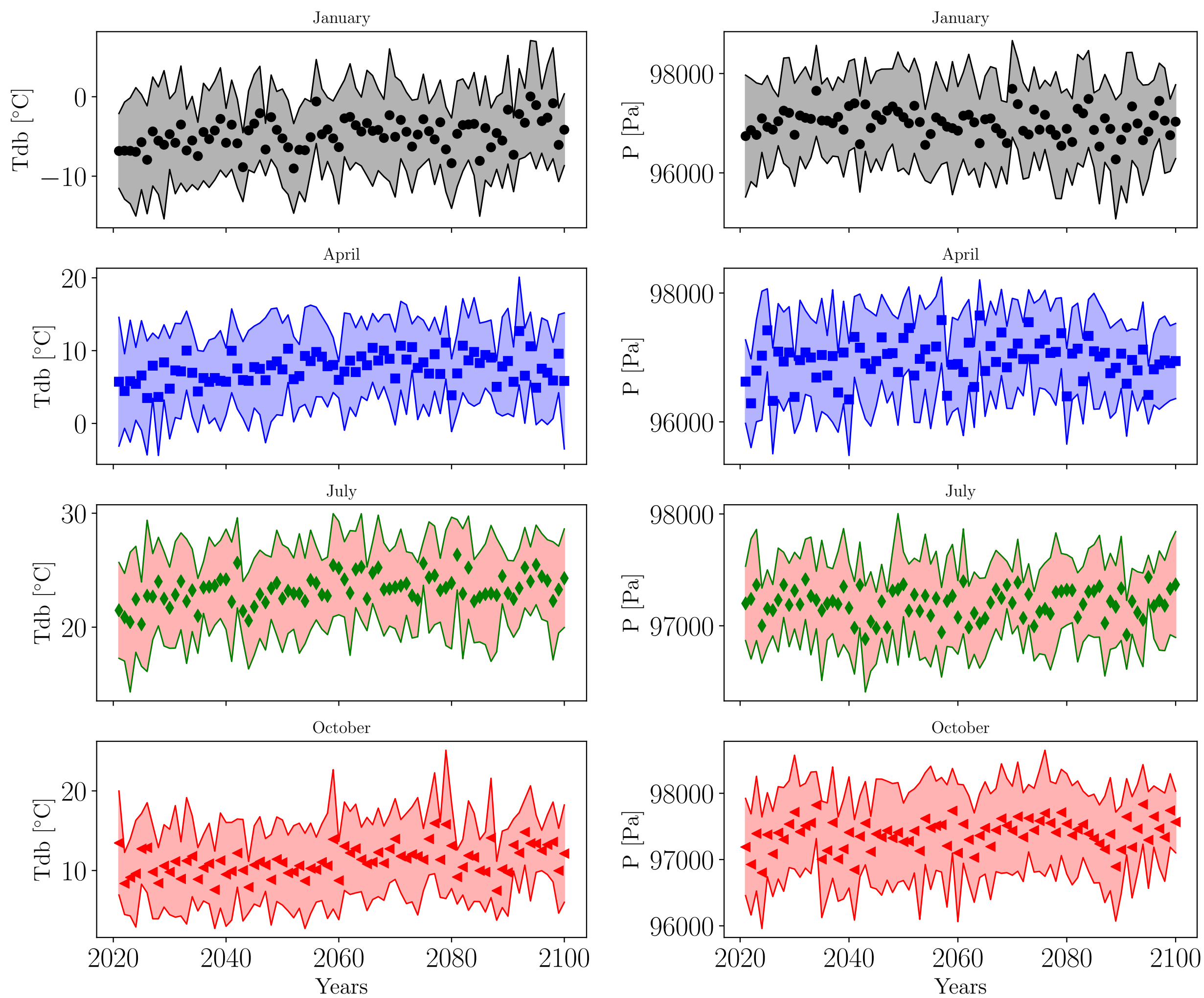


Figure B.7: Time series of matched and corrected historical month to December 2009 for temperature [°C] and pressure [Pa]. Matching year: 1992 Matching Month:December

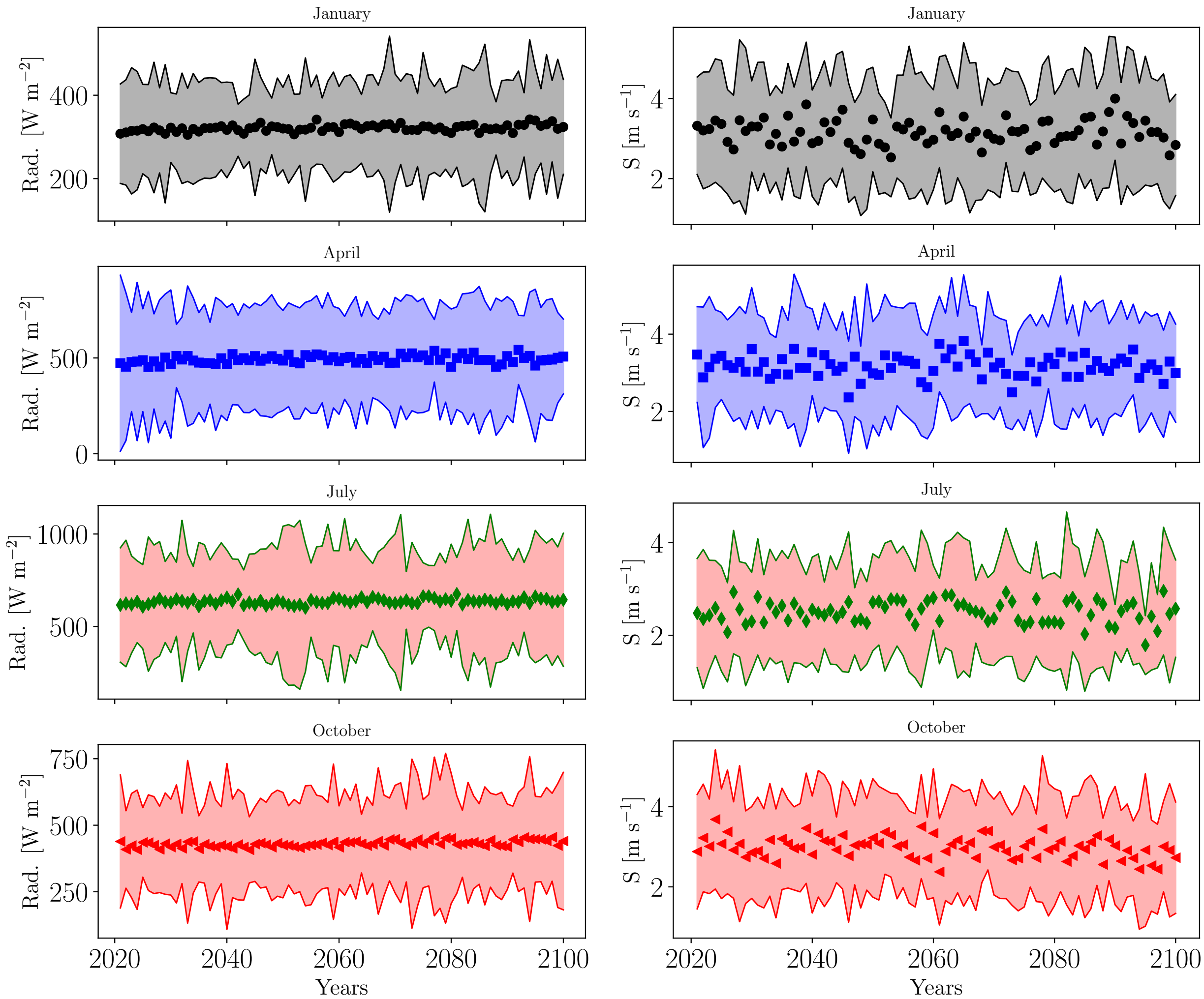


Figure B.8: Time series of matched and corrected historical month to December 2009 for radiation [W m^{-2}] and wind speed [m s^{-1}]. Matching year: 1992 Matching Month:December

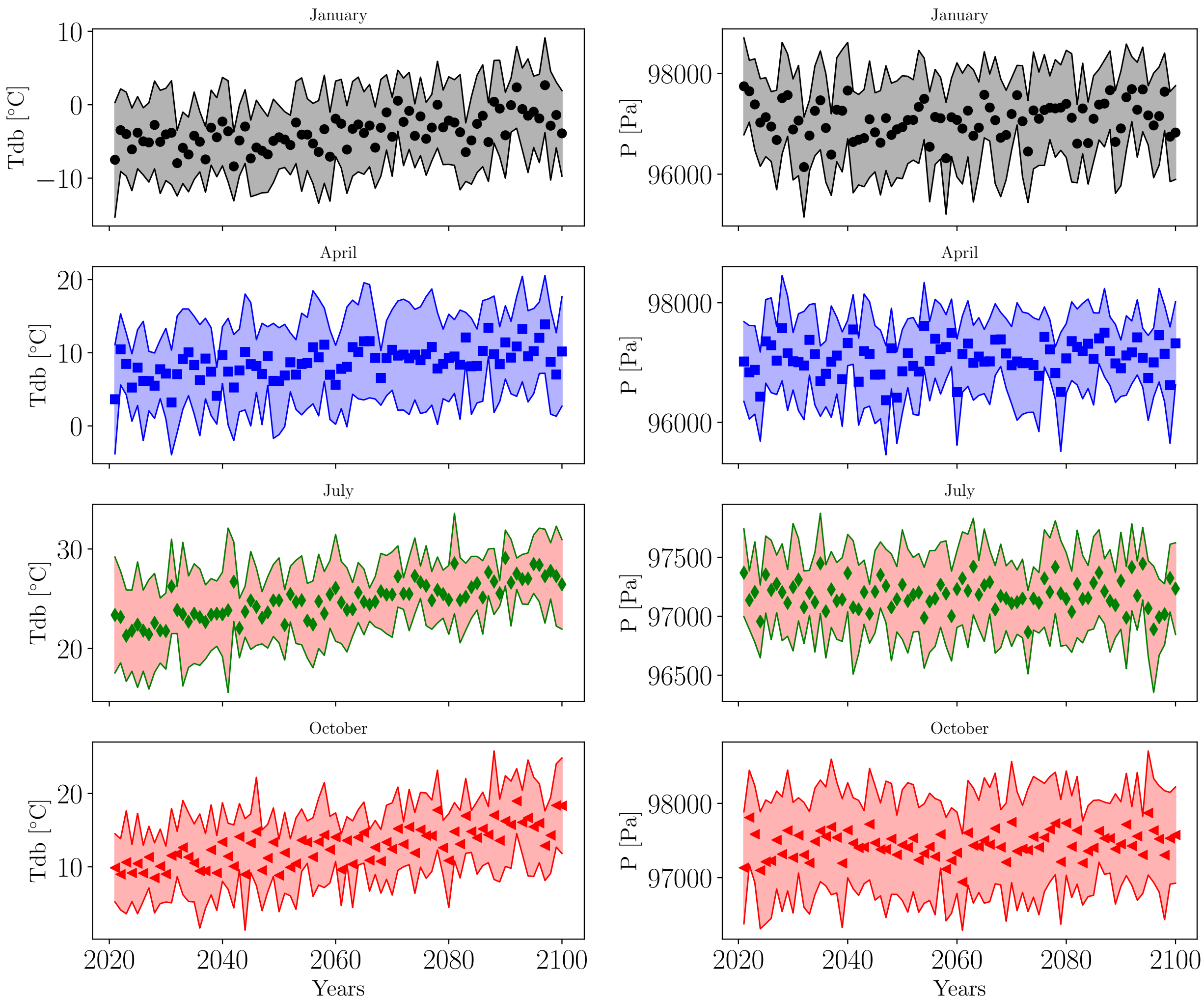


Figure B.9: Time series of matched and corrected historical month to December 2009 for temperature [°C] and pressure [Pa]. Matching year: 1999 Matching Month:December

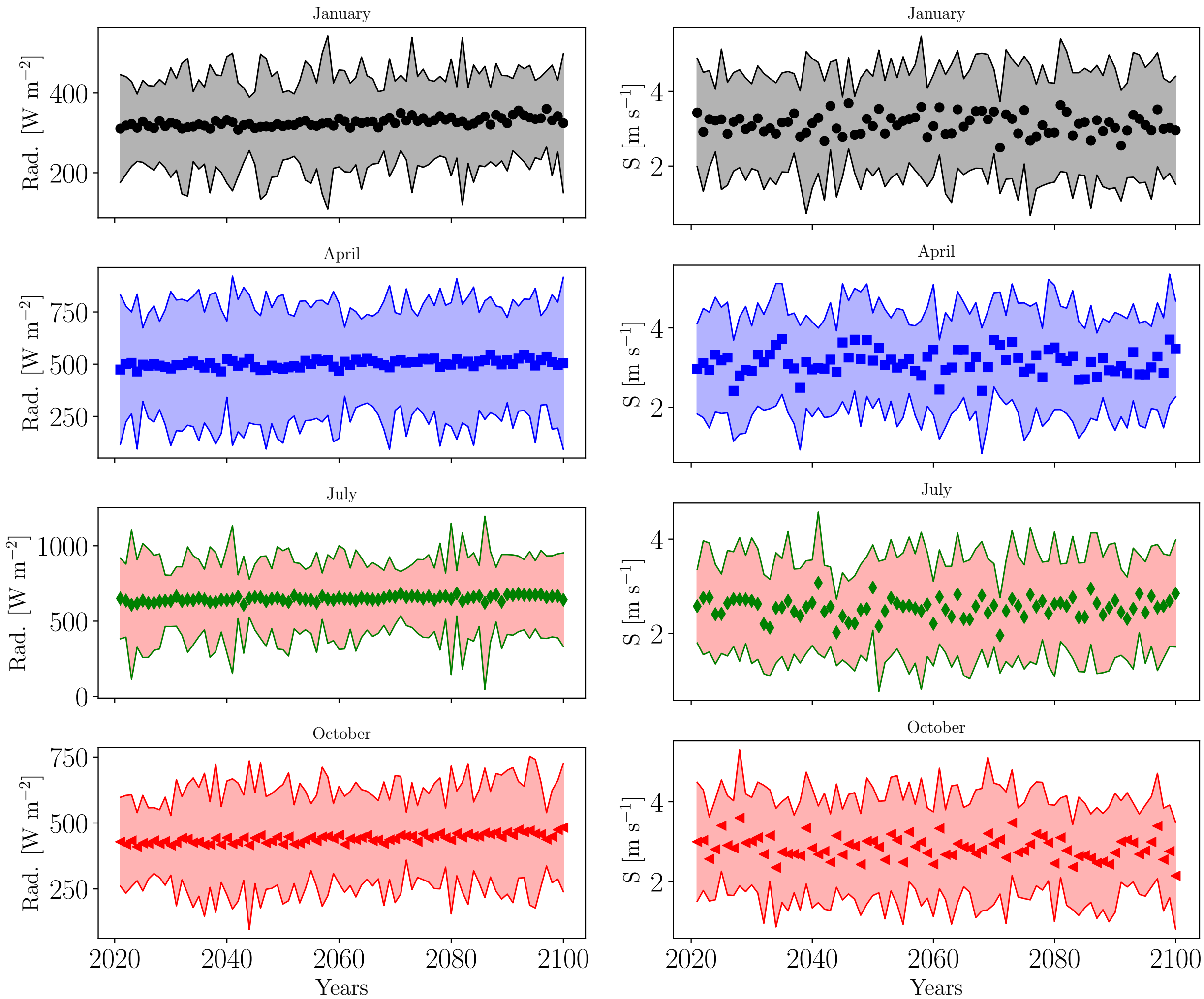


Figure B.10: Time series of matched and corrected historical month to December 2009 for radiation [W m^{-2}] and wind speed [m s^{-1}]. Matching year: 1999 Matching Month:December

Appendix C

Chapter 3 Supplement

C.1 Cost and Carbon Results

Retrofit	Year	TotalGasConsumpHeat [m^3 m^{-2}]	TotalElecCoolDemand [kW-hr m^{-2}]	CO_2e Savings [Tonnes]	Annualized Cost Savings (%)
Base	2020	25.43	18.93		
Base	2040	22.56	17.68		
Base	2060	16.69	13.05		
Base	2080	15.43	20.73		
Base	2100	16.33	22.20		
VegH	2020	25.58	17.7	-1.21	1.51
VegH	2040	22.68	16.6	-0.95	1.66
VegH	2060	16.82	12.35	-1.10	1.89
VegH	2080	15.57	19.61	-1.13	1.84
VegH	2100	16.45	20.93	-0.92	1.83
VegHH	2020	25.72	16.75	-2.37	-0.89
VegHH	2040	22.79	15.74	-1.84	-0.84
VegHH	2060	16.94	11.81	-2.12	-1.01
VegHH	2080	15.70	18.72	-2.21	-1.03
VegHH	2100	16.56	19.91	-1.79	-0.92
RvalH	2020	24.58	18.07	8.11	-3.22
RvalH	2040	21.73	16.81	7.93	-3.45
RvalH	2060	16.05	12.35	6.12	-4.39
RvalH	2080	14.81	19.73	5.97	-4.35
RvalH	2100	15.69	21.11	6.17	-4.19
InfLL	2020	10.13	25.92	142.94	28.51
InfLL	2040	8.73	24.38	129.15	27.48
InfLL	2060	5.69	21.31	102.32	25.61
InfLL	2080	4.82	27.92	98.80	24.33
InfLL	2100	5.42	29.6	101.59	24.29
InfL	2020	15.51	22.59	92.80	20.48
InfL	2040	13.57	21.16	84.07	19.97
InfL	2060	9.48	17.36	67.22	19.21
InfL	2080	8.44	24.39	65.24	18.40
InfL	2100	9.16	26.03	66.91	18.28
CR	2020	25.67	18.33	-2.17	-1.87
CR	2040	22.78	17.18	-2.00	-1.94
CR	2060	16.93	12.54	-2.19	-2.28
CR	2080	15.64	20.08	-1.89	-2.18
CR	2100	16.58	21.54	-2.26	-2.2
PVH	2020	25.43	18.93	4.70	-2.02
PVH	2040	22.56	17.68	4.22	-3.9
PVH	2060	16.69	13.05	3.69	-6.8
PVH	2080	15.43	20.73	4.37	-3.79
PVH	2100	16.33	22.2	4.79	-1.98
PVHH	2020	25.43	18.93	9.26	-10.25
PVHH	2040	22.56	17.68	8.33	-14.34
PVHH	2060	16.69	13.05	7.27	-21.07
PVHH	2080	15.43	20.73	8.63	-14.99
PVHH	2100	16.33	22.2	9.44	-11.24
Comb.	2020	10.21	24.37	142.43	26.29
Comb.	2040	8.79	23.04	128.80	25.16
Comb.	2060	5.05	27.33	107.53	24.45
Comb.	2080	4.87	26.42	98.56	21.73
Comb.	2100	5.47	28.01	101.37	21.76

Table C.1: Economic and CO_2e emissions analysis results for RCP 4.5 [W m^{-2}]

Retrofit	Year	TotalGasConsumpHeat [m^3 m^{-2}]	TotalElecCoolDemand [kW-hr m^{-2}]	CO_2e Savings [Tonnes]	Annualized Cost Savings (%)
Base	2020	25.43	18.93		
Base	2040	21.27	22.24		
Base	2060	17.34	27.15		
Base	2080	13.49	22.85		
Base	2100	10.8	55.2		
VegH	2020	25.58	17.7	-1.21	1.51
VegH	2040	21.42	21.07	-1.22	1.61
VegH	2060	17.44	25.91	-0.74	1.78
VegH	2080	13.6	21.87	-0.87	1.96
VegH	2100	10.87	53.6	-0.41	1.8
VegHH	2020	25.72	16.75	-2.37	-0.89
VegHH	2040	21.57	20.15	-2.48	-0.97
VegHH	2060	17.55	24.9	-1.61	-0.84
VegHH	2080	13.71	21.09	-1.77	-0.95
VegHH	2100	10.94	52.32	-0.86	-0.69
RvalH	2020	24.58	18.07	8.11	-3.22
RvalH	2040	20.49	21.34	7.46	-3.54
RvalH	2060	16.27	25.98	10.23	-3.15
RvalH	2080	12.93	21.82	5.41	-4.61
RvalH	2100	10.34	53.56	4.55	-4.25
InfLL	2020	10.13	25.92	142.94	28.51
InfLL	2040	7.84	28.23	125.49	26.75
InfLL	2060	6.02	32.31	105.76	23.97
InfLL	2080	4.18	30.23	86.54	22.22
InfLL	2100	3.26	54.27	71.05	16.19
InfL	2020	15.51	22.59	92.80	20.48
InfL	2040	12.51	25.82	81.90	19.56
InfL	2060	9.97	29.75	68.96	17.82
InfL	2080	7.31	26.62	57.60	17.18
InfL	2100	5.8	53.94	47.20	12.88
CR	2020	25.67	18.33	-2.17	-1.87
CR	2040	21.5	21.68	-2.09	-1.96
CR	2060	17.53	26.4	-1.68	-1.98
CR	2080	13.71	22.07	-1.96	-2.27
CR	2100	9.67	51.87	-1.26	-1.86
PVH	2020	25.43	18.93	4.70	-2.02
PVH	2040	21.27	22.24	4.61	-2.47
PVH	2060	17.34	27.15	4.57	-2.75
PVH	2080	13.49	22.85	4.49	-3.41
PVH	2100	10.8	55.2	4.69	-2.22
PVHH	2020	25.43	18.93	9.26	-10.25
PVHH	2040	21.27	22.24	9.09	-11.51
PVHH	2060	17.34	27.15	9.01	-12.4
PVHH	2080	13.49	22.85	8.85	-14.48
PVHH	2100	10.8	55.2	9.26	-11.20
Comb.	2020	25.43	24.37	142.43	26.29
Comb.	2040	21.27	26.7	125.07	24.41
Comb.	2060	17.34	30.82	105.52	21.55
Comb.	2080	13.49	28.94	86.37	19.56
Comb.	2100	10.8	52.41	71.14	13.89

Table C.2: Economic and CO_2e emissions analysis results for RCP 8.5 [W m^{-2}]

Retrofit	Year	TotalGasConsumpHeat [m^3 m^{-2}]	TotalElecCoolDemand [kW-hr m^{-2}]	CO_2e Savings [Tonnes]	Annualized Cost Savings (%)
Base	2020	26.16	27.95		
Base	2040	27.5	31.36		
Base	2060	28.62	37.71		
Base	2080	26.62	39.98		
Base	2100	25.1	44.12		
VegH	2020	26.35	26.32	-1.08	0.30
VegH	2040	27.66	29.88	-0.89	0.33
VegH	2060	28.81	36.03	-1.08	0.28
VegH	2080	26.79	38.15	-0.91	0.31
VegH	2100	25.3	42.50	-1.16	0.27
VegHH	2020	26.52	25.04	-2.08	-2.05
VegHH	2040	27.79	28.73	-1.62	-1.88
VegHH	2060	28.98	34.69	-2.06	-1.89
VegHH	2080	26.95	36.73	-1.81	-1.88
VegHH	2100	25.47	41.25	-2.16	-1.93
RvalH	2020	25.28	27.37	6.43	-3.44
RvalH	2040	26.56	30.49	6.91	-3.24
RvalH	2060	27.65	36.74	7.14	-3.05
RvalH	2080	25.73	38.88	6.58	-3.21
RvalH	2100	20.62	43.31	32.39	1.6
InfLL	2020	11.31	36.46	105.60	21.65
InfLL	2040	12.20	37.31	109.24	21.5
InfLL	2060	12.59	42.2	114.73	21.49
InfLL	2080	11.96	45.71	104.67	20
InfLL	2100	10.75	47.38	102.82	19.59
InfL	2020	16.55	32.66	68.46	15.55
InfL	2040	17.66	34.57	70.35	15.31
InfL	2060	18.31	40.07	73.87	15.24
InfL	2080	17.19	43.08	67.42	14.30
InfL	2100	15.81	45.60	66.67	14.12
CR	2020	26.33	27.38	-1.13	-1.58
CR	2040	27.66	30.74	-1.05	-1.51
CR	2060	28.78	36.99	-1.04	-1.45
CR	2080	26.76	39.20	-0.89	-1.44
CR	2100	25.27	43.41	-1.11	-1.48
PVH	2020	26.16	27.95	6.12	6.92
PVH	2040	27.50	31.36	5.48	4.63
PVH	2060	28.62	37.71	5.90	5.69
PVH	2080	26.62	39.98	6.27	6.93
PVH	2100	25.10	44.12	6.18	6.68
PVHH	2020	26.16	27.95	12.06	8.60
PVHH	2040	27.5	31.36	10.80	4.25
PVHH	2060	28.62	37.71	11.63	6.28
PVHH	2080	26.62	39.98	12.36	8.95
PVHH	2100	25.1	44.12	12.19	8.44
Comb.	2020	11.41	34.50	117.28	25.40
Comb.	2040	12.30	35.58	114.30	21.53
Comb.	2060	12.71	40.25	125.82	23.58
Comb.	2080	12.07	43.62	116.58	24.39
Comb.	2100	9.99	44.46	120.97	17.96

Table C.3: Economic and CO_2e emissions analysis results for RCP 4.5 [W m^{-2}]

Retrofit	Year	TotalGasConsumpHeat [m^3 m^{-2}]	TotalElecCoolDemand [kW-hr m^{-2}]	CO_2e Savings [Tonnes]	Annualized Cost Savings (%)
Base	2020	26.16	27.95		
Base	2040	23.65	34.37		
Base	2060	22.63	46.26		
Base	2080	23.25	50.41		
Base	2100	19.97	54.63		
VegH	2020	26.35	26.32	-1.08	0.3
VegH	2040	23.83	32.67	-1.00	0.32
VegH	2060	22.81	44.13	-0.93	0.3
VegH	2080	23.43	48.2	-0.92	0.29
VegH	2100	20.12	52.77	-0.76	0.34
VegHH	2020	26.52	25.04	-0.76	-2.05
VegHH	2040	23.99	31.36	-2.08	-2.03
VegHH	2060	22.97	42.49	-1.92	-1.94
VegHH	2080	23.59	46.47	-1.80	-1.88
VegHH	2100	20.26	51.34	-1.78	-1.86
RvalH	2020	25.28	27.37	6.43	-3.44
RvalH	2040	22.84	33.58	5.96	-3.55
RvalH	2060	21.79	45.36	6.19	-3.35
RvalH	2080	22.45	49.16	5.96	-3.31
RvalH	2100	19.28	53.42	5.16	-3.54
InfLL	2020	11.31	36.46	105.60	21.65
InfLL	2040	9.97	41.38	97.41	20.03
InfLL	2060	9.51	50.94	93.74	18.36
InfLL	2080	9.97	54.52	94.99	18.05
InfLL	2100	8.41	55.96	83.04	16.13
InfL	2020	16.55	32.66	68.46	15.55
InfL	2040	14.79	38.14	63.21	14.51
InfL	2060	14.13	48.59	60.84	13.36
InfL	2080	14.69	52.57	61.30	13.06
InfL	2100	12.5	55.04	53.73	11.89
CR	2020	26.33	27.38	-1.13	-1.58
CR	2040	23.81	33.71	-1.05	-1.57
CR	2060	22.78	45.54	-0.97	-1.49
CR	2080	23.39	49.57	-0.88	-1.43
CR	2100	20.11	53.86	-0.89	-1.47
PVH	2020	26.16	27.95	6.12	6.92
PVH	2040	23.65	34.37	5.68	5.49
PVH	2060	22.63	46.26	6.90	9.09
PVH	2080	23.25	50.41	6.68	8.17
PVH	2100	19.97	54.63	5.95	6.06
PVHH	2020	26.16	27.95	12.06	8.6
PVHH	2040	23.65	34.37	11.21	5.76
PVHH	2060	22.63	46.26	13.60	13.1
PVHH	2080	23.25	50.41	13.17	11.42
PVHH	2100	19.97	54.63	11.73	7.13
Comb.	2020	11.41	34.5	117.28	25.4
Comb.	2040	10.08	39.36	108.17	20.91
Comb.	2060	9.6	48.49	107.10	26.83
Comb.	2080	10.07	52.05	107.85	24.95
Comb.	2100	8.49	53.89	94.54	18.67

Table C.4: Economic and CO_2e emissions analysis results for RCP 8.5 [W m^{-2}]

C.2 Annual Gas and Electricity Demands

C.2.1 Vancouver

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	35.33	40.33	31.84	17.23	10.26	3.17	0.20	1.18	5.58	20.43	30.83	51.92	248.30
TotalGasConsumpHeat [m^3 m^{-2}]	3.62	4.13	3.26	1.77	1.05	0.32	0.02	0.12	0.57	2.09	3.16	5.32	25.43
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.02	4.40	3.74	16.18	18.28	13.09	3.34	0.17	0.02	0.00	59.24
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.01	1.41	1.19	5.17	5.84	4.18	1.07	0.06	0.00	0.00	18.93
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.76	4.96	5.49	5.00	4.73	4.18	3.79	3.69	3.89	4.46	4.68	5.10	54.74
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.51	0.56	0.51	0.48	0.43	0.39	0.38	0.40	0.46	0.48	0.52	5.61
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	31.04	103.79											

Table C.5: Residential Gas and Electricity Consumption/Production for Vancouver base case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	34.15	34.83	22.41	15.66	7.09	5.71	0.30	0.10	6.38	12.99	34.21	33.85	207.69
TotalGasConsumpHeat [m^3 m^{-2}]	3.50	3.57	2.30	1.60	0.73	0.58	0.03	0.01	0.65	1.33	3.50	3.47	21.27
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.98	0.01	0.46	2.81	3.88	23.24	27.96	8.97	1.28	0.00	0.00	69.60
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.31	0.00	0.15	0.90	1.24	7.43	8.93	2.87	0.41	0.00	0.00	22.24
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.08	4.76	5.25	5.00	4.58	4.37	4.14	3.78	3.88	4.41	4.75	5.20	55.20
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.49	0.54	0.51	0.47	0.45	0.42	0.39	0.40	0.45	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	26.92	107.11											

Table C.6: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] base case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	21.44	34.29	22.06	12.27	7.64	4.41	0.16	0.00	0.88	8.92	25.75	31.45	169.27
TotalGasConsumpHeat [m^3 m^{-2}]	2.20	3.51	2.26	1.26	0.78	0.45	0.02	0.00	0.09	0.91	2.64	3.22	17.34
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	1.13	3.18	7.72	25.54	27.12	18.32	1.82	0.06	0.08	84.97
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.36	1.02	2.47	8.16	8.66	5.85	0.58	0.02	0.03	27.15
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.87	5.35	5.10	4.78	4.18	4.16	3.94	3.90	4.51	4.67	5.32	55.45
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.50	0.55	0.52	0.49	0.43	0.43	0.40	0.40	0.46	0.48	0.54	5.68
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	23.02	112.02											

Table C.7: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] base case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	20.65	17.37	14.16	7.44	5.86	2.09	0.02	0.00	2.39	2.82	22.15	36.78	131.73
TotalGasConsumpHeat [m^3 m^{-2}]	2.11	1.78	1.45	0.76	0.60	0.21	0.00	0.00	0.25	0.29	2.27	3.77	13.49
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.25	0.07	0.00	2.04	2.99	5.31	24.77	16.08	18.35	1.62	0.05	0.00	71.52
TotalElecCoolDemand [kW-hr m^{-2}]	0.08	0.02	0.00	0.65	0.96	1.70	7.91	5.14	5.86	0.52	0.02	0.00	22.85
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.72	4.78	5.30	5.06	4.78	4.32	3.99	3.94	4.01	4.35	4.71	5.61	55.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.52	0.49	0.44	0.41	0.40	0.41	0.45	0.48	0.57	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	19.18	107.72											

Table C.8: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] base case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	20.96	11.13	6.40	5.33	1.55	2.54	0.00	0.00	0.00	4.78	16.22	23.96	92.87
TotalGasConsumpHeat [m^3 m^{-2}]	2.15	1.14	0.66	0.55	0.16	0.26	0.00	0.00	0.00	0.49	1.66	2.45	9.51
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.01	0.18	0.95	3.26	11.14	24.84	43.63	44.74	30.46	6.84	0.02	0.01	166.07
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.06	0.30	1.04	3.56	7.93	13.94	14.29	9.73	2.18	0.01	0.00	53.06
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.68	4.76	5.31	5.06	4.76	4.40	3.99	3.89	3.90	4.52	4.75	5.20	55.22
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.52	0.49	0.45	0.41	0.40	0.40	0.46	0.49	0.53	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	15.17	137.93											

Table C.9: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] base case 2100.

C.2.1.1 Base-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	28.25	32.91	25.23	15.90	7.90	4.62	2.14	1.52	2.40	13.89	29.62	55.92	220.31
TotalGasConsumpHeat [m^3 m^{-2}]	2.89	3.37	2.58	1.63	0.81	0.47	0.22	0.16	0.25	1.42	3.03	5.73	22.56
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.01	0.04	0.59	1.00	6.55	2.49	9.02	20.87	14.51	0.28	0.00	0.00	55.35
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.19	0.32	2.09	0.80	2.88	6.67	4.63	0.09	0.00	0.00	17.68
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.77	5.30	5.23	4.80	4.19	4.16	4.01	3.90	4.41	4.70	5.15	55.31
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.54	0.49	0.43	0.43	0.41	0.40	0.45	0.48	0.53	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.23	102.55											

Table C.10: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] base case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	38.55	20.31	14.74	8.64	9.10	1.50	2.92	0.09	0.44	9.33	26.83	30.54	162.98
TotalGasConsumpHeat [m^3 m^{-2}]	3.95	2.08	1.51	0.88	0.93	0.15	0.30	0.01	0.05	0.96	2.75	3.13	16.69
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.03	0.73	1.84	2.55	4.15	12.70	10.96	6.69	1.19	0.00	0.00	40.84
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.23	0.59	0.82	1.33	4.06	3.50	2.14	0.38	0.00	0.00	13.05
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.83	4.84	5.19	5.05	4.75	4.31	4.06	3.78	4.08	4.25	4.72	5.17	55.03
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.50	0.53	0.52	0.49	0.44	0.42	0.39	0.42	0.44	0.48	0.53	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	22.33	97.92											

Table C.11: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] base case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	30.40	20.27	16.12	8.02	9.53	3.87	0.83	0.02	2.27	9.44	27.31	22.57	150.64
TotalGasConsumpHeat [m^3 m^{-2}]	3.11	2.08	1.65	0.82	0.98	0.40	0.09	0.00	0.23	0.97	2.80	2.31	15.43
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.04	0.01	0.03	1.13	6.13	4.34	16.38	25.25	10.81	0.75	0.01	0.00	64.89
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.00	0.01	0.36	1.96	1.39	5.23	8.07	3.45	0.24	0.00	0.00	20.73
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.96	4.99	5.02	4.60	4.33	4.14	4.01	3.73	4.35	4.73	4.99	54.69
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.51	0.51	0.47	0.44	0.42	0.41	0.38	0.45	0.48	0.51	5.60
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	21.03	105.60											

Table C.12: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] base case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	29.75	19.75	14.48	10.21	3.33	3.59	0.00	0.41	4.16	11.54	28.06	34.16	159.45
TotalGasConsumpHeat [m^3 m^{-2}]	3.05	2.02	1.48	1.05	0.34	0.37	0.00	0.04	0.43	1.18	2.87	3.50	16.33
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.03	0.12	3.83	1.81	5.36	20.68	22.00	15.65	0.01	0.00	0.00	69.49
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.04	1.22	0.58	1.71	6.61	7.03	5.00	0.00	0.00	0.00	22.20
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.03	4.84	5.45	5.06	5.17	4.41	4.16	4.01	3.78	4.31	4.69	5.20	56.11
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.50	0.56	0.52	0.53	0.45	0.43	0.41	0.39	0.44	0.48	0.53	5.75
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	22.08	107.07											

Table C.13: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] base case 2100.

C.2.1.2 VegH-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	35.45	40.51	32.11	17.43	10.43	3.25	0.20	1.21	5.65	20.55	30.91	52.04	249.76
TotalGasConsumpHeat [m^3 m^{-2}]	3.63	4.15	3.29	1.79	1.07	0.33	0.02	0.12	0.58	2.10	3.17	5.33	25.58
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	3.94	3.33	15.38	17.20	12.40	3.03	0.11	0.01	0.00	55.39
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	1.26	1.06	4.91	5.50	3.96	0.97	0.04	0.00	0.00	17.70
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.76	4.96	5.49	5.00	4.73	4.18	3.79	3.69	3.89	4.46	4.68	5.10	54.74
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.51	0.56	0.51	0.48	0.43	0.39	0.38	0.40	0.46	0.48	0.52	5.61
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	31.19	102.57											

Table C.14: Residential Gas and Electricity Consumption/Production for Vancouver VegH case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	34.20	35.00	22.70	15.90	7.24	5.78	0.30	0.10	6.45	13.11	34.41	33.99	209.19
TotalGasConsumpHeat [m^3 m^{-2}]	3.50	3.58	2.33	1.63	0.74	0.59	0.03	0.01	0.66	1.34	3.52	3.48	21.42
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.90	0.00	0.33	2.47	3.66	22.27	26.85	8.37	1.09	0.00	0.00	65.93
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.29	0.00	0.11	0.79	1.17	7.11	8.58	2.67	0.35	0.00	0.00	21.07
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.08	4.76	5.25	5.00	4.58	4.37	4.14	3.78	3.88	4.41	4.75	5.20	55.20
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.49	0.54	0.51	0.47	0.45	0.42	0.39	0.40	0.45	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	27.08	105.93											

Table C.15: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] VegH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	21.54	34.46	22.13	12.40	7.77	4.49	0.16	0.00	0.88	8.98	25.87	31.62	170.31
TotalGasConsumpHeat [m^3 m^{-2}]	2.21	3.53	2.27	1.27	0.80	0.46	0.02	0.00	0.09	0.92	2.65	3.24	17.44
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.97	2.83	7.44	24.50	25.98	17.57	1.72	0.04	0.06	81.10
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.31	0.90	2.38	7.83	8.30	5.61	0.55	0.01	0.02	25.91
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.87	5.35	5.10	4.78	4.18	4.16	3.94	3.90	4.51	4.67	5.32	55.45
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.50	0.55	0.52	0.49	0.43	0.43	0.40	0.40	0.46	0.48	0.54	5.68
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	23.12	110.78											

Table C.16: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] VegH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	20.89	17.49	14.31	7.57	5.94	2.12	0.02	0.00	2.41	2.86	22.28	36.93	132.83
TotalGasConsumpHeat [m^3 m^{-2}]	2.14	1.79	1.47	0.78	0.61	0.22	0.00	0.00	0.25	0.29	2.28	3.78	13.60
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.14	0.03	0.00	1.70	2.66	5.04	24.04	15.96	17.50	1.33	0.04	0.00	68.45
TotalElecCoolDemand [kW-hr m^{-2}]	0.05	0.01	0.00	0.54	0.85	1.61	7.68	5.10	5.59	0.42	0.01	0.00	21.87
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.72	4.78	5.30	5.06	4.78	4.32	3.99	3.94	4.01	4.35	4.71	5.61	55.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.52	0.49	0.44	0.41	0.40	0.41	0.45	0.48	0.57	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	19.30	106.74											

Table C.17: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] VegH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	10.96	23.22	11.62	3.87	5.52	0.01	0.00	0.00	0.00	2.55	21.23	27.16	106.15
TotalGasConsumpHeat [m^3 m^{-2}]	1.12	2.38	1.19	0.40	0.57	0.00	0.00	0.00	0.00	0.26	2.17	2.78	10.87
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.03	0.00	0.48	1.90	8.61	28.53	48.95	44.98	28.87	5.20	0.24	0.00	167.78
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.00	0.15	0.61	2.75	9.12	15.64	14.37	9.22	1.66	0.08	0.00	53.60
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.78	5.31	4.96	4.93	4.19	3.99	4.01	3.90	4.31	4.75	5.17	55.13
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.49	0.54	0.51	0.51	0.43	0.41	0.41	0.40	0.44	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	16.52	138.47											

Table C.18: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] VegH case 2100.

C.2.1.3 VegH-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	28.29	33.06	25.46	16.05	8.04	4.69	2.18	1.54	2.42	13.99	29.74	56.03	221.49
TotalGasConsumpHeat [m^3 m^{-2}]	2.90	3.39	2.61	1.64	0.82	0.48	0.22	0.16	0.25	1.43	3.05	5.74	22.68
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.03	0.55	0.90	6.07	2.36	8.42	19.70	13.77	0.15	0.00	0.00	51.96
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.18	0.29	1.94	0.75	2.69	6.30	4.40	0.05	0.00	0.00	16.60
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.77	5.30	5.23	4.80	4.19	4.16	4.01	3.90	4.41	4.70	5.15	55.31
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.54	0.49	0.43	0.43	0.41	0.40	0.45	0.48	0.53	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.35	101.47											

Table C.19: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] VegH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	38.75	20.45	14.93	8.73	9.27	1.53	2.97	0.09	0.45	9.36	27.00	30.68	164.20
TotalGasConsumpHeat [m^3 m^{-2}]	3.97	2.09	1.53	0.89	0.95	0.16	0.30	0.01	0.05	0.96	2.77	3.14	16.82
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	0.48	1.62	2.29	3.88	12.21	10.71	6.26	1.18	0.00	0.00	38.65
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.15	0.52	0.73	1.24	3.90	3.42	2.00	0.38	0.00	0.00	12.35
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.83	4.84	5.19	5.05	4.75	4.31	4.06	3.78	4.08	4.25	4.72	5.17	55.03
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.50	0.53	0.52	0.49	0.44	0.42	0.39	0.42	0.44	0.48	0.53	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	22.45	97.22											

Table C.20: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] VegH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	30.70	20.41	16.28	8.14	9.69	3.94	0.85	0.02	2.29	9.53	27.43	22.71	151.98
TotalGasConsumpHeat [m^3 m^{-2}]	3.14	2.09	1.67	0.83	0.99	0.40	0.09	0.00	0.23	0.98	2.81	2.33	15.57
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.02	0.01	0.01	0.85	5.75	4.16	15.74	24.12	10.08	0.63	0.01	0.00	61.38
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.00	0.00	0.27	1.84	1.33	5.03	7.71	3.22	0.20	0.00	0.00	19.61
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.96	4.99	5.02	4.60	4.33	4.14	4.01	3.73	4.35	4.73	4.99	54.69
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.51	0.51	0.47	0.44	0.42	0.41	0.38	0.45	0.48	0.51	5.60
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	21.17	104.48											

Table C.21: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] VegH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	29.84	19.88	14.67	10.34	3.40	3.70	0.00	0.42	4.19	11.69	28.16	34.29	160.59
TotalGasConsumpHeat [m^3 m^{-2}]	3.06	2.04	1.50	1.06	0.35	0.38	0.00	0.04	0.43	1.20	2.88	3.51	16.45
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.07	3.45	1.54	4.98	19.81	20.76	14.89	0.00	0.00	0.00	65.51
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.02	1.10	0.49	1.59	6.33	6.63	4.76	0.00	0.00	0.00	20.93
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.03	4.84	5.45	5.06	5.17	4.41	4.16	4.01	3.78	4.31	4.69	5.20	56.11
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.50	0.56	0.52	0.53	0.45	0.43	0.41	0.39	0.44	0.48	0.53	5.75
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	22.19	105.80											

Table C.22: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] VegH case 2100.

C.2.1.4 VegHH-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	35.56	40.67	32.36	17.61	10.60	3.33	0.20	1.23	5.72	20.66	31.00	52.15	251.09
TotalGasConsumpHeat [m^3 m^{-2}]	3.64	4.17	3.31	1.80	1.09	0.34	0.02	0.13	0.59	2.12	3.17	5.34	25.72
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	3.58	3.00	14.75	16.38	11.86	2.77	0.07	0.00	0.00	52.42
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	1.15	0.96	4.71	5.23	3.79	0.89	0.02	0.00	0.00	16.75
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.76	4.96	5.49	5.00	4.73	4.18	3.79	3.69	3.89	4.46	4.68	5.10	54.74
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.51	0.56	0.51	0.48	0.43	0.39	0.38	0.40	0.46	0.48	0.52	5.61
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	31.32	101.62											

Table C.23: Residential Gas and Electricity Consumption/Production for Vancouver VegHH case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	34.24	35.17	22.95	16.12	7.38	5.84	0.30	0.11	6.54	13.22	34.57	34.13	210.59
TotalGasConsumpHeat [m^3 m^{-2}]	3.51	3.60	2.35	1.65	0.76	0.60	0.03	0.01	0.67	1.35	3.54	3.50	21.57
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.83	0.00	0.25	2.22	3.49	21.49	25.96	7.88	0.95	0.00	0.00	63.08
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.26	0.00	0.08	0.71	1.12	6.87	8.30	2.52	0.30	0.00	0.00	20.15
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.08	4.76	5.25	5.00	4.58	4.37	4.14	3.78	3.88	4.41	4.75	5.20	55.20
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.49	0.54	0.51	0.47	0.45	0.42	0.39	0.40	0.45	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	27.22	105.02											

Table C.24: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] VegHH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	21.63	34.62	22.19	12.52	7.90	4.59	0.16	0.00	0.89	9.04	25.97	31.82	171.34
TotalGasConsumpHeat [m^3 m^{-2}]	2.22	3.55	2.27	1.28	0.81	0.47	0.02	0.00	0.09	0.93	2.66	3.26	17.55
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.84	2.57	7.15	23.68	25.06	16.93	1.64	0.02	0.05	77.95
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.27	0.82	2.29	7.57	8.00	5.41	0.52	0.01	0.02	24.90
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.87	5.35	5.10	4.78	4.18	4.16	3.94	3.90	4.51	4.67	5.32	55.45
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.50	0.55	0.52	0.49	0.43	0.43	0.40	0.40	0.46	0.48	0.54	5.68
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	23.23	109.77											

Table C.25: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] VegHH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	21.13	17.61	14.45	7.69	6.04	2.14	0.02	0.00	2.42	2.91	22.41	37.05	133.88
TotalGasConsumpHeat [m^3 m^{-2}]	2.16	1.80	1.48	0.79	0.62	0.22	0.00	0.00	0.25	0.30	2.29	3.79	13.71
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.08	0.01	0.00	1.43	2.38	4.83	23.49	15.87	16.79	1.09	0.04	0.00	66.00
TotalElecCoolDemand [kW-hr m^{-2}]	0.03	0.00	0.00	0.46	0.76	1.54	7.50	5.07	5.36	0.35	0.01	0.00	21.09
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.72	4.78	5.30	5.06	4.78	4.32	3.99	3.94	4.01	4.35	4.71	5.61	55.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.52	0.49	0.44	0.41	0.40	0.41	0.45	0.48	0.57	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	19.40	105.96											

Table C.26: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] VegHH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	11.02	23.34	11.73	3.95	5.58	0.01	0.00	0.00	0.00	2.57	21.45	27.21	106.86
TotalGasConsumpHeat [m^3 m^{-2}]	1.13	2.39	1.20	0.40	0.57	0.00	0.00	0.00	0.00	0.26	2.20	2.79	10.94
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.02	0.00	0.40	1.59	8.17	28.06	48.32	43.97	28.30	4.79	0.14	0.00	163.77
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.13	0.51	2.61	8.97	15.44	14.05	9.04	1.53	0.04	0.00	52.32
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.78	5.31	4.96	4.93	4.19	3.99	4.01	3.90	4.31	4.75	5.17	55.13
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.49	0.54	0.51	0.51	0.43	0.41	0.41	0.40	0.44	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	16.59	137.19											

Table C.27: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] VegHH case 2100.

C.2.1.5 VegHH-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	28.32	33.20	25.66	16.20	8.16	4.75	2.22	1.55	2.44	14.10	29.84	56.13	222.56
TotalGasConsumpHeat [m^3 m^{-2}]	2.90	3.40	2.63	1.66	0.84	0.49	0.23	0.16	0.25	1.44	3.06	5.75	22.79
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	0.52	0.82	5.69	2.24	7.96	18.79	13.15	0.08	0.00	0.00	49.28
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.17	0.26	1.82	0.72	2.54	6.00	4.20	0.03	0.00	0.00	15.74
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.77	5.30	5.23	4.80	4.19	4.16	4.01	3.90	4.41	4.70	5.15	55.31
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.54	0.49	0.43	0.43	0.41	0.40	0.45	0.48	0.53	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.46	100.61											

Table C.28: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] VegHH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	38.93	20.58	15.11	8.82	9.42	1.55	3.01	0.09	0.45	9.40	27.17	30.83	165.36
TotalGasConsumpHeat [m^3 m^{-2}]	3.99	2.11	1.55	0.90	0.96	0.16	0.31	0.01	0.05	0.96	2.78	3.16	16.94
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	0.33	1.44	2.10	3.68	11.82	10.52	5.90	1.16	0.00	0.00	36.96
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.10	0.46	0.67	1.17	3.78	3.36	1.88	0.37	0.00	0.00	11.81
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.83	4.84	5.19	5.05	4.75	4.31	4.06	3.78	4.08	4.25	4.72	5.17	55.03
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.50	0.53	0.52	0.49	0.44	0.42	0.39	0.42	0.44	0.48	0.53	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	22.57	96.68											

Table C.29: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] VegHH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	31.01	20.54	16.42	8.25	9.85	4.00	0.87	0.02	2.31	9.63	27.56	22.85	153.30
TotalGasConsumpHeat [m^3 m^{-2}]	3.18	2.10	1.68	0.84	1.01	0.41	0.09	0.00	0.24	0.99	2.82	2.34	15.70
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.01	0.00	0.00	0.64	5.44	4.03	15.23	23.21	9.50	0.54	0.00	0.00	58.60
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.20	1.74	1.29	4.87	7.42	3.03	0.17	0.00	0.00	18.72
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.96	4.99	5.02	4.60	4.33	4.14	4.01	3.73	4.35	4.73	4.99	54.69
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.51	0.51	0.47	0.44	0.42	0.41	0.38	0.45	0.48	0.51	5.60
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	21.30	103.59											

Table C.30: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] VegHH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	29.92	20.00	14.85	10.49	3.47	3.82	0.00	0.42	4.22	11.83	28.25	34.41	161.68
TotalGasConsumpHeat [m^3 m^{-2}]	3.06	2.05	1.52	1.07	0.36	0.39	0.00	0.04	0.43	1.21	2.89	3.52	16.56
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.03	3.13	1.33	4.66	19.15	19.78	14.23	0.00	0.00	0.00	62.31
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.01	1.00	0.43	1.49	6.12	6.32	4.55	0.00	0.00	0.00	19.91
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.03	4.84	5.45	5.06	5.17	4.41	4.16	4.01	3.78	4.31	4.69	5.20	56.11
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.50	0.56	0.52	0.53	0.45	0.43	0.41	0.39	0.44	0.48	0.53	5.75
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	22.31	104.78											

Table C.31: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] VegHH case 2100.

C.2.1.6 RvalH-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	34.21	39.14	30.94	16.72	9.89	2.95	0.12	0.99	5.17	19.70	29.82	50.33	239.98
TotalGasConsumpHeat [m^3 m^{-2}]	3.50	4.01	3.17	1.71	1.01	0.30	0.01	0.10	0.53	2.02	3.05	5.15	24.58
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.02	4.09	3.42	15.50	17.70	12.54	3.10	0.17	0.02	0.00	56.56
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.01	1.31	1.09	4.95	5.65	4.01	0.99	0.05	0.01	0.00	18.07
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.76	4.96	5.49	5.00	4.73	4.18	3.79	3.69	3.89	4.46	4.68	5.10	54.74
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.51	0.56	0.51	0.48	0.43	0.39	0.38	0.40	0.46	0.48	0.52	5.61
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	30.19	102.94											

Table C.32: Residential Gas and Electricity Consumption/Production for Vancouver RvalH case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	33.05	33.71	21.82	15.11	6.72	5.37	0.24	0.06	5.87	12.33	33.06	32.73	200.07
TotalGasConsumpHeat [m^3 m^{-2}]	3.38	3.45	2.23	1.55	0.69	0.55	0.03	0.01	0.60	1.26	3.39	3.35	20.49
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.94	0.01	0.44	2.52	3.62	22.56	27.03	8.44	1.23	0.00	0.00	66.79
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.30	0.00	0.14	0.80	1.16	7.21	8.64	2.70	0.39	0.00	0.00	21.34
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.08	4.76	5.25	5.00	4.58	4.37	4.14	3.78	3.88	4.41	4.75	5.20	55.20
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.49	0.54	0.51	0.47	0.45	0.42	0.39	0.40	0.45	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	26.14	106.21											

Table C.33: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] RvalH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	20.60	33.19	21.34	11.73	7.21	3.91	0.10	0.00	0.69	8.35	21.42	30.33	158.87
TotalGasConsumpHeat [m^3 m^{-2}]	2.11	3.40	2.19	1.20	0.74	0.40	0.01	0.00	0.07	0.86	2.19	3.11	16.27
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	1.03	3.00	7.13	24.63	26.11	17.57	1.73	0.04	0.08	81.32
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.33	0.96	2.28	7.87	8.34	5.61	0.55	0.01	0.02	25.98
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.87	5.35	5.10	4.78	4.18	4.16	3.94	3.90	4.51	4.71	5.32	55.49
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.50	0.55	0.52	0.49	0.43	0.43	0.40	0.40	0.46	0.48	0.54	5.68
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	21.95	110.85											

Table C.34: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] RvalH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	19.89	16.82	13.59	7.07	5.55	1.76	0.01	0.00	2.05	2.53	21.42	35.54	126.23
TotalGasConsumpHeat [m^3 m^{-2}]	2.04	1.72	1.39	0.72	0.57	0.18	0.00	0.00	0.21	0.26	2.19	3.64	12.93
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.25	0.07	0.00	1.87	2.71	5.02	23.82	15.66	17.41	1.45	0.04	0.00	68.29
TotalElecCoolDemand [kW-hr m^{-2}]	0.08	0.02	0.00	0.60	0.86	1.60	7.61	5.00	5.56	0.46	0.01	0.00	21.82
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.72	4.78	5.30	5.06	4.78	4.32	3.99	3.94	4.01	4.35	4.71	5.61	55.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.52	0.49	0.44	0.41	0.40	0.41	0.45	0.48	0.57	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	18.62	106.69											

Table C.35: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] RvalH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	10.36	22.33	11.01	3.50	5.13	0.00	0.00	0.00	0.00	2.31	20.23	26.11	100.99
TotalGasConsumpHeat [m^3 m^{-2}]	1.06	2.29	1.13	0.36	0.53	0.00	0.00	0.00	0.00	0.24	2.07	2.67	10.34
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.04	0.01	0.55	2.07	8.73	28.23	48.40	45.05	28.81	5.34	0.43	0.00	167.65
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.00	0.17	0.66	2.79	9.02	15.46	14.39	9.20	1.71	0.14	0.00	53.56
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.78	5.31	4.96	4.93	4.19	3.99	4.01	3.90	4.31	4.75	5.17	55.13
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.49	0.54	0.51	0.51	0.43	0.41	0.41	0.40	0.44	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	15.99	138.43											

Table C.36: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] RvalH case 2100.

C.2.1.7 RvalH-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	27.23	32.01	24.41	15.30	7.55	4.22	1.91	1.34	2.09	13.28	28.58	54.23	212.15
TotalGasConsumpHeat [m^3 m^{-2}]	2.79	3.28	2.50	1.57	0.77	0.43	0.20	0.14	0.21	1.36	2.93	5.55	21.73
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.01	0.03	0.54	0.91	6.01	2.27	8.82	20.06	13.70	0.27	0.00	0.00	52.63
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.17	0.29	1.92	0.73	2.82	6.41	4.38	0.09	0.00	0.00	16.81
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.77	5.30	5.23	4.80	4.19	4.16	4.01	3.90	4.41	4.70	5.15	55.31
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.54	0.49	0.43	0.43	0.41	0.40	0.45	0.48	0.53	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	27.39	101.68											

Table C.37: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] RvalH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	37.37	19.58	14.24	8.20	8.71	1.33	2.58	0.05	0.34	8.78	25.98	29.59	156.75
TotalGasConsumpHeat [m^3 m^{-2}]	3.83	2.01	1.46	0.84	0.89	0.14	0.26	0.00	0.04	0.90	2.66	3.03	16.05
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	0.67	1.66	2.37	3.82	12.05	10.60	6.37	1.09	0.00	0.00	38.65
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.21	0.53	0.76	1.22	3.85	3.39	2.03	0.35	0.00	0.00	12.35
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.83	4.84	5.19	5.05	4.75	4.31	4.06	3.78	4.08	4.25	4.72	5.17	55.03
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.50	0.53	0.52	0.49	0.44	0.42	0.39	0.42	0.44	0.48	0.53	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	21.69	97.22											

Table C.38: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] RvalH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	29.52	19.54	15.49	7.60	9.00	3.61	0.70	0.01	1.96	8.99	26.47	21.70	144.59
TotalGasConsumpHeat [m^3 m^{-2}]	3.02	2.00	1.59	0.78	0.92	0.37	0.07	0.00	0.20	0.92	2.71	2.22	14.81
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.05	0.01	0.03	1.10	5.74	4.02	15.61	24.35	10.16	0.67	0.01	0.00	61.76
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.00	0.01	0.35	1.83	1.29	4.99	7.78	3.25	0.22	0.00	0.00	19.73
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.96	4.99	5.02	4.60	4.33	4.14	4.01	3.73	4.35	4.73	4.99	54.69
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.51	0.51	0.47	0.44	0.42	0.41	0.38	0.45	0.48	0.51	5.60
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	20.41	104.60											

Table C.39: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] RvalH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	28.80	19.16	14.02	9.72	3.06	3.24	0.00	0.32	3.67	11.09	27.04	33.08	153.20
TotalGasConsumpHeat [m^3 m^{-2}]	2.95	1.96	1.44	1.00	0.31	0.33	0.00	0.03	0.38	1.14	2.77	3.39	15.69
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.03	0.11	3.41	1.61	5.00	20.25	20.94	14.72	0.01	0.00	0.00	66.09
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.04	1.09	0.51	1.60	6.47	6.69	4.70	0.00	0.00	0.00	21.11
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.03	4.84	5.45	5.06	5.17	4.41	4.16	4.01	3.78	4.31	4.69	5.20	56.11
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.50	0.56	0.52	0.53	0.45	0.43	0.41	0.39	0.44	0.48	0.53	5.75
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	21.44	105.98											

Table C.40: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] RvalH case 2100.

C.2.1.8 InfLL-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	15.70	18.12	12.28	5.30	1.95	0.31	0.00	0.01	0.61	6.65	12.83	25.14	98.89
TotalGasConsumpHeat [m^3 m^{-2}]	1.61	1.86	1.26	0.54	0.20	0.03	0.00	0.00	0.06	0.68	1.31	2.57	10.13
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.01	0.03	0.91	7.41	7.50	19.16	22.68	16.54	6.02	0.80	0.08	0.00	81.13
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.29	2.37	2.40	6.12	7.25	5.28	1.92	0.26	0.03	0.00	25.92
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.76	4.96	5.49	5.00	4.73	4.18	3.79	3.69	3.89	4.46	4.68	5.10	54.74
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.51	0.56	0.51	0.48	0.43	0.39	0.38	0.40	0.46	0.48	0.52	5.61
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 15.73	110.79												

Table C.41: Residential Gas and Electricity Consumption/Production for Vancouver InfLL case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	15.41	15.49	6.52	4.18	0.92	0.90	0.00	0.00	1.24	3.04	14.39	14.46	76.56
TotalGasConsumpHeat [m^3 m^{-2}]	1.58	1.59	0.67	0.43	0.09	0.09	0.00	0.00	0.13	0.31	1.47	1.48	7.84
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	1.46	0.32	2.80	7.34	7.70	25.33	28.29	12.11	2.93	0.03	0.06	88.35
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.47	0.10	0.89	2.35	2.46	8.09	9.04	3.87	0.93	0.01	0.02	28.23
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.08	4.76	5.25	5.00	4.58	4.37	4.14	3.78	3.88	4.41	4.75	5.20	55.20
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.49	0.54	0.51	0.47	0.45	0.42	0.39	0.40	0.45	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 13.50	113.10												

Table C.42: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] InfLL case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	7.71	14.88	6.96	2.80	1.31	0.72	0.00	0.00	0.02	1.61	9.73	13.05	58.79
TotalGasConsumpHeat [m^3 m^{-2}]	0.79	1.52	0.71	0.29	0.13	0.07	0.00	0.00	0.00	0.16	1.00	1.34	6.02
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.06	0.08	0.02	3.19	7.22	11.62	26.94	28.17	20.02	3.16	0.24	0.41	101.13
TotalElecCoolDemand [kW-hr m^{-2}]	0.02	0.03	0.01	1.02	2.31	3.71	8.61	9.00	6.40	1.01	0.08	0.13	32.31
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.87	5.35	5.10	4.78	4.18	4.16	3.94	3.90	4.51	4.67	5.32	55.45
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.50	0.55	0.52	0.49	0.43	0.43	0.40	0.40	0.46	0.48	0.54	5.68
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 11.70	117.18												

Table C.43: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] InfLL case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	6.79	5.32	2.59	1.03	0.94	0.07	0.00	0.00	0.31	0.02	7.61	16.13	40.80
TotalGasConsumpHeat [m^3 m^{-2}]	0.70	0.55	0.26	0.11	0.10	0.01	0.00	0.00	0.03	0.00	0.78	1.65	4.18
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	1.40	0.82	0.18	6.11	7.61	9.71	26.30	17.42	19.73	5.13	0.20	0.00	94.62
TotalElecCoolDemand [kW-hr m^{-2}]	0.45	0.26	0.06	1.95	2.43	3.10	8.40	5.57	6.30	1.64	0.06	0.00	30.23
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.72	4.78	5.30	5.06	4.78	4.32	3.99	3.94	4.01	4.35	4.71	5.61	55.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.52	0.49	0.44	0.41	0.40	0.41	0.45	0.48	0.57	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 9.87	115.10												

Table C.44: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] InfLL case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	2.06	8.60	2.08	0.16	0.94	0.00	0.00	0.00	0.00	0.15	7.09	10.70	31.78
TotalGasConsumpHeat [m^3 m^{-2}]	0.21	0.88	0.21	0.02	0.10	0.00	0.00	0.00	0.00	0.02	0.73	1.10	3.26
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.19	0.51	1.78	6.92	12.79	27.70	41.46	40.26	27.19	9.02	2.02	0.03	169.88
TotalElecCoolDemand [kW-hr m^{-2}]	0.06	0.16	0.57	2.21	4.09	8.85	13.25	12.86	8.69	2.88	0.65	0.01	54.27
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.78	5.31	4.96	4.93	4.19	3.99	4.01	3.90	4.31	4.75	5.17	55.13
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.49	0.54	0.51	0.51	0.43	0.41	0.41	0.40	0.44	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 8.90	139.14												

Table C.45: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] InfLL case 2100.

C.2.1.9 InfLL-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	12.07	14.04	9.21	4.32	1.45	0.53	0.18	0.19	0.24	3.35	11.98	27.69	85.22
TotalGasConsumpHeat [m^3 m^{-2}]	1.24	1.44	0.94	0.44	0.15	0.05	0.02	0.02	0.02	0.34	1.23	2.84	8.73
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.06	0.13	1.25	2.81	10.39	6.23	13.45	23.44	17.11	1.42	0.03	0.00	76.33
TotalElecCoolDemand [kW-hr m^{-2}]	0.02	0.04	0.40	0.90	3.32	1.99	4.30	7.49	5.47	0.45	0.01	0.00	24.38
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.77	5.30	5.23	4.80	4.19	4.16	4.01	3.90	4.41	4.70	5.15	55.31
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.54	0.49	0.43	0.43	0.41	0.40	0.45	0.48	0.53	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 14.39	109.25												

Table C.46: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] InfLL case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	17.14	6.90	3.49	1.48	1.58	0.06	0.29	0.00	0.00	2.00	10.20	12.44	55.59
TotalGasConsumpHeat [m^3 m^{-2}]	1.76	0.71	0.36	0.15	0.16	0.01	0.03	0.00	0.00	0.20	1.05	1.27	5.69
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.14	0.37	2.96	4.70	5.81	9.63	15.63	14.20	10.75	2.18	0.23	0.10	66.69
TotalElecCoolDemand [kW-hr m^{-2}]	0.04	0.12	0.95	1.50	1.86	3.08	4.99	4.54	3.44	0.70	0.07	0.03	21.31
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.83	4.84	5.19	5.05	4.75	4.31	4.06	3.78	4.08	4.25	4.72	5.17	55.03
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.50	0.53	0.52	0.49	0.44	0.42	0.39	0.42	0.44	0.48	0.53	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 11.33	106.18												

Table C.47: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] InfLL case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	12.12	6.90	3.66	1.28	2.15	0.49	0.05	0.00	0.14	1.89	10.65	7.76	47.11
TotalGasConsumpHeat [m^3 m^{-2}]	1.24	0.71	0.38	0.13	0.22	0.05	0.01	0.00	0.01	0.19	1.09	0.79	4.82
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.57	0.35	0.39	4.60	9.52	8.26	19.67	27.00	14.30	2.38	0.20	0.16	87.38
TotalElecCoolDemand [kW-hr m^{-2}]	0.18	0.11	0.12	1.47	3.04	2.64	6.28	8.63	4.57	0.76	0.07	0.05	27.92
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.96	4.99	5.02	4.60	4.33	4.14	4.01	3.73	4.35	4.73	4.99	54.69
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.51	0.51	0.47	0.44	0.42	0.41	0.38	0.45	0.48	0.51	5.60
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 10.43	112.79												

Table C.48: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] InfLL case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	12.51	6.37	2.96	2.33	0.11	0.39	0.00	0.00	0.61	1.83	11.24	14.56	52.92
TotalGasConsumpHeat [m^3 m^{-2}]	1.28	0.65	0.30	0.24	0.01	0.04	0.00	0.00	0.06	0.19	1.15	1.49	5.42
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.01	0.52	1.12	7.69	6.47	10.56	23.36	24.98	17.36	0.46	0.12	0.01	92.66
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.17	0.36	2.46	2.07	3.37	7.46	7.98	5.55	0.15	0.04	0.00	29.60
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.03	4.84	5.45	5.06	5.17	4.41	4.16	4.01	3.78	4.31	4.69	5.20	56.11
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.50	0.56	0.52	0.53	0.45	0.43	0.41	0.39	0.44	0.48	0.53	5.75
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 11.17	114.47												

Table C.49: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] InfLL case 2100.

C.2.1.10 InfL-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	22.89	26.22	19.25	9.34	4.50	1.04	0.00	0.18	2.02	11.57	19.43	34.99	151.43
TotalGasConsumpHeat [m^3 m^{-2}]	2.34	2.69	1.97	0.96	0.46	0.11	0.00	0.02	0.21	1.18	1.99	3.58	15.51
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.37	5.99	5.65	17.69	20.87	14.95	4.66	0.47	0.05	0.00	70.69
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.12	1.92	1.80	5.65	6.67	4.78	1.49	0.15	0.01	0.00	22.59
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.76	4.96	5.49	5.00	4.73	4.18	3.79	3.69	3.89	4.46	4.68	5.10	54.74
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.51	0.56	0.51	0.48	0.43	0.39	0.38	0.40	0.46	0.48	0.52	5.61
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 21.12	107.45												

Table C.50: Residential Gas and Electricity Consumption/Production for Vancouver InfL case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	22.29	22.49	12.08	7.99	2.68	2.32	0.01	0.00	2.83	6.37	21.63	21.51	122.18
TotalGasConsumpHeat [m^3 m^{-2}]	2.28	2.30	1.24	0.82	0.27	0.24	0.00	0.00	0.29	0.65	2.21	2.20	12.51
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	1.19	0.11	1.48	5.12	5.85	26.27	28.10	10.63	2.04	0.01	0.01	80.81
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.38	0.04	0.47	1.64	1.87	8.39	8.98	3.40	0.65	0.00	0.00	25.82
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.08	4.76	5.25	5.00	4.58	4.37	4.16	3.78	3.88	4.41	4.75	5.20	55.22
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.49	0.54	0.51	0.47	0.45	0.43	0.39	0.40	0.45	0.49	0.53	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 18.17	110.69												

Table C.51: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] InfL case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	12.70	21.92	12.44	5.84	3.17	1.80	0.01	0.00	0.19	3.96	15.56	19.71	97.31
TotalGasConsumpHeat [m^3 m^{-2}]	1.30	2.25	1.27	0.60	0.32	0.18	0.00	0.00	0.02	0.41	1.59	2.02	9.97
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.01	0.01	0.00	2.13	5.20	9.84	26.27	27.73	19.22	2.36	0.14	0.19	93.11
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.68	1.66	3.14	8.39	8.86	6.14	0.76	0.04	0.06	29.75
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.87	5.35	5.10	4.78	4.18	4.16	3.94	3.90	4.51	4.67	5.32	55.45
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.50	0.55	0.52	0.49	0.43	0.43	0.40	0.40	0.46	0.48	0.54	5.68
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 15.65	114.62												

Table C.52: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] InfL case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	11.69	9.60	6.45	2.89	2.36	0.48	0.00	0.00	0.91	0.49	12.82	23.65	71.34
TotalGasConsumpHeat [m^3 m^{-2}]	1.20	0.98	0.66	0.30	0.24	0.05	0.00	0.00	0.09	0.05	1.31	2.42	7.31
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.78	0.36	0.05	4.09	5.42	7.64	25.69	16.93	19.05	3.22	0.10	0.00	83.33
TotalElecCoolDemand [kW-hr m^{-2}]	0.25	0.12	0.01	1.31	1.73	2.44	8.21	5.41	6.09	1.03	0.03	0.00	26.62
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.72	4.78	5.30	5.06	4.78	4.32	3.99	3.94	4.01	4.35	4.71	5.61	55.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.52	0.49	0.44	0.41	0.40	0.41	0.45	0.48	0.57	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 13.00	111.49												

Table C.53: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] InfL case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	5.08	13.81	5.15	0.85	2.32	0.00	0.00	0.00	0.00	0.79	11.93	16.71	56.63
TotalGasConsumpHeat [m^3 m^{-2}]	0.52	1.41	0.53	0.09	0.24	0.00	0.00	0.00	0.00	0.08	1.22	1.71	5.80
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.10	0.20	1.11	4.47	11.10	28.19	44.49	42.46	28.00	7.53	1.18	0.01	168.83
TotalElecCoolDemand [kW-hr m^{-2}]	0.03	0.06	0.35	1.43	3.55	9.01	14.21	13.56	8.95	2.40	0.38	0.00	53.94
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.78	5.31	4.96	4.93	4.19	3.99	4.01	3.90	4.31	4.75	5.17	55.13
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.49	0.54	0.51	0.51	0.43	0.41	0.41	0.40	0.44	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 11.45	138.81												

Table C.54: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] InfL case 2100.

C.2.1.11 InfL-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	17.99	20.88	14.84	8.23	3.46	1.63	0.65	0.57	0.83	6.93	18.43	38.07	132.51
TotalGasConsumpHeat [m^3 m^{-2}]	1.84	2.14	1.52	0.84	0.35	0.17	0.07	0.06	0.09	0.71	1.89	3.90	13.57
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.03	0.07	0.87	1.81	8.64	4.37	11.45	22.29	15.92	0.79	0.02	0.00	66.24
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.02	0.28	0.58	2.76	1.39	3.66	7.12	5.08	0.25	0.00	0.00	21.16
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.77	5.30	5.23	4.80	4.19	4.16	4.01	3.90	4.41	4.70	5.15	55.31
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.54	0.49	0.43	0.43	0.41	0.40	0.45	0.48	0.53	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 19.24	106.03												

Table C.55: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] InfL case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	24.95	11.72	7.26	3.68	3.89	0.36	0.99	0.00	0.02	4.42	16.24	19.03	92.55
TotalGasConsumpHeat [m^3 m^{-2}]	2.55	1.20	0.74	0.38	0.40	0.04	0.10	0.00	0.00	0.45	1.66	1.95	9.48
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.05	0.14	1.87	3.23	4.15	7.15	14.26	12.85	8.95	1.59	0.09	0.01	54.34
TotalElecCoolDemand [kW-hr m^{-2}]	0.02	0.04	0.60	1.03	1.33	2.29	4.56	4.11	2.86	0.51	0.03	0.00	17.36
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.83	4.84	5.19	5.05	4.75	4.31	4.06	3.78	4.08	4.25	4.72	5.17	55.03
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.50	0.53	0.52	0.49	0.44	0.42	0.39	0.42	0.44	0.48	0.53	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 15.12	102.23												

Table C.56: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] InfL case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	18.67	11.73	7.93	3.29	4.43	1.37	0.25	0.00	0.68	4.34	16.67	13.07	82.44
TotalGasConsumpHeat [m^3 m^{-2}]	1.91	1.20	0.81	0.34	0.45	0.14	0.03	0.00	0.07	0.44	1.71	1.34	8.44
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.23	0.12	0.15	2.79	7.82	6.33	18.28	26.29	12.75	1.44	0.07	0.05	76.33
TotalElecCoolDemand [kW-hr m^{-2}]	0.07	0.04	0.05	0.89	2.50	2.02	5.84	8.40	4.07	0.46	0.02	0.02	24.39
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.96	4.99	5.02	4.60	4.33	4.14	4.01	3.73	4.35	4.73	4.99	54.69
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.51	0.51	0.47	0.44	0.42	0.41	0.38	0.45	0.48	0.51	5.60
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 14.04	109.26												

Table C.57: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] InfL case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	18.82	11.16	6.80	4.85	0.68	1.24	0.00	0.07	1.71	5.02	17.37	21.70	89.43
TotalGasConsumpHeat [m^3 m^{-2}]	1.93	1.14	0.70	0.50	0.07	0.13	0.00	0.01	0.18	0.51	1.78	2.22	9.16
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.27	0.49	5.87	4.00	8.14	22.31	23.73	16.50	0.14	0.05	0.00	81.49
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.09	0.16	1.88	1.28	2.60	7.13	7.58	5.27	0.04	0.02	0.00	26.03
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.03	4.84	5.45	5.06	5.17	4.41	4.16	4.01	3.78	4.31	4.69	5.20	56.11
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.50	0.56	0.52	0.53	0.45	0.43	0.41	0.39	0.44	0.48	0.53	5.75
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 14.91	110.90												

Table C.58: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] InfL case 2100.

C.2.1.12 CR-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	35.44	40.48	32.16	17.65	10.69	3.43	0.24	1.29	5.77	20.59	30.92	51.99	250.65
TotalGasConsumpHeat [m^3 m^{-2}]	3.63	4.15	3.29	1.81	1.10	0.35	0.02	0.13	0.59	2.11	3.17	5.33	25.67
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.02	4.27	3.58	15.70	17.70	12.69	3.23	0.17	0.02	0.00	57.38
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.01	1.36	1.14	5.02	5.66	4.05	1.03	0.05	0.00	0.00	18.33
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.76	4.96	5.49	5.00	4.73	4.18	3.79	3.69	3.89	4.46	4.68	5.10	54.74
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.51	0.56	0.51	0.48	0.43	0.39	0.38	0.40	0.46	0.48	0.52	5.61
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 31.28	103.20												

Table C.59: Residential Gas and Electricity Consumption/Production for Vancouver CR case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	34.24	34.99	22.67	16.05	7.53	5.98	0.33	0.13	6.63	13.16	34.30	33.96	209.95
TotalGasConsumpHeat [m^3 m^{-2}]	3.51	3.58	2.32	1.64	0.77	0.61	0.03	0.01	0.68	1.35	3.51	3.48	21.50
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.97	0.01	0.44	2.61	3.70	22.63	27.44	8.77	1.27	0.00	0.00	67.85
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.31	0.00	0.14	0.83	1.18	7.23	8.77	2.80	0.41	0.00	0.00	21.68
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.08	4.76	5.25	5.00	4.58	4.37	4.14	3.78	3.88	4.41	4.75	5.20	55.20
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.49	0.54	0.51	0.47	0.45	0.42	0.39	0.40	0.45	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 27.16	106.55												

Table C.60: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] CR case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	21.50	34.42	22.24	12.62	7.99	4.80	0.20	0.00	0.94	9.05	25.86	31.53	171.15
TotalGasConsumpHeat [m^3 m^{-2}]	2.20	3.53	2.28	1.29	0.82	0.49	0.02	0.00	0.10	0.93	2.65	3.23	17.53
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	1.10	3.02	7.24	24.86	26.51	17.95	1.79	0.06	0.08	82.62
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.35	0.97	2.31	7.94	8.47	5.73	0.57	0.02	0.03	26.40
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.87	5.35	5.10	4.78	4.18	4.16	3.94	3.90	4.51	4.67	5.32	55.45
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.50	0.55	0.52	0.49	0.43	0.43	0.40	0.40	0.46	0.48	0.54	5.68
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 23.21	111.27												

Table C.61: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] CR case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	20.79	17.55	14.46	7.92	6.20	2.28	0.03	0.00	2.51	2.99	22.29	36.84	133.86
TotalGasConsumpHeat [m^3 m^{-2}]	2.13	1.80	1.48	0.81	0.63	0.23	0.00	0.00	0.26	0.31	2.28	3.77	13.71
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.24	0.06	0.00	1.95	2.76	5.06	23.76	15.61	18.02	1.56	0.05	0.00	69.08
TotalElecCoolDemand [kW-hr m^{-2}]	0.08	0.02	0.00	0.62	0.88	1.62	7.59	4.99	5.76	0.50	0.02	0.00	22.07
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.72	4.78	5.30	5.06	4.78	4.32	3.99	3.94	4.01	4.35	4.71	5.61	55.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.52	0.49	0.44	0.41	0.40	0.41	0.45	0.48	0.57	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 19.40	106.94												

Table C.62: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] CR case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	11.00	23.26	11.80	4.16	5.67	0.01	0.00	0.00	0.01	2.59	21.22	27.17	106.88
TotalGasConsumpHeat [m^3 m^{-2}]	1.13	2.38	1.21	0.43	0.58	0.00	0.00	0.00	0.00	0.27	2.17	2.78	10.95
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.04	0.01	0.58	2.15	8.91	28.42	48.76	45.58	29.04	5.50	0.43	0.00	169.41
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.00	0.19	0.69	2.85	9.08	15.58	14.56	9.28	1.76	0.14	0.00	54.12
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.78	5.31	4.96	4.93	4.19	3.99	4.01	3.90	4.31	4.75	5.17	55.13
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.49	0.54	0.51	0.51	0.43	0.41	0.41	0.40	0.44	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 16.59	138.99												

Table C.63: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] CR case 2100.

C.2.1.13 CR-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	28.30	33.11	25.47	16.25	8.24	4.90	2.25	1.63	2.54	14.07	29.71	55.99	222.46
TotalGasConsumpHeat [m^3 m^{-2}]	2.90	3.39	2.61	1.66	0.84	0.50	0.23	0.17	0.26	1.44	3.04	5.73	22.78
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.01	0.03	0.58	0.97	6.28	2.27	8.85	20.36	14.15	0.28	0.00	0.00	53.77
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.18	0.31	2.01	0.72	2.83	6.51	4.52	0.09	0.00	0.00	17.18
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.77	5.30	5.23	4.80	4.19	4.16	4.01	3.90	4.41	4.70	5.15	55.31
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.54	0.49	0.43	0.43	0.41	0.40	0.45	0.48	0.53	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 28.45	102.05												

Table C.64: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] CR case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	38.74	20.49	15.12	9.02	9.50	1.66	3.13	0.12	0.49	9.45	26.98	30.65	165.34
TotalGasConsumpHeat [m^3 m^{-2}]	3.97	2.10	1.55	0.92	0.97	0.17	0.32	0.01	0.05	0.97	2.76	3.14	16.93
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	0.70	1.75	2.42	3.85	12.25	10.60	6.48	1.16	0.00	0.00	39.24
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.22	0.56	0.77	1.23	3.91	3.39	2.07	0.37	0.00	0.00	12.54
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.83	4.84	5.19	5.05	4.75	4.31	4.06	3.78	4.08	4.25	4.72	5.17	55.03
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.50	0.53	0.52	0.49	0.44	0.42	0.39	0.42	0.44	0.48	0.53	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 22.57	97.41												

Table C.65: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] CR case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	30.56	20.41	16.33	8.28	9.92	4.11	0.93	0.03	2.40	9.63	27.43	22.66	152.68
TotalGasConsumpHeat [m^3 m^{-2}]	3.13	2.09	1.67	0.85	1.02	0.42	0.10	0.00	0.25	0.99	2.81	2.32	15.64
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.04	0.01	0.03	1.10	5.88	4.11	15.74	24.63	10.59	0.71	0.01	0.00	62.86
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.00	0.01	0.35	1.88	1.31	5.03	7.87	3.38	0.23	0.00	0.00	20.08
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.96	4.99	5.02	4.60	4.33	4.14	4.01	3.73	4.35	4.73	4.99	54.69
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.51	0.51	0.47	0.44	0.42	0.41	0.38	0.45	0.48	0.51	5.60
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 21.24	104.95												

Table C.66: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] CR case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	29.86	19.97	14.78	10.63	3.68	3.93	0.00	0.46	4.37	11.76	28.15	34.26	161.84
TotalGasConsumpHeat [m^3 m^{-2}]	3.06	2.04	1.51	1.09	0.38	0.40	0.00	0.05	0.45	1.20	2.88	3.51	16.58
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.03	0.12	3.67	1.63	4.99	20.16	21.45	15.34	0.01	0.00	0.00	67.41
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.04	1.17	0.52	1.59	6.44	6.85	4.90	0.00	0.00	0.00	21.54
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.03	4.84	5.45	5.06	5.17	4.41	4.16	4.01	3.78	4.31	4.69	5.20	56.11
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.50	0.56	0.52	0.53	0.45	0.43	0.41	0.39	0.44	0.48	0.53	5.75
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]: 22.32	106.41												

Table C.67: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] CR case 2100.

C.2.1.14 PVH-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	35.33	40.33	31.84	17.23	10.26	3.17	0.20	1.18	5.58	20.43	30.83	51.92	248.30
TotalGasConsumpHeat [m^3 m^{-2}]	3.62	4.13	3.26	1.77	1.05	0.32	0.02	0.12	0.57	2.09	3.16	5.32	25.43
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.02	4.40	3.74	16.18	18.28	13.09	3.34	0.17	0.02	0.00	59.24
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.01	1.41	1.19	5.17	5.84	4.18	1.07	0.06	0.00	0.00	18.93
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.76	4.96	5.49	5.00	4.73	4.18	3.79	3.69	3.89	4.46	4.68	5.10	54.74
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.51	0.56	0.51	0.48	0.43	0.39	0.38	0.40	0.46	0.48	0.52	5.61
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.60	0.93	2.10	4.32	4.24	6.16	6.58	4.71	2.34	1.15	0.36	0.50	34.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	31.04	69.80											

Table C.68: Residential Gas and Electricity Consumption/Production for Vancouver PVH case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	34.15	34.83	22.41	15.66	7.09	5.71	0.30	0.10	6.38	12.99	34.21	33.85	207.69
TotalGasConsumpHeat [m^3 m^{-2}]	3.50	3.57	2.30	1.60	0.73	0.58	0.03	0.01	0.65	1.33	3.50	3.47	21.27
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.98	0.01	0.46	2.81	3.88	23.24	27.96	8.97	1.28	0.00	0.00	69.60
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.31	0.00	0.15	0.90	1.24	7.43	8.93	2.87	0.41	0.00	0.00	22.24
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.08	4.76	5.25	5.00	4.58	4.37	4.14	3.78	3.88	4.41	4.75	5.20	55.20
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.49	0.54	0.51	0.47	0.45	0.42	0.39	0.40	0.45	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.25	1.50	1.96	3.40	4.16	4.08	5.84	4.66	4.51	1.62	0.79	0.58	33.36
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	26.92	73.75											

Table C.69: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] PVH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	21.44	34.29	22.06	12.27	7.64	4.41	0.16	0.00	0.88	8.92	25.75	31.45	169.27
TotalGasConsumpHeat [m^3 m^{-2}]	2.20	3.51	2.26	1.26	0.78	0.45	0.02	0.00	0.09	0.91	2.64	3.22	17.34
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	1.13	3.18	7.72	25.54	27.12	18.32	1.82	0.06	0.08	84.97
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.36	1.02	2.47	8.16	8.66	5.85	0.58	0.02	0.03	27.15
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.87	5.35	5.10	4.78	4.18	4.16	3.94	3.90	4.51	4.67	5.32	55.45
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.50	0.55	0.52	0.49	0.43	0.43	0.40	0.40	0.46	0.48	0.54	5.68
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.48	0.89	0.78	2.80	4.14	6.03	6.38	4.68	4.39	1.04	0.58	0.88	33.07
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	23.02	78.95											

Table C.70: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] PVH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	20.65	17.37	14.16	7.44	5.86	2.09	0.02	0.00	2.39	2.82	22.15	36.78	131.73
TotalGasConsumpHeat [m^3 m^{-2}]	2.11	1.78	1.45	0.76	0.60	0.21	0.00	0.00	0.25	0.29	2.27	3.77	13.49
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.25	0.07	0.00	2.04	2.99	5.31	24.77	16.08	18.35	1.62	0.05	0.00	71.52
TotalElecCoolDemand [kW-hr m^{-2}]	0.08	0.02	0.00	0.65	0.96	1.70	7.91	5.14	5.86	0.52	0.02	0.00	22.85
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.72	4.78	5.30	5.06	4.78	4.32	3.99	3.94	4.01	4.35	4.71	5.61	55.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.52	0.49	0.44	0.41	0.40	0.41	0.45	0.48	0.57	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.37	1.17	1.15	4.76	3.37	4.59	6.50	2.19	4.31	1.96	0.55	0.55	32.46
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	19.18	75.26											

Table C.71: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] PVH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	10.91	23.10	11.50	3.80	5.46	0.01	0.00	0.00	0.00	2.52	21.04	27.10	105.44
TotalGasConsumpHeat [m^3 m^{-2}]	1.12	2.37	1.18	0.39	0.56	0.00	0.00	0.00	0.00	0.26	2.16	2.78	10.80
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.04	0.01	0.59	2.26	9.14	29.13	49.73	46.26	29.54	5.64	0.43	0.00	172.79
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.00	0.19	0.72	2.92	9.31	15.89	14.78	9.44	1.80	0.14	0.00	55.20
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.78	5.31	4.96	4.93	4.19	3.99	4.01	3.90	4.31	4.75	5.17	55.13
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.49	0.54	0.51	0.51	0.43	0.41	0.41	0.40	0.44	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.40	1.06	1.49	3.52	3.88	3.54	6.81	5.49	3.90	2.15	1.44	0.28	33.96
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	16.45	106.11											

Table C.72: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] PVH case 2100.

C.2.1.15 PVH-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	28.25	32.91	25.23	15.90	7.90	4.62	2.14	1.52	2.40	13.89	29.62	55.92	220.31
TotalGasConsumpHeat [m^3 m^{-2}]	2.89	3.37	2.58	1.63	0.81	0.47	0.22	0.16	0.25	1.42	3.03	5.73	22.56
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.01	0.04	0.59	1.00	6.55	2.49	9.02	20.87	14.51	0.28	0.00	0.00	55.35
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.19	0.32	2.09	0.80	2.88	6.67	4.63	0.09	0.00	0.00	17.68
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.77	5.30	5.23	4.80	4.19	4.16	4.01	3.90	4.41	4.70	5.15	55.31
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.54	0.49	0.43	0.43	0.41	0.40	0.45	0.48	0.53	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.26	0.68	1.90	3.08	4.22	3.71	4.46	5.62	4.41	1.31	0.50	0.42	30.56
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.23	72.00											

Table C.73: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] PVH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	38.55	20.31	14.74	8.64	9.10	1.50	2.92	0.09	0.44	9.33	26.83	30.54	162.98
TotalGasConsumpHeat [m^3 m^{-2}]	3.95	2.08	1.51	0.88	0.93	0.15	0.30	0.01	0.05	0.96	2.75	3.13	16.69
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.03	0.73	1.84	2.55	4.15	12.70	10.96	6.69	1.19	0.00	0.00	40.84
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.23	0.59	0.82	1.33	4.06	3.50	2.14	0.38	0.00	0.00	13.05
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.83	4.84	5.19	5.05	4.75	4.31	4.06	3.78	4.08	4.25	4.72	5.17	55.03
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.50	0.53	0.52	0.49	0.44	0.42	0.39	0.42	0.44	0.48	0.53	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.67	0.97	2.85	3.20	3.69	4.38	4.27	2.64	2.01	0.55	0.82	0.60	26.67
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	22.33	71.25											

Table C.74: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] PVH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	30.40	20.27	16.12	8.02	9.53	3.87	0.83	0.02	2.27	9.44	27.31	22.57	150.64
TotalGasConsumpHeat [m^3 m^{-2}]	3.11	2.08	1.65	0.82	0.98	0.40	0.09	0.00	0.23	0.97	2.80	2.31	15.43
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.04	0.01	0.03	1.13	6.13	4.34	16.38	25.25	10.81	0.75	0.01	0.00	64.89
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.00	0.01	0.36	1.96	1.39	5.23	8.07	3.45	0.24	0.00	0.00	20.73
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.96	4.99	5.02	4.60	4.33	4.14	4.01	3.73	4.35	4.73	4.99	54.69
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.51	0.51	0.47	0.44	0.42	0.41	0.38	0.45	0.48	0.51	5.60
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.28	0.91	1.36	3.19	4.65	4.04	5.40	4.80	3.61	1.14	0.66	0.63	31.65
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	21.03	73.95											

Table C.75: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] PVH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	29.75	19.75	14.48	10.21	3.33	3.59	0.00	0.41	4.16	11.54	28.06	34.16	159.45
TotalGasConsumpHeat [m^3 m^{-2}]	3.05	2.02	1.48	1.05	0.34	0.37	0.00	0.04	0.43	1.18	2.87	3.50	16.33
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.03	0.12	3.83	1.81	5.36	20.68	22.00	15.65	0.01	0.00	0.00	69.49
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.04	1.22	0.58	1.71	6.61	7.03	5.00	0.00	0.00	0.00	22.20
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.03	4.84	5.45	5.06	5.17	4.41	4.16	4.01	3.78	4.31	4.69	5.20	56.11
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.50	0.56	0.52	0.53	0.45	0.43	0.41	0.39	0.44	0.48	0.53	5.75
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.36	1.07	2.08	5.28	2.98	5.42	5.16	5.81	4.56	0.92	0.54	0.48	34.66
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	22.08	72.42											

Table C.76: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] PVH case 2100.

C.2.1.16 PVHH-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	35.33	40.33	31.84	17.23	10.26	3.17	0.20	1.18	5.58	20.43	30.83	51.92	248.30
TotalGasConsumpHeat [m^3 m^{-2}]	3.62	4.13	3.26	1.77	1.05	0.32	0.02	0.12	0.57	2.09	3.16	5.32	25.43
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.02	4.40	3.74	16.18	18.28	13.09	3.34	0.17	0.02	0.00	59.24
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.01	1.41	1.19	5.17	5.84	4.18	1.07	0.06	0.00	0.00	18.93
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.76	4.96	5.49	5.00	4.73	4.18	3.79	3.69	3.89	4.46	4.68	5.10	54.74
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.51	0.56	0.51	0.48	0.43	0.39	0.38	0.40	0.46	0.48	0.52	5.61
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.19	1.82	4.14	8.51	8.36	12.15	12.98	9.29	4.61	2.27	0.72	0.99	67.02
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	31.04	36.77											

Table C.77: Residential Gas and Electricity Consumption/Production for Vancouver PVHH case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	34.15	34.83	22.41	15.66	7.09	5.71	0.30	0.10	6.38	12.99	34.21	33.85	207.69
TotalGasConsumpHeat [m^3 m^{-2}]	3.50	3.57	2.30	1.60	0.73	0.58	0.03	0.01	0.65	1.33	3.50	3.47	21.27
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.98	0.01	0.46	2.81	3.88	23.24	27.96	8.97	1.28	0.00	0.00	69.60
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.31	0.00	0.15	0.90	1.24	7.43	8.93	2.87	0.41	0.00	0.00	22.24
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.08	4.76	5.25	5.00	4.58	4.37	4.14	3.78	3.88	4.41	4.75	5.20	55.20
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.49	0.54	0.51	0.47	0.45	0.42	0.39	0.40	0.45	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.49	2.96	3.86	6.71	8.19	8.05	11.52	9.19	8.90	3.20	1.55	1.14	65.77
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	26.92	41.34											

Table C.78: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] PVHH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	21.44	34.29	22.06	12.27	7.64	4.41	0.16	0.00	0.88	8.92	25.75	31.45	169.27
TotalGasConsumpHeat [m^3 m^{-2}]	2.20	3.51	2.26	1.26	0.78	0.45	0.02	0.00	0.09	0.91	2.64	3.22	17.34
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	1.13	3.18	7.72	25.54	27.12	18.32	1.82	0.06	0.08	84.97
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.36	1.02	2.47	8.16	8.66	5.85	0.58	0.02	0.03	27.15
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.87	5.35	5.10	4.78	4.18	4.16	3.94	3.90	4.51	4.67	5.32	55.45
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.50	0.55	0.52	0.49	0.43	0.43	0.40	0.40	0.46	0.48	0.54	5.68
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.95	1.76	1.53	5.51	8.16	11.88	12.58	9.22	8.66	2.05	1.15	1.74	65.20
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	23.02	46.82											

Table C.79: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] PVHH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	20.65	17.37	14.16	7.44	5.86	2.09	0.02	0.00	2.39	2.82	22.15	36.78	131.73
TotalGasConsumpHeat [m^3 m^{-2}]	2.11	1.78	1.45	0.76	0.60	0.21	0.00	0.00	0.25	0.29	2.27	3.77	13.49
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.25	0.07	0.00	2.04	2.99	5.31	24.77	16.08	18.35	1.62	0.05	0.00	71.52
TotalElecCoolDemand [kW-hr m^{-2}]	0.08	0.02	0.00	0.65	0.96	1.70	7.91	5.14	5.86	0.52	0.02	0.00	22.85
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.72	4.78	5.30	5.06	4.78	4.32	3.99	3.94	4.01	4.35	4.71	5.61	55.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.52	0.49	0.44	0.41	0.40	0.41	0.45	0.48	0.57	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	2.70	2.30	2.26	9.37	6.64	9.05	12.82	4.32	8.49	3.87	1.09	1.08	63.99
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	19.18	43.73											

Table C.80: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] PVHH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	10.91	23.10	11.50	3.80	5.46	0.01	0.00	0.00	0.00	2.52	21.04	27.10	105.44
TotalGasConsumpHeat [m^3 m^{-2}]	1.12	2.37	1.18	0.39	0.56	0.00	0.00	0.00	0.00	0.26	2.16	2.78	10.80
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.04	0.01	0.59	2.26	9.14	29.13	49.73	46.26	29.54	5.64	0.43	0.00	172.79
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.00	0.19	0.72	2.92	9.31	15.89	14.78	9.44	1.80	0.14	0.00	55.20
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.78	5.31	4.96	4.93	4.19	3.99	4.01	3.90	4.31	4.75	5.17	55.13
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.49	0.54	0.51	0.51	0.43	0.41	0.41	0.40	0.44	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.78	2.08	2.93	6.94	7.64	6.99	13.43	10.83	7.69	4.24	2.85	0.55	66.95
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	16.45	73.12											

Table C.81: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] PVHH case 2099.

C.2.1.17 PVHH-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	28.25	32.91	25.23	15.90	7.90	4.62	2.14	1.52	2.40	13.89	29.62	55.92	220.31
TotalGasConsumpHeat [m^3 m^{-2}]	2.89	3.37	2.58	1.63	0.81	0.47	0.22	0.16	0.25	1.42	3.03	5.73	22.56
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.01	0.04	0.59	1.00	6.55	2.49	9.02	20.87	14.51	0.28	0.00	0.00	55.35
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.19	0.32	2.09	0.80	2.88	6.67	4.63	0.09	0.00	0.00	17.68
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.77	5.30	5.23	4.80	4.19	4.16	4.01	3.90	4.41	4.70	5.15	55.31
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.54	0.49	0.43	0.43	0.41	0.40	0.45	0.48	0.53	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.51	1.35	3.74	6.07	8.31	7.31	8.78	11.08	8.70	2.57	0.99	0.83	60.24
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.23	42.31											

Table C.82: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] PVHH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	38.55	20.31	14.74	8.64	9.10	1.50	2.92	0.09	0.44	9.33	26.83	30.54	162.98
TotalGasConsumpHeat [m^3 m^{-2}]	3.95	2.08	1.51	0.88	0.93	0.15	0.30	0.01	0.05	0.96	2.75	3.13	16.69
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.03	0.73	1.84	2.55	4.15	12.70	10.96	6.69	1.19	0.00	0.00	40.84
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.23	0.59	0.82	1.33	4.06	3.50	2.14	0.38	0.00	0.00	13.05
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.83	4.84	5.19	5.05	4.75	4.31	4.06	3.78	4.08	4.25	4.72	5.17	55.03
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.50	0.53	0.52	0.49	0.44	0.42	0.39	0.42	0.44	0.48	0.53	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.32	1.92	5.62	6.31	7.27	8.64	8.42	5.21	3.95	1.09	1.62	1.19	52.58
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	22.33	45.34											

Table C.83: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] PVHH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	30.40	20.27	16.12	8.02	9.53	3.87	0.83	0.02	2.27	9.44	27.31	22.57	150.64
TotalGasConsumpHeat [m^3 m^{-2}]	3.11	2.08	1.65	0.82	0.98	0.40	0.09	0.00	0.23	0.97	2.80	2.31	15.43
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.04	0.01	0.03	1.13	6.13	4.34	16.38	25.25	10.81	0.75	0.01	0.00	64.89
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.00	0.01	0.36	1.96	1.39	5.23	8.07	3.45	0.24	0.00	0.00	20.73
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.96	4.99	5.02	4.60	4.33	4.14	4.01	3.73	4.35	4.73	4.99	54.69
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.51	0.51	0.47	0.44	0.42	0.41	0.38	0.45	0.48	0.51	5.60
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	2.51	1.80	2.68	6.29	9.16	7.96	10.65	9.46	7.12	2.24	1.30	1.23	62.40
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	21.03	43.20											

Table C.84: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] PVHH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	29.75	19.75	14.48	10.21	3.33	3.59	0.00	0.41	4.16	11.54	28.06	34.16	159.45
TotalGasConsumpHeat [m^3 m^{-2}]	3.05	2.02	1.48	1.05	0.34	0.37	0.00	0.04	0.43	1.18	2.87	3.50	16.33
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.03	0.12	3.83	1.81	5.36	20.68	22.00	15.65	0.01	0.00	0.00	69.49
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.04	1.22	0.58	1.71	6.61	7.03	5.00	0.00	0.00	0.00	22.20
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.03	4.84	5.45	5.06	5.17	4.41	4.16	4.01	3.78	4.31	4.69	5.20	56.11
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.50	0.56	0.52	0.53	0.45	0.43	0.41	0.39	0.44	0.48	0.53	5.75
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.72	2.10	4.10	10.41	5.87	10.69	10.17	11.45	8.98	1.81	1.07	0.94	68.32
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	22.08	38.75											

Table C.85: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] PVHH case 2100.

C.2.2 Toronto

C.2.2.1 Base-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	53.16	56.95	32.85	18.80	7.47	0.61	0.18	0.14	2.02	9.44	33.91	39.91	255.42
TotalGasConsumpHeat [m^3 m^{-2}]	5.44	5.83	3.36	1.93	0.76	0.06	0.02	0.01	0.21	0.97	3.47	4.09	26.16
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.82	4.11	10.40	17.45	15.36	22.79	9.32	2.43	0.20	4.62	87.48
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.26	1.31	3.32	5.58	4.91	7.28	2.98	0.78	0.06	1.47	27.95
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.86	5.02	5.54	4.90	4.65	3.85	3.67	3.49	3.47	3.94	4.58	5.22	53.19
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.57	0.50	0.48	0.39	0.38	0.36	0.36	0.40	0.47	0.54	5.45
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	31.61	112.82											

Table C.86: Residential Gas and Electricity Consumption/Production for Toronto base case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.29	33.13	38.12	12.26	6.30	0.57	0.00	0.00	1.14	6.24	32.43	54.46	230.94
TotalGasConsumpHeat [m^3 m^{-2}]	4.74	3.39	3.90	1.26	0.65	0.06	0.00	0.00	0.12	0.64	3.32	5.58	23.65
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.55	1.87	1.18	1.77	6.41	21.32	28.34	23.95	14.17	7.72	0.13	0.17	107.58
TotalElecCoolDemand [kW-hr m^{-2}]	0.17	0.60	0.38	0.57	2.05	6.81	9.05	7.65	4.53	2.47	0.04	0.05	34.37
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.05	5.72	5.59	4.56	4.13	3.76	3.55	3.59	4.22	4.62	5.43	55.29
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.59	0.57	0.47	0.42	0.38	0.36	0.37	0.43	0.47	0.56	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	29.32	119.24											

Table C.87: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] base case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	47.15	45.14	32.28	20.99	4.27	1.07	0.06	0.17	0.28	4.17	23.93	41.40	220.93
TotalGasConsumpHeat [m^3 m^{-2}]	4.83	4.62	3.31	2.15	0.44	0.11	0.01	0.02	0.03	0.43	2.45	4.24	22.63
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.32	0.79	18.17	25.31	36.24	34.18	23.67	2.14	0.83	3.14	144.81
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.10	0.25	5.80	8.08	11.58	10.92	7.56	0.68	0.27	1.00	46.26
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.64	5.47	4.58	3.77	3.67	3.53	3.59	4.25	4.50	5.21	54.43
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.56	0.47	0.39	0.38	0.36	0.37	0.44	0.46	0.53	5.57
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.20	131.13											

Table C.88: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] base case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.98	42.41	48.10	12.71	0.48	0.36	0.00	0.00	0.00	9.79	24.34	41.87	227.04
TotalGasConsumpHeat [m^3 m^{-2}]	4.81	4.34	4.93	1.30	0.05	0.04	0.00	0.00	0.00	1.00	2.49	4.29	23.25
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	2.19	0.00	5.62	19.74	29.48	35.01	24.93	32.21	8.19	0.18	0.27	157.80
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.70	0.00	1.80	6.31	9.42	11.18	7.96	10.29	2.62	0.06	0.09	50.41
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.13	5.67	4.99	4.49	3.77	3.73	3.58	3.53	4.22	4.62	5.39	54.18
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.51	0.46	0.39	0.38	0.37	0.36	0.43	0.47	0.55	5.55
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.80	135.28											

Table C.89: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] base case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.59	40.87	28.18	12.71	1.90	0.00	0.00	0.00	0.06	2.48	19.64	42.59	195.00
TotalGasConsumpHeat [m^3 m^{-2}]	4.77	4.19	2.89	1.30	0.19	0.00	0.00	0.00	0.01	0.25	2.01	4.36	19.97
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	1.43	0.00	0.97	5.75	20.11	36.66	37.45	34.49	21.77	11.34	0.78	0.24	171.00
TotalElecCoolDemand [kW-hr m^{-2}]	0.46	0.00	0.31	1.84	6.43	11.71	11.97	11.02	6.96	3.62	0.25	0.08	54.63
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.94	4.99	5.64	5.45	4.95	3.98	3.67	3.53	3.50	4.46	4.62	5.22	54.96
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.51	0.58	0.56	0.51	0.41	0.38	0.36	0.36	0.46	0.47	0.53	5.63
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	25.60	139.50											

Table C.90: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] base case 2100.

C.2.2.2 Base-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	57.60	44.92	51.57	20.31	2.71	0.43	0.00	1.74	0.83	14.70	28.19	45.50	268.49
TotalGasConsumpHeat [m^3 m^{-2}]	5.90	4.60	5.28	2.08	0.28	0.04	0.00	0.18	0.09	1.51	2.89	4.66	27.50
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	0.00	0.81	12.39	19.90	27.64	20.93	11.86	2.71	0.08	1.82	98.15
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.00	0.26	3.96	6.36	8.83	6.69	3.79	0.86	0.03	0.58	31.36
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.91	4.99	5.64	5.47	4.49	3.77	3.59	3.68	3.59	4.52	4.71	5.22	54.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.58	0.56	0.46	0.39	0.37	0.38	0.37	0.46	0.48	0.53	5.59
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	33.09	116.23											

Table C.91: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] base case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	56.47	47.21	47.51	21.84	7.46	0.10	0.00	0.00	0.96	14.93	30.09	52.84	279.41
TotalGasConsumpHeat [m^3 m^{-2}]	5.78	4.83	4.87	2.24	0.76	0.01	0.00	0.00	0.10	1.53	3.08	5.41	28.62
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	1.49	0.00	0.33	5.81	24.57	31.35	28.74	18.77	5.98	0.98	0.01	118.05
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.48	0.00	0.11	1.86	7.85	10.02	9.18	6.00	1.91	0.31	0.00	37.71
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.16	5.10	5.69	5.42	4.56	3.98	3.73	3.68	3.68	4.39	4.62	5.31	55.32
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.53	0.52	0.58	0.55	0.47	0.41	0.38	0.38	0.38	0.45	0.47	0.54	5.67
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	34.28	122.58											

Table C.92: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] base case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	65.83	49.58	39.31	25.35	0.40	0.54	0.32	0.00	1.62	6.94	23.72	46.28	259.89
TotalGasConsumpHeat [m^3 m^{-2}]	6.74	5.08	4.03	2.60	0.04	0.05	0.03	0.00	0.17	0.71	2.43	4.74	26.62
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.77	0.74	22.10	19.20	29.79	26.83	15.53	5.01	0.51	4.65	125.13
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.24	0.24	7.06	6.14	9.52	8.57	4.96	1.60	0.16	1.48	39.98
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.10	5.09	5.64	5.47	4.91	3.77	3.68	3.66	3.59	4.23	4.64	5.31	55.09
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.58	0.56	0.50	0.39	0.38	0.38	0.37	0.43	0.48	0.54	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	32.26	124.85											

Table C.93: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] base case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	53.72	39.43	39.38	25.64	8.32	2.06	0.00	0.00	0.31	10.41	23.73	42.07	245.05
TotalGasConsumpHeat [m^3 m^{-2}]	5.50	4.04	4.03	2.63	0.85	0.21	0.00	0.00	0.03	1.07	2.43	4.31	25.10
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	1.21	3.53	11.86	20.84	31.92	32.69	25.54	3.42	0.94	6.11	138.08
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.39	1.13	3.79	6.66	10.20	10.44	8.16	1.09	0.30	1.95	44.12
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.77	5.59	5.05	4.03	3.76	3.43	3.69	4.14	4.62	5.28	55.54
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.59	0.57	0.52	0.41	0.38	0.35	0.38	0.42	0.47	0.54	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	30.79	128.99											

Table C.94: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] base case 2100.

C.2.2.3 VegH-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	53.36	57.32	33.28	19.06	7.56	0.61	0.18	0.14	2.04	9.49	34.16	40.10	257.31
TotalGasConsumpHeat [m^3 m^{-2}]	5.46	5.87	3.41	1.95	0.77	0.06	0.02	0.01	0.21	0.97	3.50	4.11	26.35
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.63	3.80	9.55	16.64	14.57	21.82	8.57	2.13	0.12	4.55	82.37
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.20	1.21	3.05	5.32	4.65	6.97	2.74	0.68	0.04	1.46	26.32
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.86	5.02	5.54	4.90	4.65	3.85	3.67	3.49	3.47	3.94	4.58	5.22	53.19
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.57	0.50	0.48	0.39	0.38	0.36	0.36	0.40	0.47	0.54	5.45
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	31.80	111.19											

Table C.95: Residential Gas and Electricity Consumption/Production for Toronto VegH case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.54	33.34	38.40	12.46	6.38	0.58	0.00	0.00	1.15	6.30	32.60	54.96	232.71
TotalGasConsumpHeat [m^3 m^{-2}]	4.77	3.41	3.93	1.28	0.65	0.06	0.00	0.00	0.12	0.64	3.34	5.63	23.83
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.53	1.81	0.99	1.41	5.80	20.51	27.37	22.92	13.47	7.25	0.10	0.11	102.27
TotalElecCoolDemand [kW-hr m^{-2}]	0.17	0.58	0.31	0.45	1.85	6.55	8.74	7.32	4.30	2.32	0.03	0.04	32.67
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.05	5.72	5.59	4.56	4.13	3.76	3.55	3.59	4.22	4.62	5.43	55.29
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.59	0.57	0.47	0.42	0.38	0.36	0.37	0.43	0.47	0.56	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	29.50	117.54											

Table C.96: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] VegH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	47.32	45.42	32.72	21.32	4.31	1.09	0.06	0.18	0.29	4.23	24.12	41.67	222.71
TotalGasConsumpHeat [m^3 m^{-2}]	4.85	4.65	3.35	2.18	0.44	0.11	0.01	0.02	0.03	0.43	2.47	4.27	22.81
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.22	0.61	17.14	24.22	35.20	32.79	22.34	1.79	0.67	3.14	138.13
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.07	0.19	5.48	7.74	11.25	10.48	7.14	0.57	0.22	1.00	44.13
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.64	5.47	4.58	3.77	3.67	3.53	3.59	4.25	4.50	5.21	54.43
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.56	0.47	0.39	0.38	0.36	0.37	0.44	0.46	0.53	5.57
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.38	129.00											

Table C.97: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] VegH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	47.19	42.75	48.48	12.89	0.48	0.36	0.00	0.00	0.00	9.90	24.50	42.22	228.77
TotalGasConsumpHeat [m^3 m^{-2}]	4.83	4.38	4.97	1.32	0.05	0.04	0.00	0.00	0.00	1.01	2.51	4.32	23.43
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	2.22	0.00	5.11	18.87	28.55	33.98	23.84	30.72	7.27	0.12	0.18	150.87
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.71	0.00	1.63	6.03	9.12	10.86	7.62	9.82	2.32	0.04	0.06	48.20
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.13	5.67	4.99	4.49	3.77	3.73	3.58	3.53	4.22	4.62	5.39	54.18
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.51	0.46	0.39	0.38	0.37	0.36	0.43	0.47	0.55	5.55
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.98	133.07											

Table C.98: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] VegH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.88	41.24	28.48	12.85	1.91	0.00	0.00	0.00	0.06	2.49	19.75	42.83	196.49
TotalGasConsumpHeat [m^3 m^{-2}]	4.80	4.22	2.92	1.32	0.20	0.00	0.00	0.00	0.01	0.25	2.02	4.39	20.12
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	1.39	0.00	0.80	5.27	19.29	35.57	36.41	33.66	21.10	10.83	0.66	0.20	165.18
TotalElecCoolDemand [kW-hr m^{-2}]	0.45	0.00	0.26	1.68	6.16	11.36	11.63	10.75	6.74	3.46	0.21	0.06	52.77
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.94	4.99	5.64	5.45	4.95	3.98	3.67	3.53	3.50	4.46	4.62	5.22	54.96
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.51	0.58	0.56	0.51	0.41	0.38	0.36	0.36	0.46	0.47	0.53	5.63
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	25.75	137.64											

Table C.99: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] VegH case 2100.

C.2.2.4 VegH-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	57.79	45.19	51.68	20.61	2.73	0.44	0.00	1.76	0.84	14.86	28.44	45.70	270.02
TotalGasConsumpHeat [m^3 m^{-2}]	5.92	4.63	5.29	2.11	0.28	0.04	0.00	0.18	0.09	1.52	2.91	4.68	27.66
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.00	0.61	11.73	19.00	26.77	20.00	11.19	2.39	0.03	1.78	93.51
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.19	3.75	6.07	8.55	6.39	3.58	0.76	0.01	0.57	29.88
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.91	4.99	5.64	5.47	4.49	3.77	3.59	3.68	3.59	4.52	4.71	5.22	54.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.58	0.56	0.46	0.39	0.37	0.38	0.37	0.46	0.48	0.53	5.59
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	33.25	114.74											

Table C.100: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] VegH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	56.72	47.57	47.88	22.11	7.60	0.10	0.00	0.00	0.98	15.09	30.28	52.94	281.28
TotalGasConsumpHeat [m^3 m^{-2}]	5.81	4.87	4.90	2.26	0.78	0.01	0.00	0.00	0.10	1.55	3.10	5.42	28.81
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	1.40	0.00	0.23	5.11	23.57	30.43	27.56	17.68	5.81	0.97	0.00	112.77
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.45	0.00	0.07	1.63	7.53	9.72	8.81	5.65	1.86	0.31	0.00	36.03
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.16	5.10	5.69	5.42	4.56	3.98	3.73	3.68	3.68	4.39	4.62	5.31	55.32
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.53	0.52	0.58	0.55	0.47	0.41	0.38	0.38	0.38	0.45	0.47	0.54	5.67
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	34.47	120.90											

Table C.101: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] VegH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	66.05	49.88	39.62	25.69	0.41	0.55	0.32	0.00	1.65	7.01	23.84	46.59	261.60
TotalGasConsumpHeat [m^3 m^{-2}]	6.76	5.11	4.06	2.63	0.04	0.06	0.03	0.00	0.17	0.72	2.44	4.77	26.79
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.67	0.51	21.27	18.32	28.80	25.69	14.73	4.44	0.43	4.56	119.42
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.21	0.16	6.79	5.85	9.20	8.21	4.71	1.42	0.14	1.46	38.15
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.10	5.09	5.64	5.47	4.91	3.77	3.68	3.66	3.59	4.23	4.64	5.31	55.09
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.58	0.56	0.50	0.39	0.38	0.38	0.37	0.43	0.48	0.54	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	32.44	123.02											

Table C.102: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] VegH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	53.85	39.78	39.87	25.96	8.42	2.09	0.00	0.00	0.31	10.48	23.96	42.28	247.00
TotalGasConsumpHeat [m^3 m^{-2}]	5.52	4.07	4.08	2.66	0.86	0.21	0.00	0.00	0.03	1.07	2.45	4.33	25.30
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.01	1.05	3.24	11.21	19.81	30.90	31.94	24.72	3.09	0.80	6.26	133.03
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.34	1.04	3.58	6.33	9.87	10.21	7.90	0.99	0.25	2.00	42.50
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.77	5.59	5.05	4.03	3.76	3.43	3.69	4.14	4.62	5.28	55.54
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.59	0.57	0.52	0.41	0.38	0.35	0.38	0.42	0.47	0.54	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	30.99	127.37											

Table C.103: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] VegH case 2100.

C.2.2.5 VegHH-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	53.52	57.63	33.67	19.30	7.65	0.62	0.18	0.14	2.06	9.55	34.39	40.27	258.98
TotalGasConsumpHeat [m^3 m^{-2}]	5.48	5.90	3.45	1.98	0.78	0.06	0.02	0.01	0.21	0.98	3.52	4.12	26.52
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.49	3.52	8.90	16.02	13.96	21.05	7.99	1.90	0.08	4.46	78.37
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.16	1.12	2.84	5.12	4.46	6.73	2.55	0.61	0.02	1.42	25.04
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.86	5.02	5.54	4.90	4.65	3.85	3.67	3.49	3.47	3.94	4.58	5.22	53.19
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.57	0.50	0.48	0.39	0.38	0.36	0.36	0.40	0.47	0.54	5.45
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	31.97	109.91											

Table C.104: Residential Gas and Electricity Consumption/Production for Toronto VegHH case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.76	33.51	38.65	12.65	6.48	0.58	0.00	0.00	1.16	6.35	32.73	55.39	234.27
TotalGasConsumpHeat [m^3 m^{-2}]	4.79	3.43	3.96	1.30	0.66	0.06	0.00	0.00	0.12	0.65	3.35	5.67	23.99
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.52	1.79	0.84	1.13	5.34	19.89	26.62	22.10	12.91	6.86	0.08	0.09	98.16
TotalElecCoolDemand [kW-hr m^{-2}]	0.17	0.57	0.27	0.36	1.71	6.36	8.50	7.06	4.12	2.19	0.03	0.03	31.36
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.05	5.72	5.59	4.56	4.13	3.76	3.55	3.59	4.22	4.62	5.43	55.29
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.59	0.57	0.47	0.42	0.38	0.36	0.37	0.43	0.47	0.56	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	29.66	116.23											

Table C.105: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] VegHH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	47.45	45.68	33.10	21.63	4.34	1.10	0.06	0.18	0.29	4.28	24.29	41.91	224.29
TotalGasConsumpHeat [m^3 m^{-2}]	4.86	4.68	3.39	2.21	0.44	0.11	0.01	0.02	0.03	0.44	2.49	4.29	22.97
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.15	0.49	16.33	23.39	34.40	31.69	21.31	1.52	0.56	3.13	132.98
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.05	0.16	5.22	7.47	10.99	10.13	6.81	0.49	0.18	1.00	42.49
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.64	5.47	4.58	3.77	3.67	3.53	3.59	4.25	4.50	5.21	54.43
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.56	0.47	0.39	0.38	0.36	0.37	0.44	0.46	0.53	5.57
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.55	127.35											

Table C.106: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] VegHH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	47.37	43.10	48.81	13.04	0.48	0.37	0.00	0.00	0.00	9.97	24.64	42.54	230.32
TotalGasConsumpHeat [m^3 m^{-2}]	4.85	4.41	5.00	1.34	0.05	0.04	0.00	0.00	0.00	1.02	2.52	4.36	23.59
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	2.09	0.00	4.83	18.19	27.87	33.19	22.97	29.51	6.58	0.09	0.13	145.44
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.67	0.00	1.54	5.81	8.90	10.60	7.34	9.43	2.10	0.03	0.04	46.47
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.13	5.67	4.99	4.49	3.77	3.73	3.58	3.53	4.22	4.62	5.39	54.18
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.51	0.46	0.39	0.38	0.37	0.36	0.43	0.47	0.55	5.55
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	29.14	131.34											

Table C.107: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] VegHH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	47.12	41.58	28.74	12.97	1.92	0.00	0.00	0.00	0.06	2.50	19.85	43.04	197.80
TotalGasConsumpHeat [m^3 m^{-2}]	4.83	4.26	2.94	1.33	0.20	0.00	0.00	0.00	0.01	0.26	2.03	4.41	20.26
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	1.39	0.00	0.68	4.88	18.63	34.76	35.60	33.01	20.57	10.43	0.57	0.17	160.69
TotalElecCoolDemand [kW-hr m^{-2}]	0.44	0.00	0.22	1.56	5.95	11.11	11.38	10.55	6.57	3.33	0.18	0.06	51.34
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.94	4.99	5.64	5.45	4.95	3.98	3.67	3.53	3.50	4.46	4.62	5.22	54.96
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.51	0.58	0.56	0.51	0.41	0.38	0.36	0.36	0.46	0.47	0.53	5.63
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	25.89	136.21											

Table C.108: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] VegHH case 2100.

C.2.2.6 VegHH-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	57.95	45.42	51.78	20.89	2.75	0.44	0.00	1.77	0.85	15.02	28.66	45.84	271.38
TotalGasConsumpHeat [m^3 m^{-2}]	5.94	4.65	5.30	2.14	0.28	0.05	0.00	0.18	0.09	1.54	2.94	4.70	27.79
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.00	0.45	11.21	18.33	26.11	19.25	10.65	2.14	0.01	1.77	89.93
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.14	3.58	5.85	8.34	6.15	3.40	0.68	0.00	0.56	28.73
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.91	4.99	5.64	5.47	4.49	3.77	3.59	3.68	3.59	4.52	4.71	5.22	54.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.58	0.56	0.46	0.39	0.37	0.38	0.37	0.46	0.48	0.53	5.59
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	33.38	113.60											

Table C.109: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] VegHH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	56.94	47.87	48.18	22.37	7.73	0.11	0.00	0.00	1.00	15.26	30.46	53.03	282.93
TotalGasConsumpHeat [m^3 m^{-2}]	5.83	4.90	4.93	2.29	0.79	0.01	0.00	0.00	0.10	1.56	3.12	5.43	28.98
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	1.41	0.00	0.15	4.60	22.82	29.73	26.63	16.85	5.45	0.96	0.00	108.59
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.45	0.00	0.05	1.47	7.29	9.50	8.51	5.38	1.74	0.31	0.00	34.69
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.16	5.10	5.69	5.42	4.56	3.98	3.73	3.68	3.68	4.39	4.62	5.31	55.32
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.53	0.52	0.58	0.55	0.47	0.41	0.38	0.38	0.38	0.45	0.47	0.54	5.67
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	34.64	119.56											

Table C.110: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] VegHH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	66.23	50.13	39.90	26.00	0.41	0.55	0.32	0.00	1.66	7.08	23.96	46.87	263.12
TotalGasConsumpHeat [m^3 m^{-2}]	6.78	5.13	4.09	2.66	0.04	0.06	0.03	0.00	0.17	0.73	2.45	4.80	26.95
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.60	0.35	20.61	17.66	28.04	24.80	14.10	3.99	0.38	4.46	114.97
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.19	0.11	6.59	5.64	8.96	7.92	4.50	1.28	0.12	1.42	36.73
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.10	5.09	5.64	5.47	4.91	3.77	3.68	3.66	3.59	4.23	4.64	5.31	55.09
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.58	0.56	0.50	0.39	0.38	0.38	0.37	0.43	0.48	0.54	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	32.59	121.60											

Table C.111: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] VegHH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	53.96	40.10	40.32	26.24	8.51	2.12	0.00	0.00	0.31	10.55	24.17	42.41	248.70
TotalGasConsumpHeat [m^3 m^{-2}]	5.53	4.11	4.13	2.69	0.87	0.22	0.00	0.00	0.03	1.08	2.48	4.34	25.47
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.93	3.02	10.70	19.04	30.11	31.36	24.09	2.82	0.70	6.35	129.13
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.30	0.96	3.42	6.08	9.62	10.02	7.70	0.90	0.22	2.03	41.25
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.77	5.59	5.05	4.03	3.76	3.43	3.69	4.14	4.62	5.28	55.54
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.59	0.57	0.52	0.41	0.38	0.35	0.38	0.42	0.47	0.54	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	31.16	126.12											

Table C.112: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] VegHH case 2100.

C.2.2.7 RvalH-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	51.71	55.34	31.83	18.00	7.08	0.52	0.12	0.10	1.75	8.94	32.78	38.67	246.84
TotalGasConsumpHeat [m^3 m^{-2}]	5.30	5.67	3.26	1.84	0.72	0.05	0.01	0.01	0.18	0.92	3.36	3.96	25.28
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.80	3.69	10.15	17.16	15.13	22.26	8.97	2.34	0.20	4.97	85.67
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.26	1.18	3.24	5.48	4.83	7.11	2.87	0.75	0.06	1.59	27.37
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.86	5.02	5.54	4.90	4.65	3.85	3.67	3.49	3.47	3.94	4.58	5.22	53.19
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.57	0.50	0.48	0.39	0.38	0.36	0.36	0.40	0.47	0.54	5.45
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	30.73	112.24											

Table C.113: Residential Gas and Electricity Consumption/Production for Toronto RvalH case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	44.83	31.67	36.98	11.86	5.99	0.49	0.00	0.00	0.96	5.77	31.31	53.12	222.98
TotalGasConsumpHeat [m^3 m^{-2}]	4.59	3.24	3.79	1.21	0.61	0.05	0.00	0.00	0.10	0.59	3.21	5.44	22.84
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.42	1.94	1.14	1.69	6.24	20.82	27.76	23.55	13.90	7.35	0.12	0.17	105.10
TotalElecCoolDemand [kW-hr m^{-2}]	0.13	0.62	0.36	0.54	1.99	6.65	8.87	7.53	4.44	2.35	0.04	0.05	33.58
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.05	5.72	5.59	4.56	4.13	3.76	3.55	3.59	4.22	4.62	5.43	55.29
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.59	0.57	0.47	0.42	0.38	0.36	0.37	0.43	0.47	0.56	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.50	118.45											

Table C.114: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] RvalH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	45.75	43.77	31.20	20.13	3.93	0.95	0.04	0.13	0.22	3.86	23.00	39.76	212.75
TotalGasConsumpHeat [m^3 m^{-2}]	4.69	4.48	3.20	2.06	0.40	0.10	0.00	0.01	0.02	0.40	2.36	4.07	21.79
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.33	0.79	17.86	24.70	35.61	33.55	23.30	2.05	0.81	2.98	141.97
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.10	0.25	5.71	7.89	11.38	10.72	7.44	0.65	0.26	0.95	45.36
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.64	5.47	4.58	3.77	3.67	3.53	3.59	4.25	4.50	5.21	54.43
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.56	0.47	0.39	0.38	0.36	0.37	0.44	0.46	0.53	5.57
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	27.36	130.23											

Table C.115: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] RvalH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	45.50	40.80	46.68	12.11	0.36	0.31	0.00	0.00	0.00	9.18	23.43	40.80	219.17
TotalGasConsumpHeat [m^3 m^{-2}]	4.66	4.18	4.78	1.24	0.04	0.03	0.00	0.00	0.00	0.94	2.40	4.18	22.45
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	1.75	0.00	5.17	19.33	28.85	34.46	24.47	31.51	7.87	0.17	0.28	153.88
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.56	0.00	1.65	6.18	9.22	11.01	7.82	10.07	2.51	0.06	0.09	49.16
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.13	5.67	4.99	4.49	3.77	3.73	3.58	3.53	4.22	4.62	5.39	54.18
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.51	0.46	0.39	0.38	0.37	0.36	0.43	0.47	0.55	5.55
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.00	134.03											

Table C.116: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] RvalH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	45.08	39.65	27.16	12.14	1.70	0.00	0.00	0.00	0.03	2.20	18.89	41.37	188.22
TotalGasConsumpHeat [m^3 m^{-2}]	4.62	4.06	2.78	1.24	0.17	0.00	0.00	0.00	0.00	0.23	1.93	4.24	19.28
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	1.05	0.00	0.95	5.55	19.73	35.89	36.61	33.91	21.43	11.12	0.75	0.22	167.20
TotalElecCoolDemand [kW-hr m^{-2}]	0.33	0.00	0.30	1.77	6.30	11.47	11.70	10.83	6.85	3.55	0.24	0.07	53.42
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.94	4.99	5.64	5.45	4.95	3.98	3.67	3.53	3.50	4.46	4.62	5.22	54.96
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.51	0.58	0.56	0.51	0.41	0.38	0.36	0.36	0.46	0.47	0.53	5.63
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	24.91	138.29											

Table C.117: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] RvalH case 2100.

C.2.2.8 RvalH-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	56.00	43.59	50.04	19.48	2.42	0.37	0.00	1.57	0.69	14.01	27.27	43.85	259.29
TotalGasConsumpHeat [m^3 m^{-2}]	5.74	4.46	5.12	1.99	0.25	0.04	0.00	0.16	0.07	1.43	2.79	4.49	26.56
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	0.00	0.80	12.03	19.27	27.18	20.45	11.59	2.63	0.08	1.40	95.45
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.00	0.26	3.84	6.16	8.68	6.53	3.70	0.84	0.03	0.45	30.49
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.91	4.99	5.64	5.47	4.49	3.77	3.59	3.68	3.59	4.52	4.71	5.22	54.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.58	0.56	0.46	0.39	0.37	0.38	0.37	0.46	0.48	0.53	5.59
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	32.15	115.36											

Table C.118: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] RvalH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	54.79	45.83	46.12	20.97	7.12	0.06	0.00	0.00	0.80	14.18	28.94	51.18	269.98
TotalGasConsumpHeat [m^3 m^{-2}]	5.61	4.69	4.72	2.15	0.73	0.01	0.00	0.00	0.08	1.45	2.96	5.24	27.65
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	1.21	0.00	0.33	5.55	24.03	30.66	28.27	18.42	5.57	0.95	0.01	115.01
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.39	0.00	0.11	1.77	7.68	9.79	9.03	5.88	1.78	0.31	0.00	36.74
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.16	5.10	5.69	5.42	4.56	3.98	3.73	3.68	3.68	4.39	4.62	5.31	55.32
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.53	0.52	0.58	0.55	0.47	0.41	0.38	0.38	0.38	0.45	0.47	0.54	5.67
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	33.32	121.61											

Table C.119: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] RvalH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	63.90	48.11	38.21	24.37	0.32	0.45	0.28	0.00	1.41	6.48	22.88	44.77	251.20
TotalGasConsumpHeat [m^3 m^{-2}]	6.54	4.93	3.91	2.50	0.03	0.05	0.03	0.00	0.14	0.66	2.34	4.59	25.73
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.73	0.76	21.58	18.68	29.25	26.31	15.03	4.84	0.48	4.04	121.71
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.23	0.24	6.90	5.97	9.34	8.40	4.80	1.55	0.15	1.29	38.88
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.10	5.09	5.64	5.47	4.91	3.77	3.68	3.66	3.59	4.23	4.64	5.31	55.09
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.58	0.56	0.50	0.39	0.38	0.38	0.37	0.43	0.48	0.54	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	31.37	123.75											

Table C.120: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] RvalH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	52.16	38.22	38.08	24.78	7.91	1.92	0.00	0.00	0.24	9.80	9.06	19.20	201.35
TotalGasConsumpHeat [m^3 m^{-2}]	5.34	3.91	3.90	2.54	0.81	0.20	0.00	0.00	0.02	1.00	0.93	1.97	20.62
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	1.09	3.42	11.47	20.34	31.24	32.08	25.05	3.34	1.94	5.58	135.57
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.35	1.09	3.66	6.50	9.98	10.25	8.00	1.07	0.62	1.78	43.31
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.77	5.59	5.05	4.03	3.76	3.43	3.69	4.14	4.62	5.28	55.54
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.59	0.57	0.52	0.41	0.38	0.35	0.38	0.42	0.47	0.54	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	26.31	128.18											

Table C.121: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] RvalH case 2100.

C.2.2.9 InfLL-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	26.22	27.52	13.19	6.04	1.77	0.03	0.00	0.00	0.10	2.61	14.63	18.27	110.39
TotalGasConsumpHeat [m^3 m^{-2}]	2.69	2.82	1.35	0.62	0.18	0.00	0.00	0.00	0.01	0.27	1.50	1.87	11.31
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.09	3.03	6.55	15.11	21.02	19.31	25.00	13.27	4.96	1.07	4.70	114.11
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.03	0.97	2.09	4.83	6.72	6.17	7.99	4.24	1.59	0.34	1.50	36.46
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.86	5.02	5.54	4.90	4.65	3.85	3.67	3.49	3.47	3.94	4.58	5.22	53.19
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.57	0.50	0.48	0.39	0.38	0.36	0.36	0.40	0.47	0.54	5.45
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	16.75	121.33											

Table C.122: Residential Gas and Electricity Consumption/Production for Toronto InfLL case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	22.18	13.85	16.39	2.83	1.43	0.02	0.00	0.00	0.08	1.30	14.05	25.25	97.39
TotalGasConsumpHeat [m^3 m^{-2}]	2.27	1.42	1.68	0.29	0.15	0.00	0.00	0.00	0.01	0.13	1.44	2.59	9.97
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.60	2.50	3.05	5.04	10.97	23.49	29.21	25.95	16.82	10.46	0.54	0.88	129.52
TotalElecCoolDemand [kW-hr m^{-2}]	0.19	0.80	0.97	1.61	3.51	7.50	9.33	8.29	5.37	3.34	0.17	0.28	41.38
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.05	5.72	5.59	4.56	4.13	3.76	3.55	3.59	4.22	4.62	5.43	55.29
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.59	0.57	0.47	0.42	0.38	0.36	0.37	0.43	0.47	0.56	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	15.64	126.25											

Table C.123: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] InfLL case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	22.87	21.18	12.55	6.99	0.86	0.18	0.00	0.00	0.00	0.38	9.27	18.63	92.89
TotalGasConsumpHeat [m^3 m^{-2}]	2.34	2.17	1.28	0.72	0.09	0.02	0.00	0.00	0.00	0.04	0.95	1.91	9.51
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.06	0.36	1.55	3.22	22.08	27.39	34.17	33.76	26.10	5.74	1.82	3.20	159.45
TotalElecCoolDemand [kW-hr m^{-2}]	0.02	0.11	0.49	1.03	7.05	8.75	10.92	10.78	8.34	1.83	0.58	1.02	50.94
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.64	5.47	4.58	3.77	3.67	3.53	3.59	4.25	4.50	5.21	54.43
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.56	0.47	0.39	0.38	0.36	0.37	0.44	0.46	0.53	5.57
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	15.09	135.81											

Table C.124: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] InfLL case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	22.57	19.16	21.40	3.76	0.00	0.02	0.00	0.00	0.00	2.74	9.25	18.46	97.37
TotalGasConsumpHeat [m^3 m^{-2}]	2.31	1.96	2.19	0.39	0.00	0.00	0.00	0.00	0.00	0.28	0.95	1.89	9.97
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.02	2.15	0.15	8.33	22.80	29.40	33.89	26.94	32.56	12.25	0.70	1.47	170.66
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.69	0.05	2.66	7.28	9.39	10.83	8.61	10.40	3.91	0.22	0.47	54.52
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.13	5.67	4.99	4.49	3.77	3.73	3.58	3.53	4.22	4.62	5.39	54.18
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.51	0.46	0.39	0.38	0.37	0.36	0.43	0.47	0.55	5.55
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	15.52	139.39											

Table C.125: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] InfLL case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	21.88	18.24	10.82	3.95	0.24	0.00	0.00	0.00	0.00	0.32	7.10	19.58	82.13
TotalGasConsumpHeat [m^3 m^{-2}]	2.24	1.87	1.11	0.40	0.02	0.00	0.00	0.00	0.00	0.03	0.73	2.01	8.41
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	1.32	0.24	2.71	9.12	22.08	34.84	34.93	31.83	22.18	13.37	1.78	0.75	175.16
TotalElecCoolDemand [kW-hr m^{-2}]	0.42	0.08	0.86	2.91	7.05	11.13	11.16	10.17	7.09	4.27	0.57	0.24	55.96
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.94	4.99	5.64	5.45	4.95	3.98	3.67	3.53	3.50	4.46	4.62	5.22	54.96
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.51	0.58	0.56	0.51	0.41	0.38	0.36	0.36	0.46	0.47	0.53	5.63
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	14.04	140.83											

Table C.126: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] InfLL case 2100.

C.2.2.10 InfLL-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	28.96	21.01	24.70	6.58	0.25	0.02	0.00	0.32	0.03	4.68	11.25	21.34	119.14
TotalGasConsumpHeat [m^3 m^{-2}]	2.97	2.15	2.53	0.67	0.03	0.00	0.00	0.03	0.00	0.48	1.15	2.19	12.20
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.29	0.00	3.31	16.38	23.21	27.97	22.82	15.46	5.02	0.63	1.71	116.78
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.09	0.00	1.06	5.23	7.41	8.94	7.29	4.94	1.60	0.20	0.55	37.31
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.91	4.99	5.64	5.47	4.49	3.77	3.59	3.68	3.59	4.52	4.71	5.22	54.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.58	0.56	0.46	0.39	0.37	0.38	0.37	0.46	0.48	0.53	5.59
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	17.79	122.18											

Table C.127: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] InfLL case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	28.27	21.84	21.10	6.91	1.69	0.00	0.00	0.00	0.06	4.19	12.64	26.20	122.89
TotalGasConsumpHeat [m^3 m^{-2}]	2.90	2.24	2.16	0.71	0.17	0.00	0.00	0.00	0.01	0.43	1.29	2.68	12.59
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.03	1.54	0.17	1.75	11.35	27.24	30.62	29.56	21.53	7.02	1.20	0.09	132.09
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.49	0.05	0.56	3.63	8.70	9.78	9.45	6.88	2.24	0.38	0.03	42.20
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.16	5.10	5.69	5.42	4.56	3.98	3.73	3.68	3.68	4.39	4.62	5.31	55.32
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.53	0.52	0.58	0.55	0.47	0.41	0.38	0.38	0.38	0.45	0.47	0.54	5.67
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	18.25	127.07											

Table C.128: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] InfLL case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	33.97	23.62	17.34	9.22	0.06	0.04	0.04	0.00	0.18	1.56	9.54	21.24	116.81
TotalGasConsumpHeat [m^3 m^{-2}]	3.48	2.42	1.78	0.94	0.01	0.00	0.00	0.00	0.02	0.16	0.98	2.18	11.96
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.16	2.22	3.34	24.76	22.73	29.78	28.09	18.12	8.60	1.19	4.08	143.07
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.05	0.71	1.07	7.91	7.26	9.51	8.97	5.79	2.75	0.38	1.30	45.71
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.10	5.09	5.64	5.47	4.91	3.77	3.68	3.66	3.59	4.23	4.64	5.31	55.09
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.58	0.56	0.50	0.39	0.38	0.38	0.37	0.43	0.48	0.54	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	17.61	130.58											

Table C.129: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] InfLL case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	26.96	17.48	16.68	10.02	2.23	0.47	0.00	0.00	0.00	2.83	9.06	19.20	104.93
TotalGasConsumpHeat [m^3 m^{-2}]	2.76	1.79	1.71	1.03	0.23	0.05	0.00	0.00	0.00	0.29	0.93	1.97	10.75
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.76	2.94	5.71	14.90	23.75	31.84	30.25	24.80	5.84	1.94	5.58	148.31
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.24	0.94	1.82	4.76	7.59	10.17	9.67	7.92	1.86	0.62	1.78	47.38
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.77	5.59	5.05	4.03	3.76	3.43	3.69	4.14	4.62	5.28	55.54
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.59	0.57	0.52	0.41	0.38	0.35	0.38	0.42	0.47	0.54	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	16.44	132.25											

Table C.130: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] InfLL case 2100.

C.2.2.11 InfL-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	36.13	38.23	20.04	10.37	3.58	0.18	0.02	0.01	0.55	4.81	21.54	26.13	161.57
TotalGasConsumpHeat [m^3 m^{-2}]	3.70	3.92	2.05	1.06	0.37	0.02	0.00	0.00	0.06	0.49	2.21	2.68	16.55
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	1.83	5.38	13.07	19.58	17.69	24.09	11.56	3.70	0.63	4.70	102.23
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.59	1.72	4.18	6.26	5.65	7.70	3.69	1.18	0.20	1.50	32.66
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.86	5.02	5.54	4.90	4.65	3.85	3.67	3.49	3.47	3.94	4.58	5.22	53.19
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.57	0.50	0.48	0.39	0.38	0.36	0.36	0.40	0.47	0.54	5.45
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	22.00	117.53											

Table C.131: Residential Gas and Electricity Consumption/Production for Toronto InfL case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	30.95	20.72	24.16	5.88	2.91	0.16	0.00	0.00	0.32	2.86	20.71	35.73	144.40
TotalGasConsumpHeat [m^3 m^{-2}]	3.17	2.12	2.47	0.60	0.30	0.02	0.00	0.00	0.03	0.29	2.12	3.66	14.79
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.54	2.18	2.19	3.40	8.87	22.56	28.84	25.16	15.66	9.22	0.32	0.46	119.39
TotalElecCoolDemand [kW-hr m^{-2}]	0.17	0.70	0.70	1.09	2.83	7.21	9.21	8.04	5.00	2.94	0.10	0.15	38.14
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.05	5.72	5.59	4.56	4.13	3.76	3.55	3.59	4.22	4.62	5.43	55.29
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.59	0.57	0.47	0.42	0.38	0.36	0.37	0.43	0.47	0.56	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	20.45	123.01											

Table C.132: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] InfL case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	31.76	29.88	19.40	11.73	1.91	0.42	0.00	0.04	0.03	1.42	14.48	26.84	137.92
TotalGasConsumpHeat [m^3 m^{-2}]	3.25	3.06	1.99	1.20	0.20	0.04	0.00	0.00	0.00	0.15	1.48	2.75	14.13
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.02	0.09	0.87	1.94	20.45	26.50	34.89	33.86	25.09	3.92	1.32	3.14	152.10
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.03	0.28	0.62	6.53	8.46	11.15	10.82	8.02	1.25	0.42	1.00	48.59
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.64	5.47	4.58	3.77	3.67	3.53	3.59	4.25	4.50	5.21	54.43
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.56	0.47	0.39	0.38	0.36	0.37	0.44	0.46	0.53	5.57
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	19.70	133.46											

Table C.133: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] InfL case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	31.49	27.52	30.98	6.69	0.06	0.11	0.00	0.00	0.00	5.04	14.67	26.86	143.41
TotalGasConsumpHeat [m^3 m^{-2}]	3.22	2.82	3.17	0.69	0.01	0.01	0.00	0.00	0.00	0.52	1.50	2.75	14.69
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	2.09	0.02	7.02	21.54	29.35	34.29	26.18	32.40	10.43	0.41	0.82	164.54
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.67	0.01	2.24	6.88	9.38	10.96	8.36	10.35	3.33	0.13	0.26	52.57
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.13	5.67	4.99	4.49	3.77	3.73	3.58	3.53	4.22	4.62	5.39	54.18
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.51	0.46	0.39	0.38	0.37	0.36	0.43	0.47	0.55	5.55
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	20.24	137.44											

Table C.134: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] InfL case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	30.83	26.37	16.90	6.91	0.70	0.00	0.00	0.00	0.00	0.94	11.50	27.90	122.04
TotalGasConsumpHeat [m^3 m^{-2}]	3.16	2.70	1.73	0.71	0.07	0.00	0.00	0.00	0.00	0.10	1.18	2.86	12.50
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	1.36	0.04	1.87	7.59	21.19	35.50	35.84	32.79	21.96	12.39	1.28	0.48	172.29
TotalElecCoolDemand [kW-hr m^{-2}]	0.43	0.01	0.60	2.42	6.77	11.34	11.45	10.48	7.02	3.96	0.41	0.15	55.04
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.94	4.99	5.64	5.45	4.95	3.98	3.67	3.53	3.50	4.46	4.62	5.22	54.96
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.51	0.58	0.56	0.51	0.41	0.38	0.36	0.36	0.46	0.47	0.53	5.63
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	18.13	139.91											

Table C.135: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] InfL case 2100.

C.2.2.12 InfL-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	39.48	29.72	34.53	11.22	0.92	0.12	0.00	0.75	0.20	8.06	17.32	30.13	172.47
TotalGasConsumpHeat [m^3 m^{-2}]	4.04	3.04	3.54	1.15	0.09	0.01	0.00	0.08	0.02	0.83	1.77	3.09	17.66
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.13	0.00	1.96	14.65	21.84	27.80	21.94	13.95	3.85	0.32	1.76	108.20
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.04	0.00	0.63	4.68	6.98	8.88	7.01	4.46	1.23	0.10	0.56	34.57
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.91	4.99	5.64	5.47	4.49	3.77	3.59	3.68	3.59	4.52	4.71	5.22	54.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.58	0.56	0.46	0.39	0.37	0.38	0.37	0.46	0.48	0.53	5.59
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	23.25	119.44											

Table C.136: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] InfL case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	38.61	31.08	30.60	12.07	3.42	0.00	0.00	0.00	0.27	7.81	18.93	35.97	178.77
TotalGasConsumpHeat [m^3 m^{-2}]	3.95	3.18	3.13	1.24	0.35	0.00	0.00	0.00	0.03	0.80	1.94	3.68	18.31
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.01	1.52	0.04	0.91	8.79	26.18	30.87	29.22	20.34	6.44	1.06	0.05	125.43
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.48	0.01	0.29	2.81	8.36	9.86	9.33	6.50	2.06	0.34	0.02	40.07
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.16	5.10	5.69	5.42	4.56	3.98	3.73	3.68	3.68	4.39	4.62	5.31	55.32
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.53	0.52	0.58	0.55	0.47	0.41	0.38	0.38	0.38	0.45	0.47	0.54	5.67
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	23.97	124.94											

Table C.137: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] InfL case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	45.68	33.08	25.20	14.80	0.15	0.17	0.13	0.00	0.55	3.24	14.57	30.29	167.84
TotalGasConsumpHeat [m^3 m^{-2}]	4.68	3.39	2.58	1.52	0.01	0.02	0.01	0.00	0.06	0.33	1.49	3.10	17.19
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.05	1.44	2.05	23.67	21.30	29.71	27.56	16.98	6.92	0.82	4.34	134.84
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.02	0.46	0.66	7.56	6.81	9.49	8.81	5.42	2.21	0.26	1.39	43.08
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.10	5.09	5.64	5.47	4.91	3.77	3.68	3.66	3.59	4.23	4.64	5.31	55.09
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.58	0.56	0.50	0.39	0.38	0.38	0.37	0.43	0.48	0.54	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	22.83	127.95											

Table C.138: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] InfL case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	36.80	25.32	24.60	15.44	4.23	0.95	0.00	0.00	0.05	5.36	14.25	27.40	154.39
TotalGasConsumpHeat [m^3 m^{-2}]	3.77	2.59	2.52	1.58	0.43	0.10	0.00	0.00	0.01	0.55	1.46	2.81	15.81
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.27	2.01	4.62	13.51	22.50	31.84	31.14	24.98	4.65	1.43	5.79	142.74
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.09	0.64	1.47	4.32	7.19	10.17	9.95	7.98	1.48	0.46	1.85	45.60
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.77	5.59	5.05	4.03	3.76	3.43	3.69	4.14	4.62	5.28	55.54
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.59	0.57	0.52	0.41	0.38	0.35	0.38	0.42	0.47	0.54	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	21.50	130.47											

Table C.139: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] InfL case 2100.

C.2.2.13 CR-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	53.30	57.17	33.14	19.06	7.73	0.66	0.21	0.17	2.12	9.56	34.03	40.01	257.13
TotalGasConsumpHeat [m^3 m^{-2}]	5.46	5.85	3.39	1.95	0.79	0.07	0.02	0.02	0.22	0.98	3.49	4.10	26.33
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.80	4.08	10.12	17.05	15.00	22.31	9.14	2.39	0.20	4.61	85.71
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.26	1.30	3.23	5.45	4.79	7.13	2.92	0.76	0.06	1.47	27.38
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.86	5.02	5.54	4.90	4.65	3.85	3.67	3.49	3.47	3.94	4.58	5.22	53.19
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.57	0.50	0.48	0.39	0.38	0.36	0.36	0.40	0.47	0.54	5.45
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	31.78	112.25											

Table C.140: Residential Gas and Electricity Consumption/Production for Toronto CR case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.36	33.28	38.43	12.58	6.51	0.62	0.00	0.00	1.19	6.35	32.54	54.61	232.48
TotalGasConsumpHeat [m^3 m^{-2}]	4.75	3.41	3.94	1.29	0.67	0.06	0.00	0.00	0.12	0.65	3.33	5.59	23.81
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.54	1.87	1.16	1.74	6.28	20.86	27.72	23.48	13.94	7.64	0.13	0.17	105.52
TotalElecCoolDemand [kW-hr m^{-2}]	0.17	0.60	0.37	0.56	2.01	6.67	8.86	7.50	4.45	2.44	0.04	0.05	33.71
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.05	5.72	5.59	4.56	4.13	3.76	3.55	3.59	4.22	4.62	5.43	55.29
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.59	0.57	0.47	0.42	0.38	0.36	0.37	0.43	0.47	0.56	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	29.47	118.58											

Table C.141: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] CR case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	47.28	45.33	32.53	21.29	4.47	1.14	0.07	0.19	0.30	4.33	24.04	41.49	222.46
TotalGasConsumpHeat [m^3 m^{-2}]	4.84	4.64	3.33	2.18	0.46	0.12	0.01	0.02	0.03	0.44	2.46	4.25	22.78
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.32	0.77	17.86	24.74	35.72	33.64	23.44	2.09	0.82	3.14	142.56
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.10	0.25	5.70	7.91	11.41	10.75	7.49	0.67	0.26	1.00	45.54
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.64	5.47	4.58	3.77	3.67	3.53	3.59	4.25	4.50	5.21	54.43
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.56	0.47	0.39	0.38	0.36	0.37	0.44	0.46	0.53	5.57
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.36	130.41											

Table C.142: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] CR case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	47.09	42.59	48.38	12.98	0.53	0.38	0.00	0.00	0.00	9.96	24.47	42.03	228.41
TotalGasConsumpHeat [m^3 m^{-2}]	4.82	4.36	4.95	1.33	0.05	0.04	0.00	0.00	0.00	1.02	2.51	4.31	23.39
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	2.18	0.00	5.54	19.34	28.95	34.38	24.42	31.81	8.10	0.18	0.27	155.17
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.70	0.00	1.77	6.18	9.25	10.98	7.80	10.16	2.59	0.06	0.09	49.57
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.13	5.67	4.99	4.49	3.77	3.73	3.58	3.53	4.22	4.62	5.39	54.18
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.51	0.46	0.39	0.38	0.37	0.36	0.43	0.47	0.55	5.55
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.94	134.44											

Table C.143: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] CR case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.75	41.06	28.46	13.01	1.99	0.00	0.00	0.00	0.07	2.53	19.76	42.73	196.35
TotalGasConsumpHeat [m^3 m^{-2}]	4.79	4.20	2.91	1.33	0.20	0.00	0.00	0.00	0.01	0.26	2.02	4.38	20.11
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	1.42	0.00	0.95	5.64	19.85	35.99	36.87	34.09	21.54	11.23	0.77	0.23	168.59
TotalElecCoolDemand [kW-hr m^{-2}]	0.46	0.00	0.30	1.80	6.34	11.50	11.78	10.89	6.88	3.59	0.25	0.07	53.86
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.94	4.99	5.64	5.45	4.95	3.98	3.67	3.53	3.50	4.46	4.62	5.22	54.96
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.51	0.58	0.56	0.51	0.41	0.38	0.36	0.36	0.46	0.47	0.53	5.63
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	25.74	138.73											

Table C.144: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] CR case 2100.

C.2.2.14 CR-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	57.73	45.08	51.73	20.62	2.87	0.47	0.00	1.83	0.87	14.91	28.31	45.60	270.04
TotalGasConsumpHeat [m^3 m^{-2}]	5.91	4.62	5.30	2.11	0.29	0.05	0.00	0.19	0.09	1.53	2.90	4.67	27.66
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	0.00	0.79	12.10	19.37	27.18	20.55	11.62	2.67	0.08	1.82	96.20
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.00	0.25	3.87	6.19	8.68	6.57	3.71	0.85	0.03	0.58	30.74
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.91	4.99	5.64	5.47	4.49	3.77	3.59	3.68	3.59	4.52	4.71	5.22	54.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.58	0.56	0.46	0.39	0.37	0.38	0.37	0.46	0.48	0.53	5.59
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	33.25	115.60											

Table C.145: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] CR case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	56.58	47.37	47.79	22.14	7.78	0.12	0.00	0.00	1.02	15.10	30.19	52.93	281.03
TotalGasConsumpHeat [m^3 m^{-2}]	5.79	4.85	4.90	2.27	0.80	0.01	0.00	0.00	0.10	1.55	3.09	5.42	28.78
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	1.49	0.00	0.33	5.63	23.86	30.80	28.24	18.45	5.96	0.98	0.01	115.76
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.48	0.00	0.11	1.80	7.62	9.84	9.02	5.90	1.91	0.31	0.00	36.99
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.16	5.10	5.69	5.42	4.56	3.98	3.73	3.68	3.68	4.39	4.62	5.31	55.32
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.53	0.52	0.58	0.55	0.47	0.41	0.38	0.38	0.38	0.45	0.47	0.54	5.67
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	34.45	121.85											

Table C.146: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] CR case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	65.93	49.76	39.60	25.66	0.43	0.58	0.33	0.00	1.70	7.08	23.84	46.40	261.33
TotalGasConsumpHeat [m^3 m^{-2}]	6.75	5.10	4.06	2.63	0.04	0.06	0.03	0.00	0.17	0.73	2.44	4.75	26.76
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.75	0.72	21.53	18.68	29.30	26.40	15.24	4.95	0.50	4.64	122.71
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.24	0.23	6.88	5.97	9.36	8.43	4.87	1.58	0.16	1.48	39.20
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.10	5.09	5.64	5.47	4.91	3.77	3.68	3.66	3.59	4.23	4.64	5.31	55.09
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.58	0.56	0.50	0.39	0.38	0.38	0.37	0.43	0.48	0.54	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	32.41	124.07											

Table C.147: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] CR case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	53.84	39.65	39.68	25.93	8.57	2.17	0.00	0.00	0.33	10.54	23.86	42.15	246.72
TotalGasConsumpHeat [m^3 m^{-2}]	5.51	4.06	4.06	2.66	0.88	0.22	0.00	0.00	0.03	1.08	2.44	4.32	25.27
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	1.20	3.46	11.63	20.40	31.24	32.27	25.24	3.38	0.93	6.11	135.86
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.38	1.10	3.72	6.52	9.98	10.31	8.06	1.08	0.30	1.95	43.41
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.77	5.59	5.05	4.03	3.76	3.43	3.69	4.14	4.62	5.28	55.54
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.59	0.57	0.52	0.41	0.38	0.35	0.38	0.42	0.47	0.54	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	30.96	128.28											

Table C.148: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] CR case 2100.

C.2.2.15 PVH-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	53.16	56.95	32.85	18.80	7.47	0.61	0.18	0.14	2.02	9.44	33.91	39.91	255.42
TotalGasConsumpHeat [m^3 m^{-2}]	5.44	5.83	3.36	1.93	0.76	0.06	0.02	0.01	0.21	0.97	3.47	4.09	26.16
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.82	4.11	10.40	17.45	15.36	22.79	9.32	2.43	0.20	4.62	87.48
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.26	1.31	3.32	5.58	4.91	7.28	2.98	0.78	0.06	1.47	27.95
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.86	5.02	5.54	4.90	4.65	3.85	3.67	3.49	3.47	3.94	4.58	5.22	53.19
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.57	0.50	0.48	0.39	0.38	0.36	0.36	0.40	0.47	0.54	5.45
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.83	1.84	4.01	4.19	5.51	5.53	4.48	5.17	3.58	1.64	1.48	0.78	39.03
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	31.61	73.79											

Table C.149: Residential Gas and Electricity Consumption/Production for Toronto PVH case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.29	33.13	38.12	12.26	6.30	0.57	0.00	0.00	1.14	6.24	32.43	54.46	230.94
TotalGasConsumpHeat [m^3 m^{-2}]	4.74	3.39	3.90	1.26	0.65	0.06	0.00	0.00	0.12	0.64	3.32	5.58	23.65
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.55	1.87	1.18	1.77	6.41	21.32	28.34	23.95	14.17	7.72	0.13	0.17	107.58
TotalElecCoolDemand [kW-hr m^{-2}]	0.17	0.60	0.38	0.57	2.05	6.81	9.05	7.65	4.53	2.47	0.04	0.05	34.37
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.05	5.72	5.59	4.56	4.13	3.76	3.55	3.59	4.22	4.62	5.43	55.29
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.59	0.57	0.47	0.42	0.38	0.36	0.37	0.43	0.47	0.56	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.11	1.53	3.07	3.17	3.89	4.97	5.73	4.52	3.38	2.26	0.86	1.77	36.25
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	29.32	82.98											

Table C.150: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] PVH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	47.15	45.14	32.28	20.99	4.27	1.07	0.06	0.17	0.28	4.17	23.93	41.40	220.93
TotalGasConsumpHeat [m^3 m^{-2}]	4.83	4.62	3.31	2.15	0.44	0.11	0.01	0.02	0.03	0.43	2.45	4.24	22.63
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.32	0.79	18.17	25.31	36.24	34.18	23.67	2.14	0.83	3.14	144.81
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.10	0.25	5.80	8.08	11.58	10.92	7.56	0.68	0.27	1.00	46.26
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.64	5.47	4.58	3.77	3.67	3.53	3.59	4.25	4.50	5.21	54.43
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.56	0.47	0.39	0.38	0.36	0.37	0.44	0.46	0.53	5.57
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.70	1.64	2.95	3.37	6.73	7.20	6.01	6.68	4.32	1.92	1.30	1.14	43.98
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.20	87.15											

Table C.151: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] PVH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.98	42.41	48.10	12.71	0.48	0.36	0.00	0.00	0.00	9.79	24.34	41.87	227.04
TotalGasConsumpHeat [m^3 m^{-2}]	4.81	4.34	4.93	1.30	0.05	0.04	0.00	0.00	0.00	1.00	2.49	4.29	23.25
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	2.19	0.00	5.62	19.74	29.48	35.01	24.93	32.21	8.19	0.18	0.27	157.80
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.70	0.00	1.80	6.31	9.42	11.18	7.96	10.29	2.62	0.06	0.09	50.41
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.13	5.67	4.99	4.49	3.77	3.73	3.58	3.53	4.22	4.62	5.39	54.18
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.51	0.46	0.39	0.38	0.37	0.36	0.43	0.47	0.55	5.55
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.97	2.02	2.27	3.27	5.42	5.94	6.97	4.96	4.75	3.64	0.80	1.59	42.61
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.80	92.67											

Table C.152: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] PVH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.59	40.87	28.18	12.71	1.90	0.00	0.00	0.00	0.06	2.48	19.64	42.59	195.00
TotalGasConsumpHeat [m^3 m^{-2}]	4.77	4.19	2.89	1.30	0.19	0.00	0.00	0.00	0.01	0.25	2.01	4.36	19.97
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	1.43	0.00	0.97	5.75	20.11	36.66	37.45	34.49	21.77	11.34	0.78	0.24	171.00
TotalElecCoolDemand [kW-hr m^{-2}]	0.46	0.00	0.31	1.84	6.43	11.71	11.97	11.02	6.96	3.62	0.25	0.08	54.63
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.94	4.99	5.64	5.45	4.95	3.98	3.67	3.53	3.50	4.46	4.62	5.22	54.96
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.51	0.58	0.56	0.51	0.41	0.38	0.36	0.36	0.46	0.47	0.53	5.63
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.18	1.74	2.93	3.93	4.94	6.27	5.74	4.36	2.80	1.97	0.99	1.10	37.95
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	25.60	101.56											

Table C.153: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] PVH case 2100.

C.2.2.16 PVH-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	57.60	44.92	51.57	20.31	2.71	0.43	0.00	1.74	0.83	14.70	28.19	45.50	268.49
TotalGasConsumpHeat [m^3 m^{-2}]	5.90	4.60	5.28	2.08	0.28	0.04	0.00	0.18	0.09	1.51	2.89	4.66	27.50
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	0.00	0.81	12.39	19.90	27.64	20.93	11.86	2.71	0.08	1.82	98.15
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.00	0.26	3.96	6.36	8.83	6.69	3.79	0.86	0.03	0.58	31.36
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.91	4.99	5.64	5.47	4.49	3.77	3.59	3.68	3.59	4.52	4.71	5.22	54.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.58	0.56	0.46	0.39	0.37	0.38	0.37	0.46	0.48	0.53	5.59
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.85	1.46	1.11	3.95	4.62	5.69	4.81	4.90	3.32	2.43	1.13	0.69	34.95
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	33.09	81.28											

Table C.154: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] PVH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	56.47	47.21	47.51	21.84	7.46	0.10	0.00	0.00	0.96	14.93	30.09	52.84	279.41
TotalGasConsumpHeat [m^3 m^{-2}]	5.78	4.83	4.87	2.24	0.76	0.01	0.00	0.00	0.10	1.53	3.08	5.41	28.62
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	1.49	0.00	0.33	5.81	24.57	31.35	28.74	18.77	5.98	0.98	0.01	118.05
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.48	0.00	0.11	1.86	7.85	10.02	9.18	6.00	1.91	0.31	0.00	37.71
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.16	5.10	5.69	5.42	4.56	3.98	3.73	3.68	3.68	4.39	4.62	5.31	55.32
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.53	0.52	0.58	0.55	0.47	0.41	0.38	0.38	0.38	0.45	0.47	0.54	5.67
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.05	1.71	2.26	2.75	5.65	7.03	5.11	5.13	3.72	1.96	0.74	0.49	37.61
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	34.28	84.97											

Table C.155: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] PVH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	65.83	49.58	39.31	25.35	0.40	0.54	0.32	0.00	1.62	6.94	23.72	46.28	259.89
TotalGasConsumpHeat [m^3 m^{-2}]	6.74	5.08	4.03	2.60	0.04	0.05	0.03	0.00	0.17	0.71	2.43	4.74	26.62
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.77	0.74	22.10	19.20	29.79	26.83	15.53	5.01	0.51	4.65	125.13
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.24	0.24	7.06	6.14	9.52	8.57	4.96	1.60	0.16	1.48	39.98
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.10	5.09	5.64	5.47	4.91	3.77	3.68	3.66	3.59	4.23	4.64	5.31	55.09
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.58	0.56	0.50	0.39	0.38	0.38	0.37	0.43	0.48	0.54	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.92	1.52	2.60	3.93	5.80	5.78	6.02	4.78	4.05	2.82	0.82	0.95	39.97
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	32.26	84.88											

Table C.156: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] PVH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	53.72	39.43	39.38	25.64	8.32	2.06	0.00	0.00	0.31	10.41	23.73	42.07	245.05
TotalGasConsumpHeat [m^3 m^{-2}]	5.50	4.04	4.03	2.63	0.85	0.21	0.00	0.00	0.03	1.07	2.43	4.31	25.10
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	1.21	3.53	11.86	20.84	31.92	32.69	25.54	3.42	0.94	6.11	138.08
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.39	1.13	3.79	6.66	10.20	10.44	8.16	1.09	0.30	1.95	44.12
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.77	5.59	5.05	4.03	3.76	3.43	3.69	4.14	4.62	5.28	55.54
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.59	0.57	0.52	0.41	0.38	0.35	0.38	0.42	0.47	0.54	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.58	2.21	3.91	3.24	4.70	6.53	6.38	3.86	3.37	2.24	1.46	0.97	39.44
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	30.79	89.54											

Table C.157: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] PVH case 2100.

C.2.2.17 PVHH-RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	53.16	56.95	32.85	18.80	7.47	0.61	0.18	0.14	2.02	9.44	33.91	39.91	255.42
TotalGasConsumpHeat [m^3 m^{-2}]	5.44	5.83	3.36	1.93	0.76	0.06	0.02	0.01	0.21	0.97	3.47	4.09	26.16
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.82	4.11	10.40	17.45	15.36	22.79	9.32	2.43	0.20	4.62	87.48
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.26	1.31	3.32	5.58	4.91	7.28	2.98	0.78	0.06	1.47	27.95
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.86	5.02	5.54	4.90	4.65	3.85	3.67	3.49	3.47	3.94	4.58	5.22	53.19
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.57	0.50	0.48	0.39	0.38	0.36	0.36	0.40	0.47	0.54	5.45
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.63	3.63	7.90	8.25	10.85	10.90	8.84	10.19	7.05	3.24	2.91	1.54	76.94
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	31.61	35.88											

Table C.158: Residential Gas and Electricity Consumption/Production for Toronto PVHH case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.29	33.13	38.12	12.26	6.30	0.57	0.00	0.00	1.14	6.24	32.43	54.46	230.94
TotalGasConsumpHeat [m^3 m^{-2}]	4.74	3.39	3.90	1.26	0.65	0.06	0.00	0.00	0.12	0.64	3.32	5.58	23.65
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.55	1.87	1.18	1.77	6.41	21.32	28.34	23.95	14.17	7.72	0.13	0.17	107.58
TotalElecCoolDemand [kW-hr m^{-2}]	0.17	0.60	0.38	0.57	2.05	6.81	9.05	7.65	4.53	2.47	0.04	0.05	34.37
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.05	5.72	5.59	4.56	4.13	3.76	3.55	3.59	4.22	4.62	5.43	55.29
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.59	0.57	0.47	0.42	0.38	0.36	0.37	0.43	0.47	0.56	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	2.19	3.02	6.05	6.24	7.67	9.79	11.30	8.92	6.66	4.45	1.70	3.49	71.47
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	29.32	47.77											

Table C.159: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] PVHH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	47.15	45.14	32.28	20.99	4.27	1.07	0.06	0.17	0.28	4.17	23.93	41.40	220.93
TotalGasConsumpHeat [m^3 m^{-2}]	4.83	4.62	3.31	2.15	0.44	0.11	0.01	0.02	0.03	0.43	2.45	4.24	22.63
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.32	0.79	18.17	25.31	36.24	34.18	23.67	2.14	0.83	3.14	144.81
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.10	0.25	5.80	8.08	11.58	10.92	7.56	0.68	0.27	1.00	46.26
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.64	5.47	4.58	3.77	3.67	3.53	3.59	4.25	4.50	5.21	54.43
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.56	0.47	0.39	0.38	0.36	0.37	0.44	0.46	0.53	5.57
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.37	3.23	5.81	6.64	13.28	14.20	11.85	13.18	8.52	3.79	2.57	2.26	86.71
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.20	44.42											

Table C.160: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] PVHH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.98	42.41	48.10	12.71	0.48	0.36	0.00	0.00	0.00	9.79	24.34	41.87	227.04
TotalGasConsumpHeat [m^3 m^{-2}]	4.81	4.34	4.93	1.30	0.05	0.04	0.00	0.00	0.00	1.00	2.49	4.29	23.25
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	2.19	0.00	5.62	19.74	29.48	35.01	24.93	32.21	8.19	0.18	0.27	157.80
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.70	0.00	1.80	6.31	9.42	11.18	7.96	10.29	2.62	0.06	0.09	50.41
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.13	5.67	4.99	4.49	3.77	3.73	3.58	3.53	4.22	4.62	5.39	54.18
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.51	0.46	0.39	0.38	0.37	0.36	0.43	0.47	0.55	5.55
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.92	3.98	4.47	6.46	10.69	11.71	13.74	9.78	9.37	7.17	1.58	3.14	84.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	28.80	51.28											

Table C.161: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] PVHH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	46.59	40.87	28.18	12.71	1.90	0.00	0.00	0.00	0.06	2.48	19.64	42.59	195.00
TotalGasConsumpHeat [m^3 m^{-2}]	4.77	4.19	2.89	1.30	0.19	0.00	0.00	0.00	0.01	0.25	2.01	4.36	19.97
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	1.43	0.00	0.97	5.75	20.11	36.66	37.45	34.49	21.77	11.34	0.78	0.24	171.00
TotalElecCoolDemand [kW-hr m^{-2}]	0.46	0.00	0.31	1.84	6.43	11.71	11.97	11.02	6.96	3.62	0.25	0.08	54.63
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.94	4.99	5.64	5.45	4.95	3.98	3.67	3.53	3.50	4.46	4.62	5.22	54.96
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.51	0.58	0.56	0.51	0.41	0.38	0.36	0.36	0.46	0.47	0.53	5.63
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	2.32	3.43	5.77	7.75	9.75	12.37	11.31	8.60	5.52	3.88	1.95	2.17	74.81
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	25.60	64.69											

Table C.162: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] PVHH case 2100.

C.2.2.18 PVHH-RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	57.60	44.92	51.57	20.31	2.71	0.43	0.00	1.74	0.83	14.70	28.19	45.50	268.49
TotalGasConsumpHeat [m^3 m^{-2}]	5.90	4.60	5.28	2.08	0.28	0.04	0.00	0.18	0.09	1.51	2.89	4.66	27.50
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	0.00	0.81	12.39	19.90	27.64	20.93	11.86	2.71	0.08	1.82	98.15
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.00	0.26	3.96	6.36	8.83	6.69	3.79	0.86	0.03	0.58	31.36
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.91	4.99	5.64	5.47	4.49	3.77	3.59	3.68	3.59	4.52	4.71	5.22	54.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.58	0.56	0.46	0.39	0.37	0.38	0.37	0.46	0.48	0.53	5.59
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.67	2.87	2.18	7.79	9.11	11.21	9.48	9.65	6.55	4.78	2.23	1.37	68.90
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	33.09	47.33											

Table C.163: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] PVHH case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	56.47	47.21	47.51	21.84	7.46	0.10	0.00	0.00	0.96	14.93	30.09	52.84	279.41
TotalGasConsumpHeat [m^3 m^{-2}]	5.78	4.83	4.87	2.24	0.76	0.01	0.00	0.00	0.10	1.53	3.08	5.41	28.62
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	1.49	0.00	0.33	5.81	24.57	31.35	28.74	18.77	5.98	0.98	0.01	118.05
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.48	0.00	0.11	1.86	7.85	10.02	9.18	6.00	1.91	0.31	0.00	37.71
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.16	5.10	5.69	5.42	4.56	3.98	3.73	3.68	3.68	4.39	4.62	5.31	55.32
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.53	0.52	0.58	0.55	0.47	0.41	0.38	0.38	0.38	0.45	0.47	0.54	5.67
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	2.06	3.38	4.46	5.42	11.14	13.87	10.07	10.12	7.33	3.87	1.47	0.96	74.15
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	34.28	48.43											

Table C.164: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] PVHH case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	65.83	49.58	39.31	25.35	0.40	0.54	0.32	0.00	0.96	6.94	23.72	46.28	259.22
TotalGasConsumpHeat [m^3 m^{-2}]	6.74	5.08	4.03	2.60	0.04	0.05	0.03	0.00	0.10	0.71	2.43	4.74	26.55
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.77	0.74	22.10	19.20	29.79	26.83	18.77	5.01	0.51	4.65	128.37
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.24	0.24	7.06	6.14	9.52	8.57	6.00	1.60	0.16	1.48	41.01
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.10	5.09	5.64	5.47	4.91	3.77	3.68	3.66	3.68	4.23	4.64	5.31	55.18
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.58	0.56	0.50	0.39	0.38	0.38	0.38	0.43	0.48	0.54	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.81	2.99	5.12	7.75	11.44	11.40	11.87	9.42	7.33	5.55	1.61	1.86	78.15
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	32.20	47.74											

Table C.165: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] PVHH case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	53.72	39.43	39.38	25.64	8.32	2.06	0.00	0.00	0.31	10.41	23.73	42.07	245.05
TotalGasConsumpHeat [m^3 m^{-2}]	5.50	4.04	4.03	2.63	0.85	0.21	0.00	0.00	0.03	1.07	2.43	4.31	25.10
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.02	1.21	3.53	11.86	20.84	31.92	32.69	25.54	3.42	0.94	6.11	138.08
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.39	1.13	3.79	6.66	10.20	10.44	8.16	1.09	0.30	1.95	44.12
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.77	5.59	5.05	4.03	3.76	3.43	3.69	4.14	4.62	5.28	55.54
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.59	0.57	0.52	0.41	0.38	0.35	0.38	0.42	0.47	0.54	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.14	4.36	7.70	6.38	9.26	12.87	12.57	7.62	6.65	4.41	2.88	1.92	77.76
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	30.79	51.23											

Table C.166: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] PVHH case 2100.

C.2.3 Combinations - Vancouver RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	15.80	18.27	12.42	5.37	1.98	0.31	0.00	0.01	0.62	6.70	12.90	25.29	99.67
TotalGasConsumpHeat [m^3 m^{-2}]	1.62	1.87	1.27	0.55	0.20	0.03	0.00	0.00	0.06	0.69	1.32	2.59	10.21
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.69	6.79	6.90	18.25	21.54	15.76	5.62	0.65	0.06	0.00	76.28
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.00	0.22	2.17	2.20	5.83	6.88	5.04	1.79	0.21	0.02	0.00	24.37
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.76	4.96	5.49	5.00	4.73	4.18	3.79	3.69	3.89	4.46	4.68	5.10	54.74
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.51	0.56	0.51	0.48	0.43	0.39	0.38	0.40	0.46	0.48	0.52	5.61
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	15.81	109.24											

Table C.167: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] combination case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	15.46	15.60	6.65	4.25	0.93	0.91	0.00	0.00	1.26	3.06	14.54	14.54	77.20
TotalGasConsumpHeat [m^3 m^{-2}]	1.58	1.60	0.68	0.44	0.10	0.09	0.00	0.00	0.13	0.31	1.49	1.49	7.91
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	1.30	0.22	2.41	6.82	7.37	24.32	27.14	11.36	2.58	0.01	0.03	83.56
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.41	0.07	0.77	2.18	2.36	7.77	8.67	3.63	0.83	0.00	0.01	26.70
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.08	4.76	5.25	5.00	4.58	4.37	4.14	3.78	3.88	4.41	4.75	5.20	55.20
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.49	0.54	0.51	0.47	0.45	0.42	0.39	0.40	0.45	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	13.56	111.57											

Table C.168: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] combination case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	7.77	15.00	7.01	2.83	1.34	0.74	0.00	0.00	0.02	1.62	9.81	13.13	59.27
TotalGasConsumpHeat [m^3 m^{-2}]	0.80	1.54	0.72	0.29	0.14	0.08	0.00	0.00	0.00	0.17	1.00	1.35	6.07
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.03	0.04	0.01	2.92	6.69	11.27	25.86	27.00	19.22	2.97	0.19	0.27	96.47
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.01	0.00	0.93	2.14	3.60	8.26	8.63	6.14	0.95	0.06	0.09	30.82
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.87	5.35	5.10	4.78	4.18	4.16	3.94	3.90	4.51	4.67	5.32	55.45
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.50	0.55	0.52	0.49	0.43	0.43	0.40	0.40	0.46	0.48	0.54	5.68
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	11.75	115.69											

Table C.169: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] combination case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	6.89	5.38	2.65	1.06	0.96	0.07	0.00	0.00	0.31	0.02	7.67	16.21	41.21
TotalGasConsumpHeat [m^3 m^{-2}]	0.71	0.55	0.27	0.11	0.10	0.01	0.00	0.00	0.03	0.00	0.79	1.66	4.22
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	1.11	0.65	0.13	5.60	7.14	9.38	25.56	17.31	18.85	4.70	0.16	0.00	90.59
TotalElecCoolDemand [kW-hr m^{-2}]	0.35	0.21	0.04	1.79	2.28	3.00	8.17	5.53	6.02	1.50	0.05	0.00	28.94
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.72	4.78	5.30	5.06	4.78	4.32	3.99	3.94	4.01	4.35	4.71	5.61	55.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.52	0.49	0.44	0.41	0.40	0.41	0.45	0.48	0.57	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	9.91	113.81											

Table C.170: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] combination case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	2.09	8.66	2.11	0.16	0.96	0.00	0.00	0.00	0.00	0.15	7.16	10.75	32.03
TotalGasConsumpHeat [m^3 m^{-2}]	0.21	0.89	0.22	0.02	0.10	0.00	0.00	0.00	0.00	0.02	0.73	1.10	3.28
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.14	0.38	1.56	6.38	12.16	27.08	40.67	38.96	26.51	8.53	1.65	0.02	164.04
TotalElecCoolDemand [kW-hr m^{-2}]	0.05	0.12	0.50	2.04	3.88	8.65	12.99	12.45	8.47	2.73	0.53	0.01	52.41
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.78	5.31	4.96	4.93	4.19	3.99	4.01	3.90	4.31	4.75	5.17	55.13
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.49	0.54	0.51	0.51	0.43	0.41	0.41	0.40	0.44	0.49	0.53	5.65
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	8.93	137.28											

Table C.171: Residential Gas and Electricity Consumption/Production for Vancouver RCP 8.5 [W m^{-2}] combination case 2099.

C.2.4 Combinations - Vancouver RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	12.09	14.14	9.30	4.37	1.48	0.54	0.18	0.19	0.24	3.38	12.07	27.80	85.79
TotalGasConsumpHeat [m^3 m^{-2}]	1.24	1.45	0.95	0.45	0.15	0.05	0.02	0.02	0.02	0.35	1.24	2.85	8.79
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.05	0.11	1.11	2.57	9.79	6.03	12.73	22.23	16.29	1.19	0.03	0.00	72.12
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.03	0.35	0.82	3.13	1.93	4.07	7.10	5.20	0.38	0.01	0.00	23.04
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.69	4.77	5.30	5.23	4.80	4.19	4.16	4.01	3.90	4.41	4.70	5.15	55.31
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.48	0.49	0.54	0.54	0.49	0.43	0.43	0.41	0.40	0.45	0.48	0.53	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	14.45	107.91											

Table C.172: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] combination case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	17.29	0.19	3.54	1.50	1.62	0.06	0.30	0.00	0.00	2.01	10.32	12.53	49.35
TotalGasConsumpHeat [m^3 m^{-2}]	1.77	0.02	0.36	0.15	0.17	0.01	0.03	0.00	0.00	0.21	1.06	1.28	5.05
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.09	22.23	2.55	4.37	5.39	9.28	15.07	13.93	10.29	2.14	0.15	0.05	85.55
TotalElecCoolDemand [kW-hr m^{-2}]	0.03	7.10	0.82	1.39	1.72	2.96	4.82	4.45	3.29	0.68	0.05	0.02	27.33
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.83	4.01	5.19	5.05	4.75	4.31	4.06	3.78	4.08	4.25	4.72	5.17	54.19
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.49	0.41	0.53	0.52	0.49	0.44	0.42	0.39	0.42	0.44	0.48	0.53	5.55
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	7.27	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	85.57
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	10.60	112.91											

Table C.173: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] combination case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	12.28	6.96	3.72	1.30	2.19	0.50	0.05	0.00	0.14	1.91	10.72	7.82	47.60
TotalGasConsumpHeat [m^3 m^{-2}]	1.26	0.71	0.38	0.13	0.22	0.05	0.01	0.00	0.01	0.20	1.10	0.80	4.87
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.41	0.24	0.30	4.10	8.97	7.95	18.99	25.83	13.51	2.14	0.14	0.10	82.69
TotalElecCoolDemand [kW-hr m^{-2}]	0.13	0.08	0.09	1.31	2.87	2.54	6.07	8.25	4.32	0.68	0.04	0.03	26.42
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.84	4.96	4.99	5.02	4.60	4.33	4.14	4.01	3.73	4.35	4.73	4.99	54.69
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.51	0.51	0.47	0.44	0.42	0.41	0.38	0.45	0.48	0.51	5.60
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	10.48	111.29											

Table C.174: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] combination case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	12.58	6.45	3.00	2.38	0.12	0.40	0.00	0.00	0.62	1.86	11.31	14.64	53.36
TotalGasConsumpHeat [m^3 m^{-2}]	1.29	0.66	0.31	0.24	0.01	0.04	0.00	0.00	0.06	0.19	1.16	1.50	5.47
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.42	0.88	7.15	6.06	10.04	22.48	23.70	16.51	0.34	0.09	0.00	87.69
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.13	0.28	2.29	1.94	3.21	7.18	7.57	5.28	0.11	0.03	0.00	28.01
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.03	4.84	5.45	5.06	5.17	4.41	4.16	4.01	3.78	4.31	4.69	5.20	56.11
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.50	0.56	0.52	0.53	0.45	0.43	0.41	0.39	0.44	0.48	0.53	5.75
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	11.21	112.88											

Table C.175: Residential Gas and Electricity Consumption/Production for Vancouver RCP 4.5 [W m^{-2}] combination case 2099.

C.2.5 Combinations - Toronto RCP 8.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	26.44	27.81	13.37	6.11	1.80	0.03	0.00	0.00	0.10	2.63	14.74	18.43	111.45
TotalGasConsumpHeat [m^3 m^{-2}]	2.71	2.85	1.37	0.63	0.18	0.00	0.00	0.00	0.01	0.27	1.51	1.89	11.41
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.04	2.57	6.03	14.14	20.18	18.50	24.02	12.48	4.58	0.82	4.62	107.97
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.01	0.82	1.93	4.52	6.45	5.91	7.67	3.99	1.46	0.26	1.48	34.50
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.86	5.02	5.54	4.90	4.65	3.85	3.67	3.49	3.47	3.94	4.58	5.22	53.19
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.57	0.50	0.48	0.39	0.38	0.36	0.36	0.40	0.47	0.54	5.45
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.63	3.63	7.90	8.25	10.85	10.90	8.84	10.19	7.05	3.24	2.91	1.54	76.94
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	16.86	42.43											

Table C.176: Residential Gas and Electricity Consumption/Production for Toronto combination (VegH-InfLL-PVHH)case 2021.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	22.34	14.02	16.56	2.88	1.45	0.02	0.00	0.00	0.09	1.31	14.16	25.54	98.37
TotalGasConsumpHeat [m^3 m^{-2}]	2.29	1.44	1.70	0.30	0.15	0.00	0.00	0.00	0.01	0.13	1.45	2.62	10.08
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.54	2.37	2.71	4.45	10.20	22.64	28.24	24.91	16.10	9.93	0.45	0.63	123.19
TotalElecCoolDemand [kW-hr m^{-2}]	0.17	0.76	0.87	1.42	3.26	7.23	9.02	7.96	5.14	3.17	0.15	0.20	39.36
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.05	5.72	5.59	4.56	4.13	3.76	3.55	3.59	4.22	4.62	5.43	55.29
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.59	0.57	0.47	0.42	0.38	0.36	0.37	0.43	0.47	0.56	5.66
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	2.19	3.02	6.05	6.24	7.67	9.79	11.30	8.92	6.66	4.45	1.70	3.49	71.47
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	15.74	52.75											

Table C.177: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] combination (VegH-InfLL-PVHH) case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	23.02	21.36	12.70	7.08	0.87	0.18	0.00	0.00	0.00	0.39	9.35	18.80	93.77
TotalGasConsumpHeat [m^3 m^{-2}]	2.36	2.19	1.30	0.73	0.09	0.02	0.00	0.00	0.00	0.04	0.96	1.93	9.60
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.04	0.23	1.26	2.77	21.01	26.28	33.13	32.36	24.72	5.27	1.58	3.11	151.76
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.07	0.40	0.88	6.71	8.40	10.59	10.34	7.90	1.68	0.50	0.99	48.49
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.64	5.47	4.58	3.77	3.67	3.53	3.59	4.25	4.50	5.21	54.43
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.56	0.47	0.39	0.38	0.36	0.37	0.44	0.46	0.53	5.57
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.37	3.23	5.81	6.64	13.28	14.20	11.85	13.18	8.52	3.79	2.57	2.26	86.71
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	15.18	46.64											

Table C.178: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] combination (VegH-InfLL-PVHH) case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	22.75	19.34	21.64	3.80	0.00	0.02	0.00	0.00	0.00	2.77	9.34	18.64	98.30
TotalGasConsumpHeat [m^3 m^{-2}]	2.33	1.98	2.22	0.39	0.00	0.00	0.00	0.00	0.00	0.28	0.96	1.91	10.07
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.01	2.11	0.08	7.69	21.92	28.47	32.89	25.84	30.97	11.21	0.57	1.17	162.93
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.67	0.03	2.46	7.00	9.10	10.51	8.26	9.89	3.58	0.18	0.37	52.05
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.06	5.13	5.67	4.99	4.49	3.77	3.73	3.58	3.53	4.22	4.62	5.39	54.18
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.58	0.51	0.46	0.39	0.38	0.37	0.36	0.43	0.47	0.55	5.55
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.92	3.98	4.47	6.46	10.69	11.71	13.74	9.78	9.37	7.17	1.58	3.14	84.00
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	15.62	52.92											

Table C.179: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] combination (VegH-InfLL-PVHH) case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	22.08	18.45	10.95	4.00	0.24	0.00	0.00	0.00	0.00	0.32	7.15	19.73	82.92
TotalGasConsumpHeat [m^3 m^{-2}]	2.26	1.89	1.12	0.41	0.02	0.00	0.00	0.00	0.00	0.03	0.73	2.02	8.49
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	1.27	0.12	2.38	8.53	21.23	33.75	33.89	31.00	21.49	12.84	1.58	0.60	168.68
TotalElecCoolDemand [kW-hr m^{-2}]	0.40	0.04	0.76	2.73	6.78	10.78	10.83	9.90	6.87	4.10	0.50	0.19	53.89
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.94	4.99	5.64	5.45	4.95	3.98	3.67	3.53	3.50	4.46	4.62	5.22	54.96
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.51	0.51	0.58	0.56	0.51	0.41	0.38	0.36	0.36	0.46	0.47	0.53	5.63
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	2.32	3.43	5.77	7.75	9.75	12.37	11.31	8.60	5.52	3.88	1.95	2.17	74.81
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	14.12	63.95											

Table C.180: Residential Gas and Electricity Consumption/Production for Toronto RCP 8.5 [W m^{-2}] combination (VegH-InfLL-PVH) case 2100.

C.2.6 Combinations - Toronto RCP 4.5 [W m^{-2}]

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	29.16	21.21	24.82	6.66	0.25	0.02	0.00	0.33	0.03	4.72	11.37	21.50	120.09
TotalGasConsumpHeat [m^3 m^{-2}]	2.99	2.17	2.54	0.68	0.03	0.00	0.00	0.03	0.00	0.48	1.16	2.20	12.30
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.22	0.00	2.83	15.67	22.29	27.10	21.85	14.77	4.52	0.46	1.66	111.36
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.07	0.00	0.90	5.01	7.12	8.66	6.98	4.72	1.45	0.15	0.53	35.58
TotalSensWaterHeatDemand [kW-hr m^{-2}]	4.91	4.99	5.64	5.47	4.49	3.77	3.59	3.68	3.59	4.52	4.71	5.22	54.58
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.50	0.51	0.58	0.56	0.46	0.39	0.37	0.38	0.37	0.46	0.48	0.53	5.59
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	0.85	1.46	1.11	3.95	4.62	5.69	4.81	4.90	3.32	2.43	1.13	0.69	34.95
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	17.89	85.50											

Table C.181: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] combination (VegH-InfLL-PVH) case 2040.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	28.51	22.15	21.34	7.00	1.71	0.00	0.00	0.00	0.06	4.24	12.74	26.30	124.06
TotalGasConsumpHeat [m^3 m^{-2}]	2.92	2.27	2.19	0.72	0.18	0.00	0.00	0.00	0.01	0.43	1.30	2.69	12.71
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.02	1.43	0.11	1.42	10.42	26.25	29.70	28.38	20.38	6.68	1.14	0.07	125.99
TotalElecCoolDemand [kW-hr m^{-2}]	0.01	0.46	0.03	0.45	3.33	8.39	9.49	9.07	6.51	2.13	0.36	0.02	40.25
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.16	5.10	5.69	5.42	4.56	3.98	3.73	3.68	3.68	4.39	4.62	5.31	55.32
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.53	0.52	0.58	0.55	0.47	0.41	0.38	0.38	0.38	0.45	0.47	0.54	5.67
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	2.06	3.38	4.46	5.42	11.14	13.87	10.07	10.12	7.33	3.87	1.47	0.96	74.15
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	18.37	50.97											

Table C.182: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] combination (VegH-InfLL-PVHH) case 2060.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	34.20	23.86	17.51	9.35	0.06	0.04	0.04	0.00	0.18	1.58	9.59	21.44	117.85
TotalGasConsumpHeat [m^3 m^{-2}]	3.50	2.44	1.79	0.96	0.01	0.00	0.00	0.00	0.02	0.16	0.98	2.20	12.07
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.11	1.93	2.87	23.92	21.83	28.79	26.93	17.28	7.93	1.05	3.90	136.53
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.04	0.62	0.92	7.64	6.97	9.20	8.61	5.52	2.53	0.33	1.25	43.62
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.10	5.09	5.64	5.47	4.91	3.77	3.68	3.66	3.59	4.23	4.64	5.31	55.09
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.52	0.58	0.56	0.50	0.39	0.38	0.38	0.37	0.43	0.48	0.54	5.64
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.81	2.99	5.12	7.75	11.44	11.40	11.87	9.42	7.98	5.55	1.61	1.86	78.80
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	17.71	49.69											

Table C.183: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] combination (VegH-InfLL-PVHH) case 2080.

Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TotalSensHeatDemand [kW-hr m^{-2}]	25.54	16.45	15.64	9.31	1.90	0.38	0.00	0.00	0.00	2.33	8.27	17.75	97.56
TotalGasConsumpHeat [m^3 m^{-2}]	2.62	1.69	1.60	0.95	0.19	0.04	0.00	0.00	0.00	0.24	0.85	1.82	9.99
TotalElecHeatDemand [kW-hr m^{-2}]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TotalSensCoolDemand [kW-hr m^{-2}]	0.00	0.58	2.47	5.17	13.81	22.31	30.23	28.94	23.61	5.41	1.62	5.03	139.17
TotalElecCoolDemand [kW-hr m^{-2}]	0.00	0.19	0.79	1.65	4.41	7.13	9.66	9.25	7.54	1.73	0.52	1.61	44.46
TotalSensWaterHeatDemand [kW-hr m^{-2}]	5.07	5.14	5.77	5.59	5.05	4.03	3.76	3.43	3.69	4.14	4.62	5.28	55.54
TotalGasConsumpWaterHeat [m^3 m^{-2}]	0.52	0.53	0.59	0.57	0.52	0.41	0.38	0.35	0.38	0.42	0.47	0.54	5.69
TotalElecDomesticDemand [kW-hr m^{-2}]	6.56	6.56	7.27	7.03	7.27	7.03	7.27	7.27	7.03	7.27	7.03	7.27	84.87
TotalElecProducedPV [kW-hr m^{-2}]	1.14	4.36	7.70	6.38	9.26	12.87	12.57	7.62	6.65	4.41	2.88	1.92	77.76
AnnualTotalGasConsump [m^3 m^{-2}] and AnnualTotalNetElec [kW-hr m^{-2}]	15.68	51.58											

Table C.184: Residential Gas and Electricity Consumption/Production for Toronto RCP 4.5 [W m^{-2}] combination (VegH-RvalH-InfLL-PVHH) case 2100.