

APPENDIX C – ENERGY MODELING ANALYSIS AND RESULTS

ARCHETYPE BUILDING INDEX

Introduction	C.i
1.0 Large Institutional Archetype Summary	C.1
2.0 Low-Mid Rise MURB Archetype Summary	C.6
3.0 High Rise MURB Archetype Summary	C.10
4.0 Secondary School Archetype Summary	C.17
5.0 Rec Centre Archetype Summary	C.22
6.0 Commercial Office Archetype Summary.....	C.27
7.0 Hotel Archetype Summary	C.35
8.0 Non-Food Retail Archetype Summary.....	C.40



INTRODUCTION

Introduction

The energy analysis undertaken for this study is focused on generally quantifying the impact of the opaque envelope on whole building energy use for different major building types (archetypes). The energy results shown below are for illustrative purposes to give an approximate idea of the scale of the energy impact resulting from the opaque building envelope. The results should not replace project specific energy models for design decision making, but may be used as guidance to inform early design.

Archetypes

The archetypes are rectangular buildings with size, number of stories and aspect ratios approximated based on experience with similar projects. Although buildings come in many different sizes, shapes and orientations, any geometry selected would be arbitrary; thus standard rectangular shapes were chosen.

Each archetype also uses mechanical and lighting systems that reflect standard practice for a large portion of the BC market. Mechanical and electrical systems can vary significantly between similar projects, however, one representative system was chosen for illustrative purposes. Higher performing mechanical systems may show less impact from the building envelope, while higher performing lighting systems may show more impact due to reduction in heat gain. However, the general trend and slope of the curves shown below are expected to be consistent for most buildings, though the absolute values may vary significantly depending on design. The energy model input details for each archetype are summarized below, with each input followed by graphs of electricity and gas energy use over varying R-values.

Energy Graphs

The graphs below represent both annual electricity and gas energy usage over a wide range of R-values for each archetype, at two different glazing ratios, and for 3 different BC climates. The graphs were developed to quantify the difference in electricity and gas energy related to differences in the opaque envelope related to the impact of thermal bridging through interface details. Specific scenarios and results are discussed in detail in Part 2.

Energy Use Intensity

Some readers may be interested in the overall energy results of the archetype buildings. A summary of the energy use intensity, in kWh/m², is shown in the Table below. The table considers the results for all archetype buildings, but only at one window to wall ratio, one R-value (R15) and one climate (Vancouver, BC).

Building Archetype (Vancouver Climate)	Window- to-Wall Ratio (%)	Gas Use Intensity (kWh/m ²)	Electricity Use Intensity (kWh/m ²)	Total Energy Use Intensity (kWh/m ²)
Institutional	30	250	178	427
Low Mid Rise MURB	30	126	60	186
High Rise MURB	40	126	60	186
Secondary School	20	80	69	148
Rec Centre	30	220	136	356
Commercial Office	40	36	107	143
Hotel	40	152	73	225
Non-Food Retail	30	83	88	171

THERMAL MASS

Most energy models deal with thermal mass through the use of conduction transfer functions. These functions are determined based on the materials of the assembly modeled, and tell the model how to distribute, over time, the heat losses and gains through the walls and roofs that are calculated at each time step. The calculation is independent of the U-value but impacts energy use through the distribution of heat losses and heat gains over time, dependent on the material properties modeled. Figures C0.1 and C0.2 respectively show the response factor and cumulative heat flow for low and high mass walls for a concrete high rise MURB with electric baseboard heating.

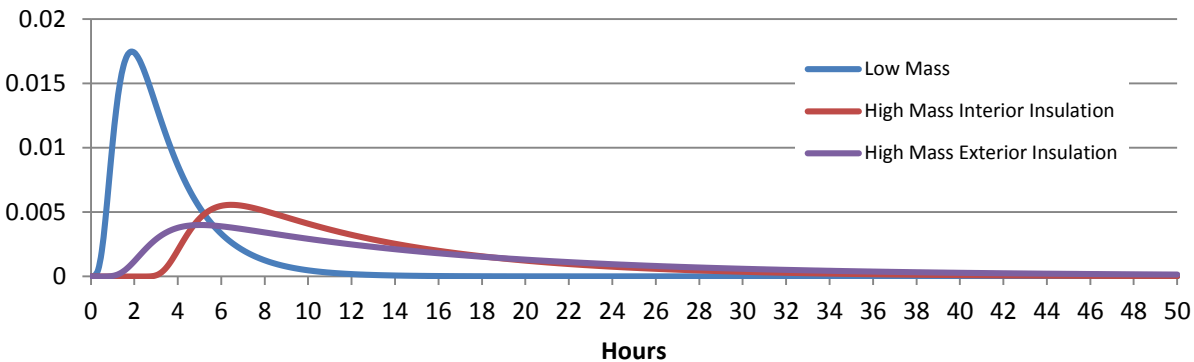


Figure C0.1: Response factor for mass walls

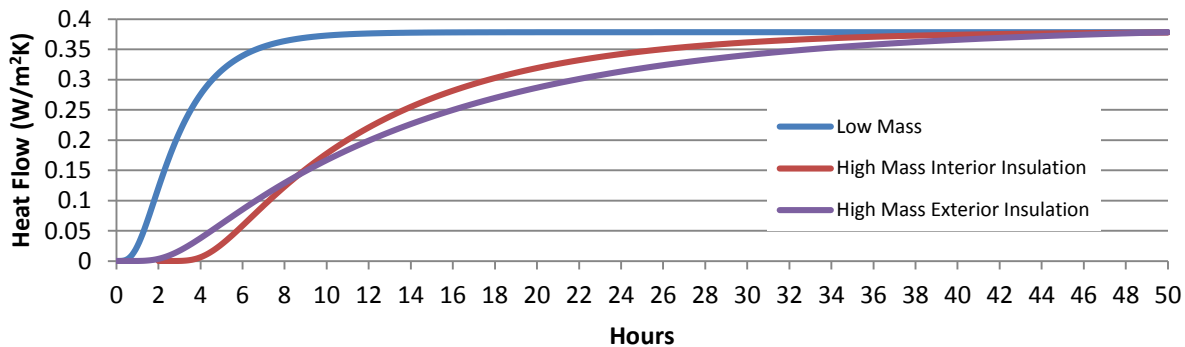


Figure C0.2: Cumulative heat flow for mass walls

Figures C0.3 through C0.8 below show the difference in energy use between high (concrete walls) and low (steel stud walls) thermal mass systems. At the lowest R-value, R2.5, there is as much as 3-5% heating energy savings for mass walls over steel stud walls for the high rise MURB archetype, depending on climate zone. However, over the range of R-values, the average difference in heating energy is 1% or less. The figures also show that a slightly lower R-value in mass walls, about R0.5 to R1.5 lower, yields the same energy use as lightweight walls. However, ASHRAE 90.1-2010 prescribes mass walls at R-values lower than steel stud walls by about R3, R1.5, and R10 for BC climate zones 5, 6, and 7, respectively. As such, the reduction in R-value for mass walls in ASHRAE 90.1 may not be fully warranted for BC climate zones. However, this point is somewhat moot since the change in absolute energy use at the higher prescribed code R-values is not significant.

THERMAL MASS ANALYSIS ANNUAL ENERGY USE

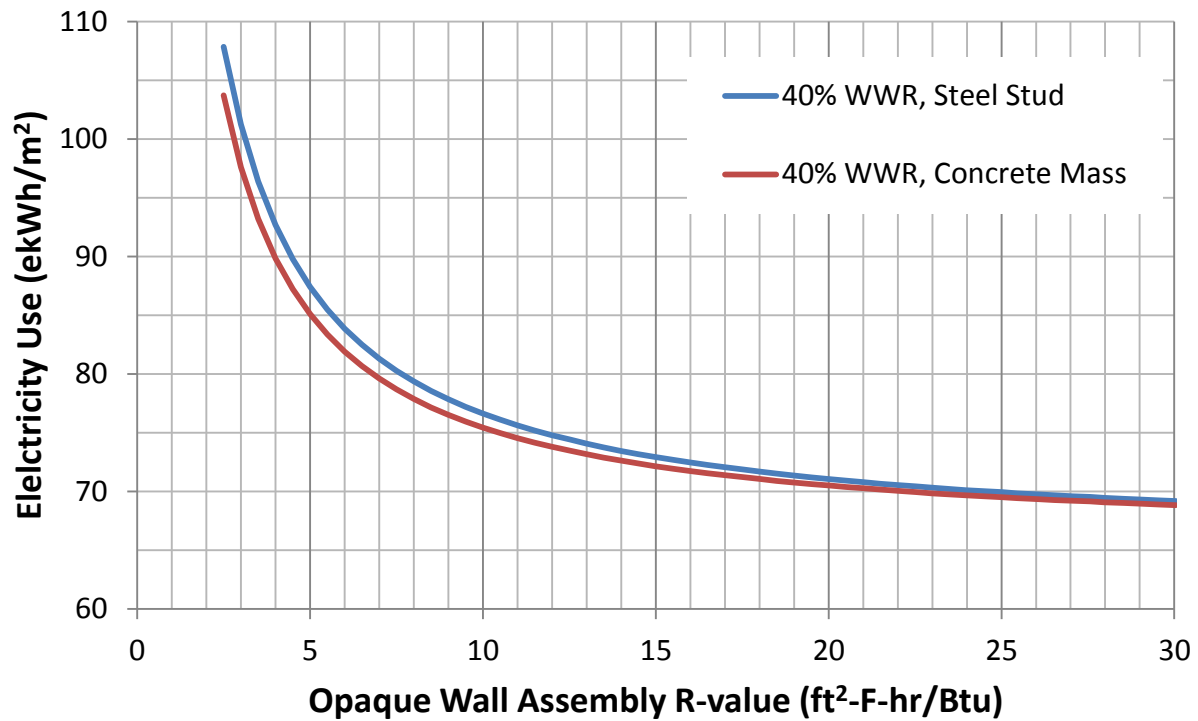


Figure C0.3: Prince George – Electricity Use vs. Opaque Wall Assembly R-Value

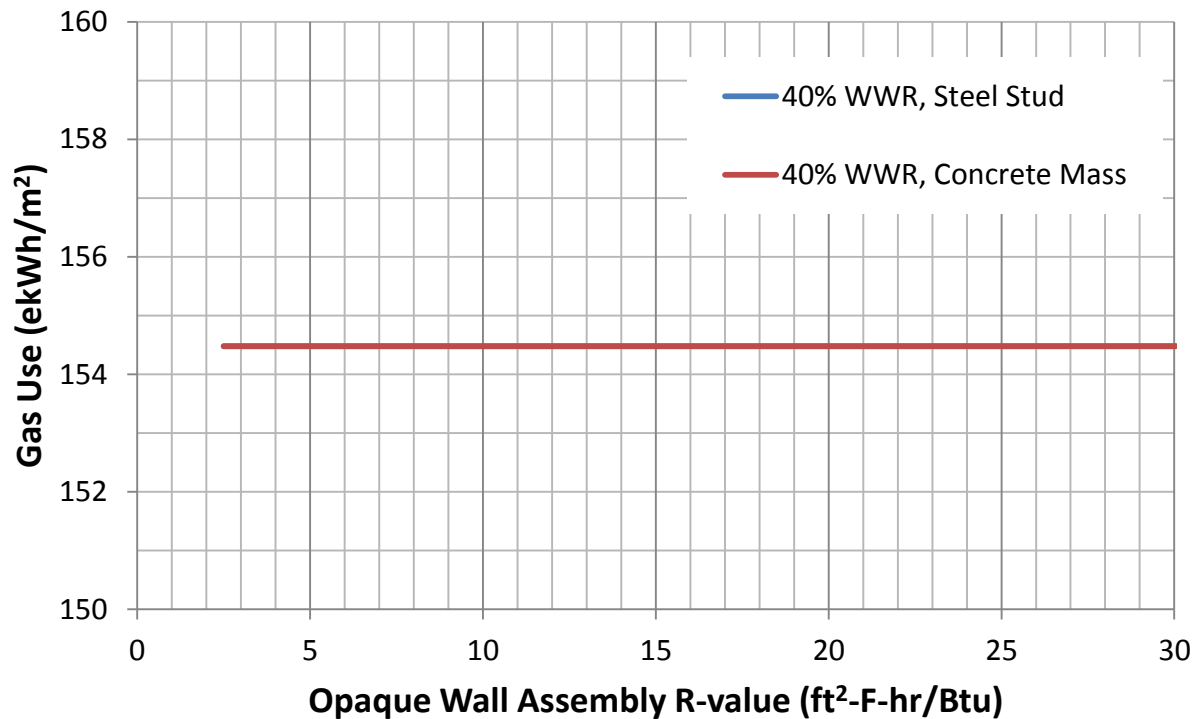


Figure C0.4: Prince George – Gas Use vs. Opaque Wall Assembly R-Value

THERMAL MASS ANALYSIS ANNUAL ENERGY USE

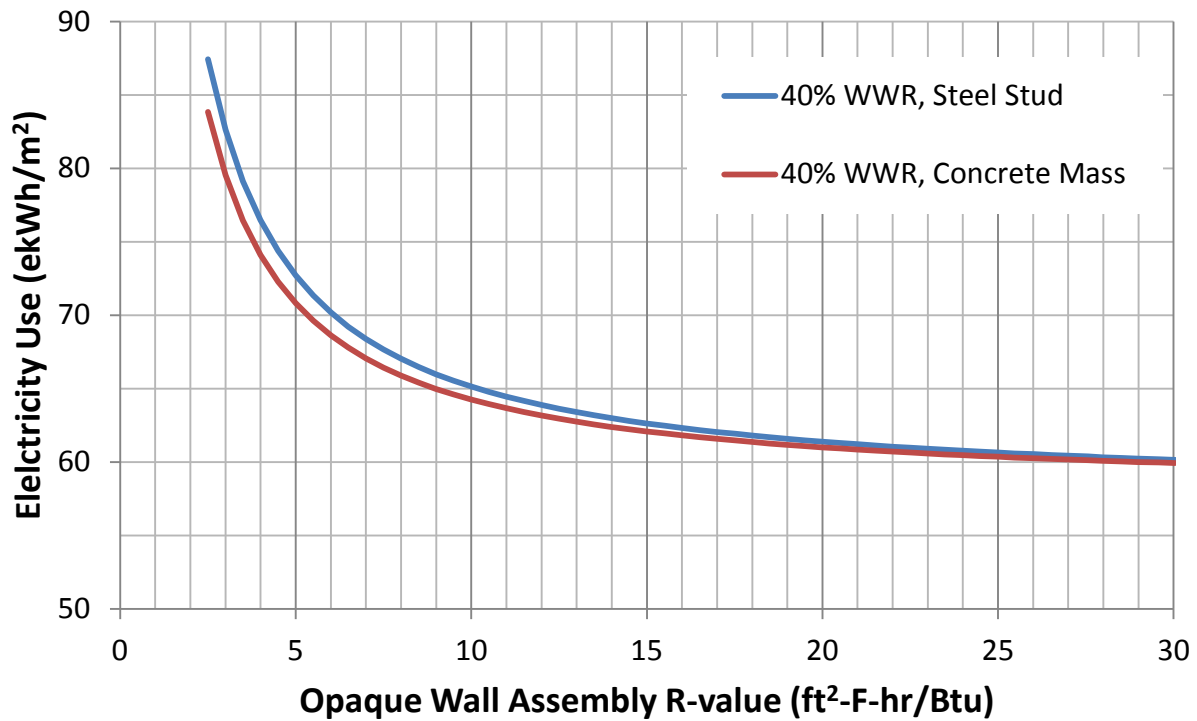


Figure C0.5: Summerland – Electricity Use vs. Opaque Wall Assembly R-Value

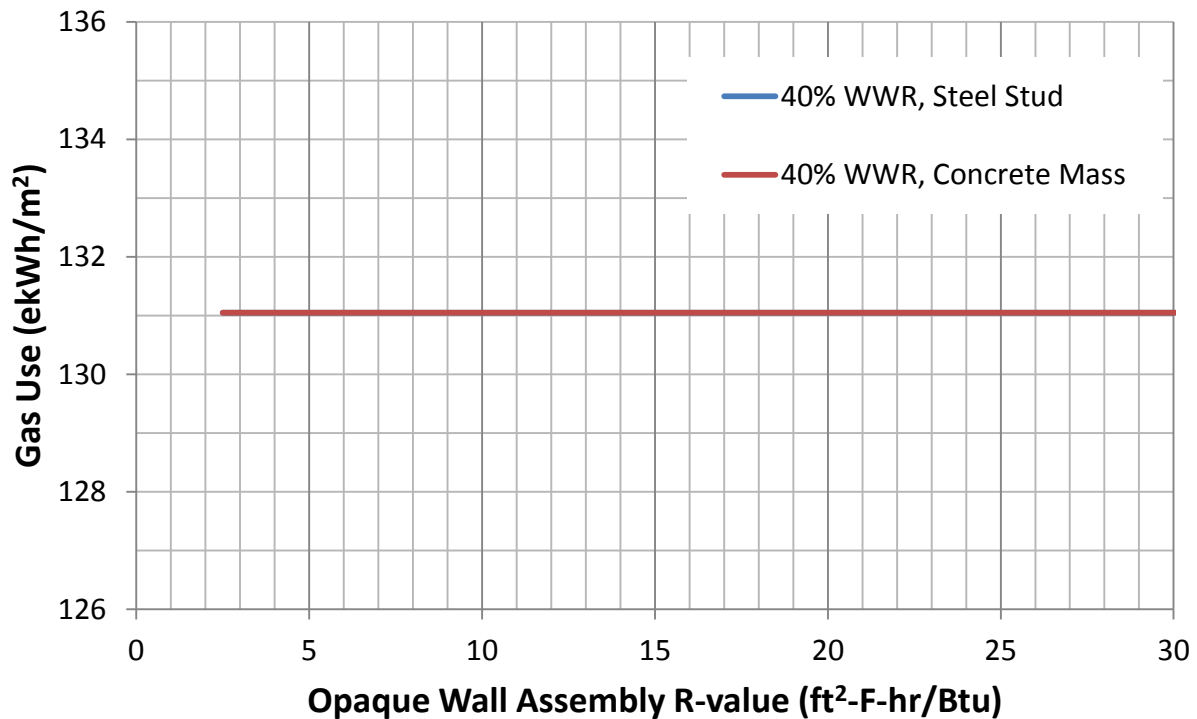


Figure C0.6: Summerland – Gas Use vs. Opaque Wall Assembly R-Value

THERMAL MASS ANALYSIS ANNUAL ENERGY USE

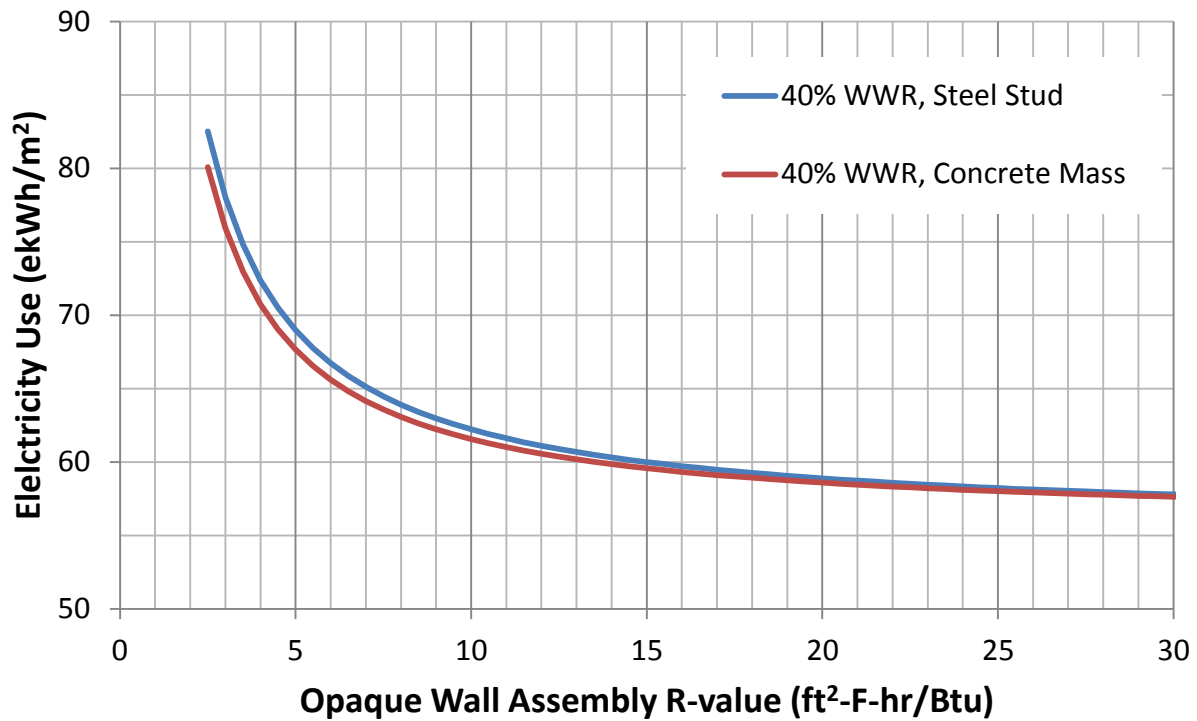


Figure C0.7: Vancouver – Electricity Use vs. Opaque Wall Assembly R-Value

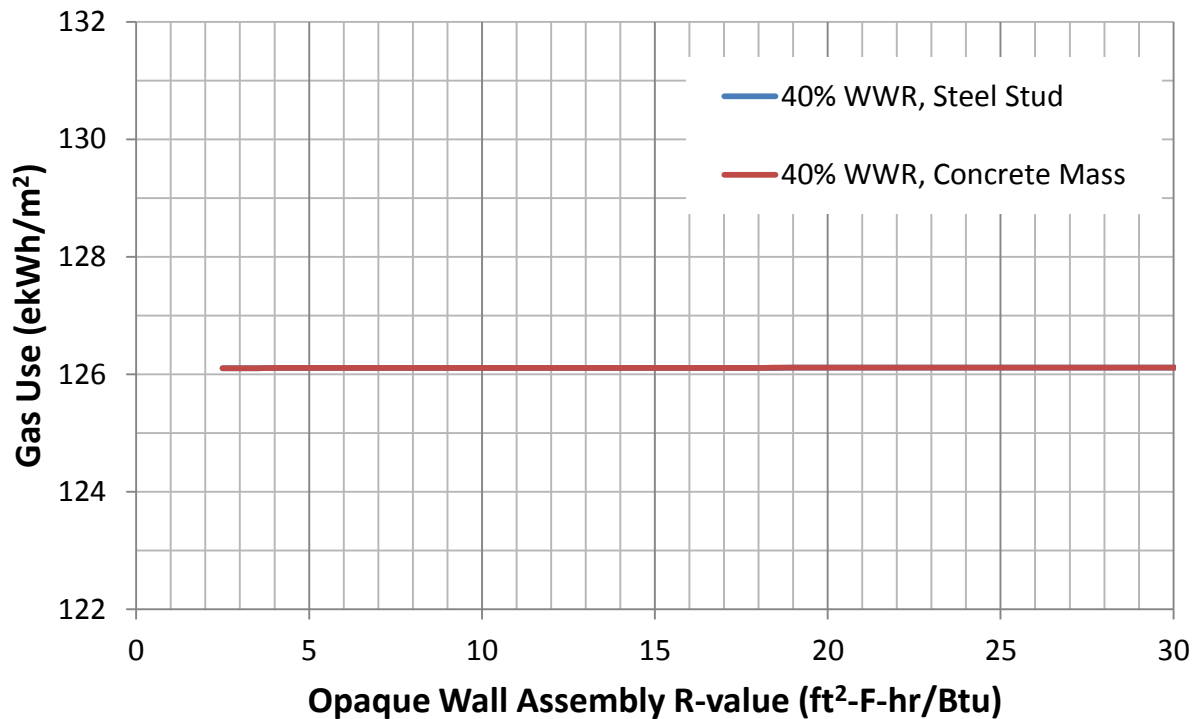


Figure C0.8: Vancouver – Gas Use vs. Opaque Wall Assembly R-Value

1.0 LARGE INSTITUTIONAL ARCHETYPE SUMMARY

Archetype Summary	Values	Units / Notes
Gross Floor Area (GFA)	240,000 (22,297)	ft ² (m ²)
Number of Floors	6	
Wall Height	15 (4.57)	ft (m)
Window:Wall Ratio (WWR)	30% / 50%	
Length:Width Ratio	4:1	
Wall:Roof Ratio	2.25	
Lighting Power Density (LPD)	1.2 (13)	W/ft ² (W/m ²)
Plug Power Density (PPD)	1 (10)	W/ft ² (W/m ²)
General System Information	Boiler/Chiller/CT Plant, Constant Volume, CSA Rates	
Performance Details	As per below	According to standard practice
Zoning	15	5/floor, multiplier for middle floors
Building Envelope Components		
Roof (insulated entirely above deck)	20.8 (3.66)	R-value, h.ft ² .F/BTU (m ² .K/W)
Wall	23.7 (4.17)	R-value Curve, h.ft ² .F/BTU (m ² .K/W)
Slab-on-grade (unheated)	0.159 (0.9)	F-factor, BTU/h.ft.F (m.K/W)
Glazing (Double-pane)	0.387 (2.2)	U-value, BTU/h.ft ² .F (m ² .K/W)
	0.45	Solar Heat Gain Coefficient (SHGC)
Internal Loads		
Occupancy	5 (20)	person/100 ft ² (m ² /person)
Lighting	1.2 (13)	W/ft ² (W/m ²)
Receptacle	1 (10)	W/ft ² (W/m ²)
Domestic Hot Water Peak	307 (90)	BTU/h/person (W/person)
Air Infiltration	0.05 (0.25)	cfm/ft ² (L/s/m ²) external surface area
Ventilation Rates		
Air Changes Per Hour	2	Healthcare Estimate
Schedules		
HVAC, Plug Loads, Lighting, Occupancy, Domestic Hot Water	Health	ASHRAE 90.1 - User's Manual, Table G-F
Zone Level Equipment		
Total Supply Airflow	Minimum at 6 ACH, peak autosized	
Heating Equipment		
Equipment Type	Hot Water Reheat Coil	
Controls		
Heating Design Supply Air Temperature	20 (11.1)	Above Space Temperature, F (°C)
Building Level Equipment		
System Type	VAV	
Fan Control	VFD	
Fan Efficiency	65	%
Motor Efficiency	90	%
Total Fan Static Pressure	5 (1250)	in (Pa)
Total Supply Airflow	Autosized	
Heating Equipment		
Equipment Type	Hot Water Coil	
Cooling Equipment		
Equipment Type	Chilled Water Coil	
Controls		
Heating Supply Air Temperature	50 (10)	F (°C)
Cooling Supply Air Temperature	Min 55, Max 64.4 (Min 12.8, Max 18)	Reset for Warmest Zone, F (°C)
Outdoor Air Economizer	75 (24)	Fixed Dry Bulb, Maximum Temperature, F (°C)

Plant Level Equipment		
Heating Equipment		
Equipment Type	Gas Boiler	
Efficiency	80	%
Design Water Outlet Temperature	177.8 (81)	F (°C)
Hot Water Pump		
Pump Control	VFD	
Pump Configuration	Primary Only	
Pump Motor Efficiency	90	%
Pump Head	60 (180)	ft (kPa)
Cooling Equipment		
Equipment Type	Electric Chiller	
Efficiency	5	COP
Condenser Type	Water Cooled	
Chiller Flow Control	Variable	
Leaving Chilled Water Temperature	44 (6.67)	F (°C)
Entering Condenser Fluid Temperature	85 (29.4)	F (°C)
Chilled Water Pump		
Pump Control	VFD	
Pump Configuration	Primary and Secondary	
Pump Motor Efficiency	90	%
Pump Head	60 (180)	ft (kPa)
Heat Rejection Equipment		
Equipment Type	Cooling Tower	
Design Inlet Air Wet-Bulb Temperature	78 (25.6)	F (°C)
Design Approach Temperature	7 (3.9)	Difference, F (°C)
Design Range Temperature	10 (5.6)	Difference, F (°C)
Condenser Pump		
Pump Control	Constant Speed	
Pump Configuration	Primary Only	
Pump Motor Efficiency	90	%
Pump Head	60 (180)	ft (kPa)
SHW Equipment		
System Type and Fuel	Gas	
Efficiency	80	%
Peak Demand	307 (90)	BTUh/person (W/person)
Controls		
Hot Water Design Exit Temperature	180 (82)	F (°C)
Hot Water Loop Design Temperature Difference	20 (11.1)	F (°C)
Chilled Water Design Exit Temperature	45 (7.22)	F (°C)
Chilled Water Loop Design Temperature Difference	44 (6.67)	F (°C)
Condenser Water Design Exit Temperature	85 (29.4)	F (°C)
Condenser Loop Design Temperature Difference	42 (5.6)	F (°C)
Hot Water Loop Temperature	Min 150, Max 180 (Min 66, Max 82)	Outdoor Air Reset, F (°C)
Chilled Water Loop Temperature	Min 45, Max 54 (Min 7, Max 12)	Outdoor Air Reset, F (°C)
Condenser Water Loop Temperature	Min 70, Max 84 (Min 21, Max 29)	Follow Outdoor Air, F (°C)

LARGE INSTITUTIONAL ANNUAL ENERGY USE

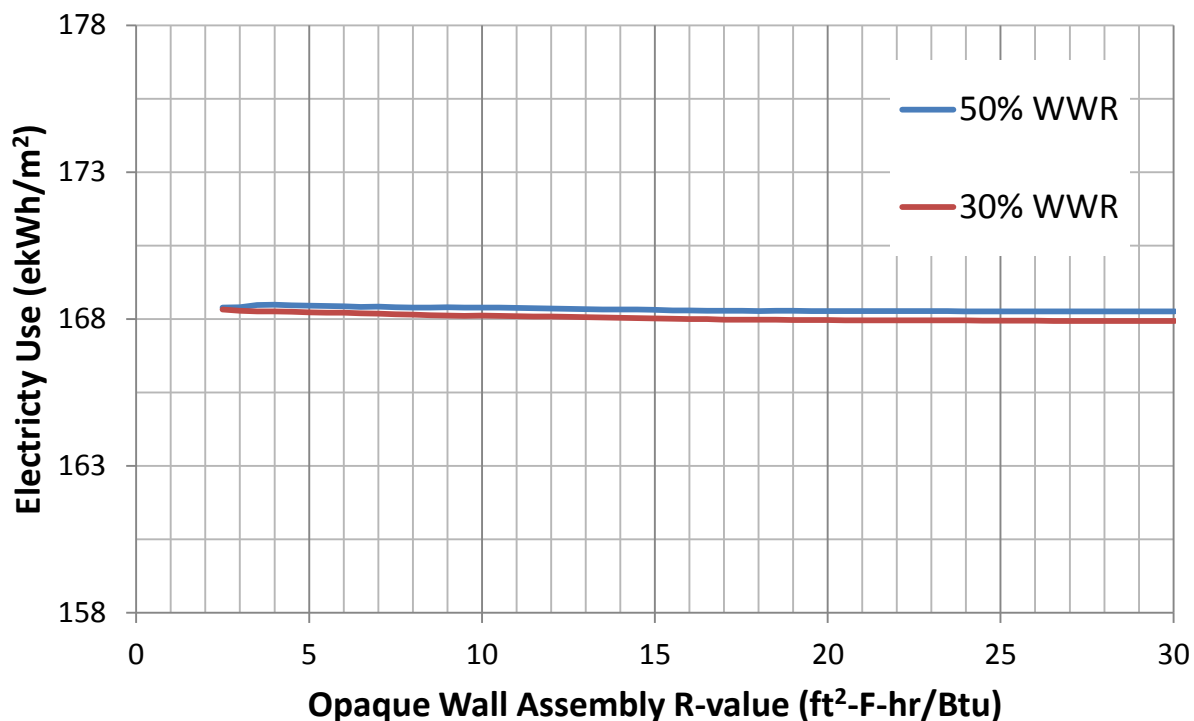


Figure C1.1: Prince George – Electricity Use vs. Opaque Wall Assembly R-Value

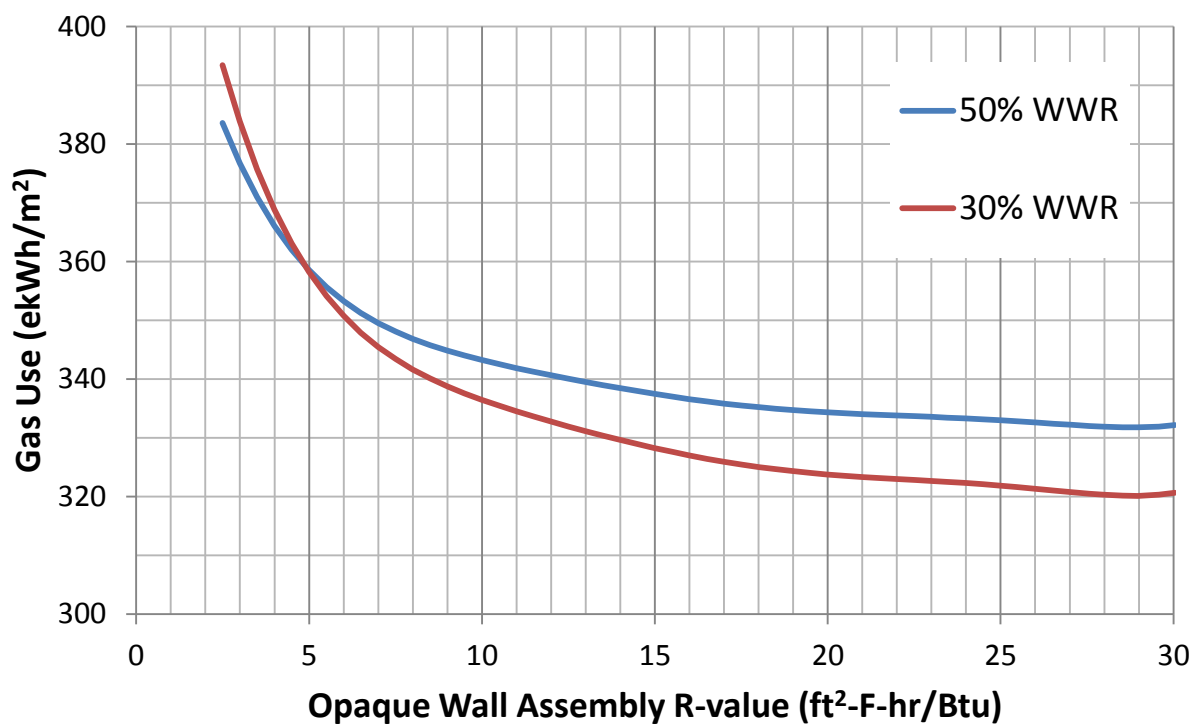


Figure C1.2: Prince George – Gas Use vs. Opaque Wall Assembly R-Value

LARGE INSTITUTIONAL ANNUAL ENERGY USE

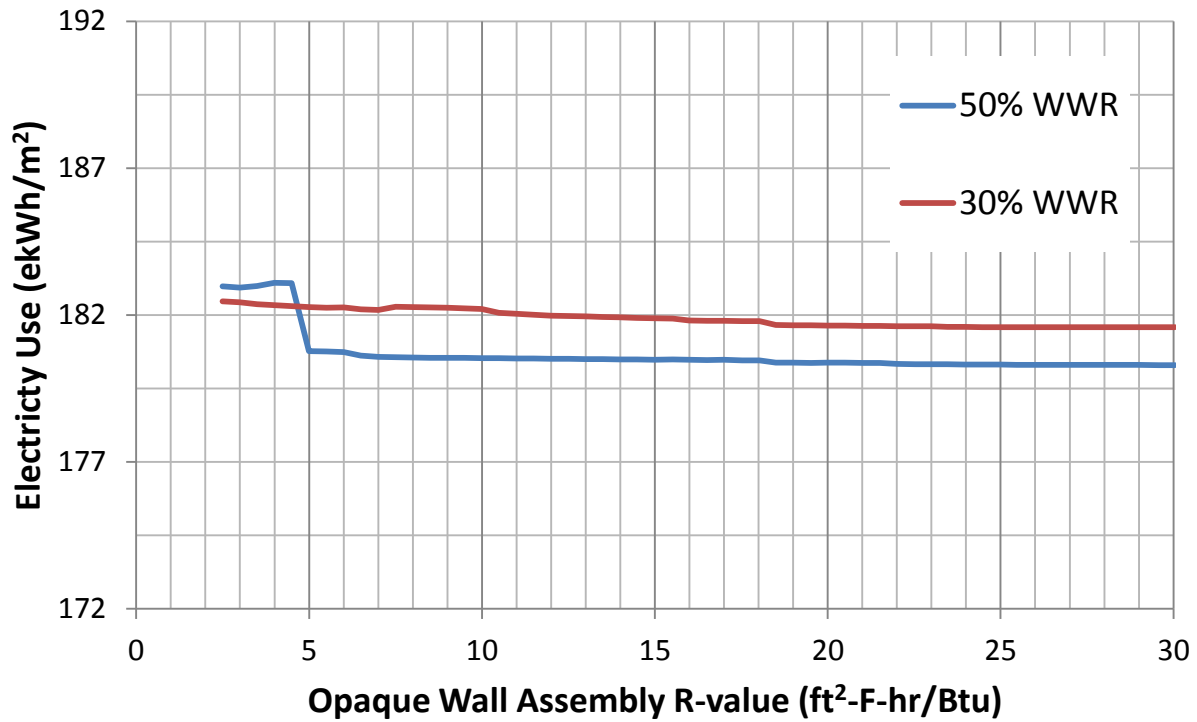


Figure C1.3: Summerland – Electricity Use vs. Opaque Wall Assembly R-Value

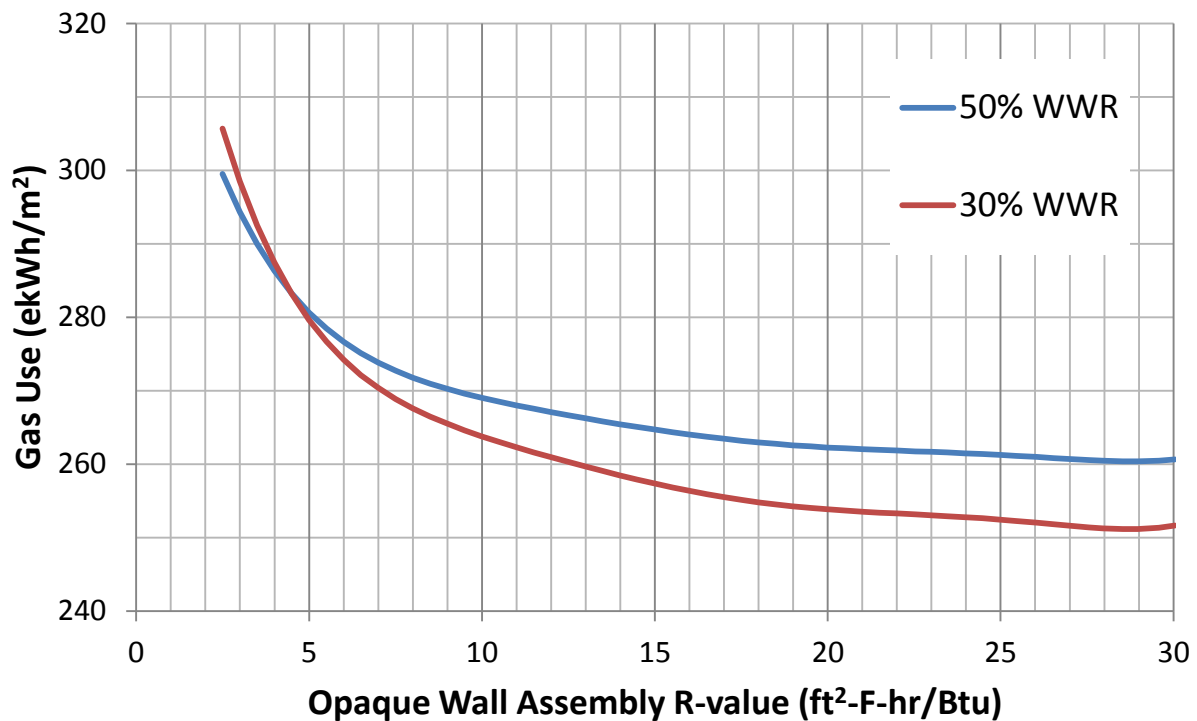


Figure C1.4: Summerland – Gas Use vs. Opaque Wall Assembly R-Value

LARGE INSTITUTIONAL ANNUAL ENERGY USE

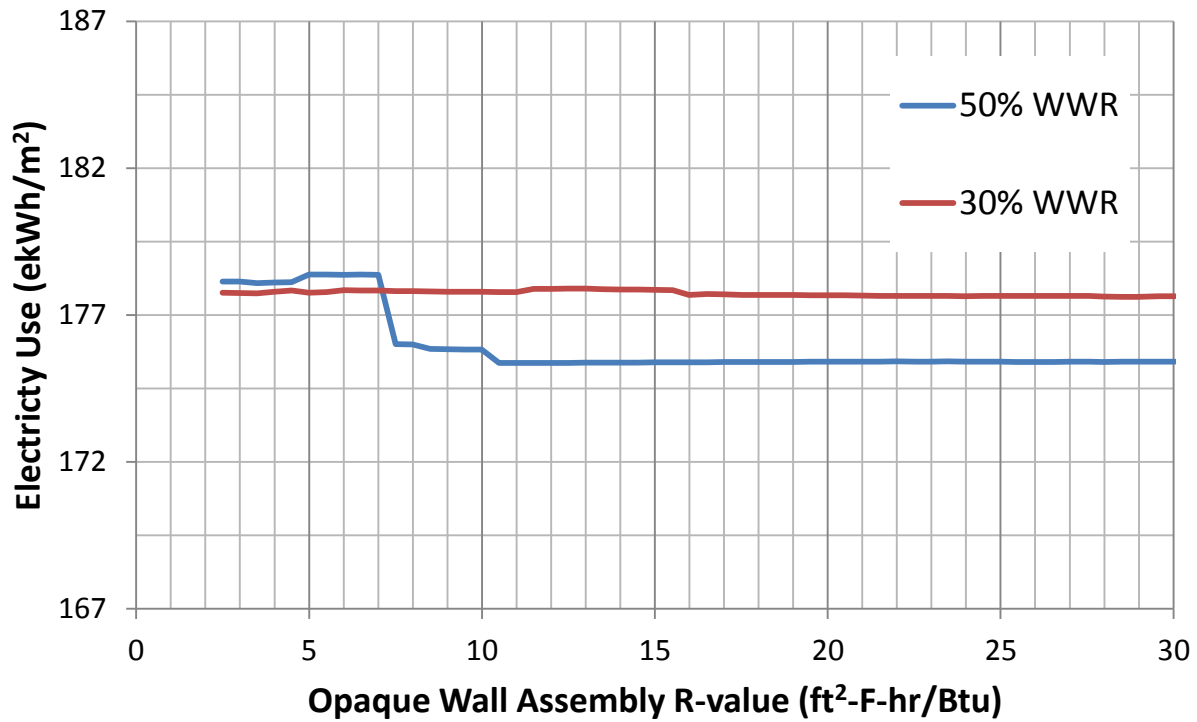


Figure C1.5: Vancouver – Electricity Use vs. Opaque Wall Assembly R-Value

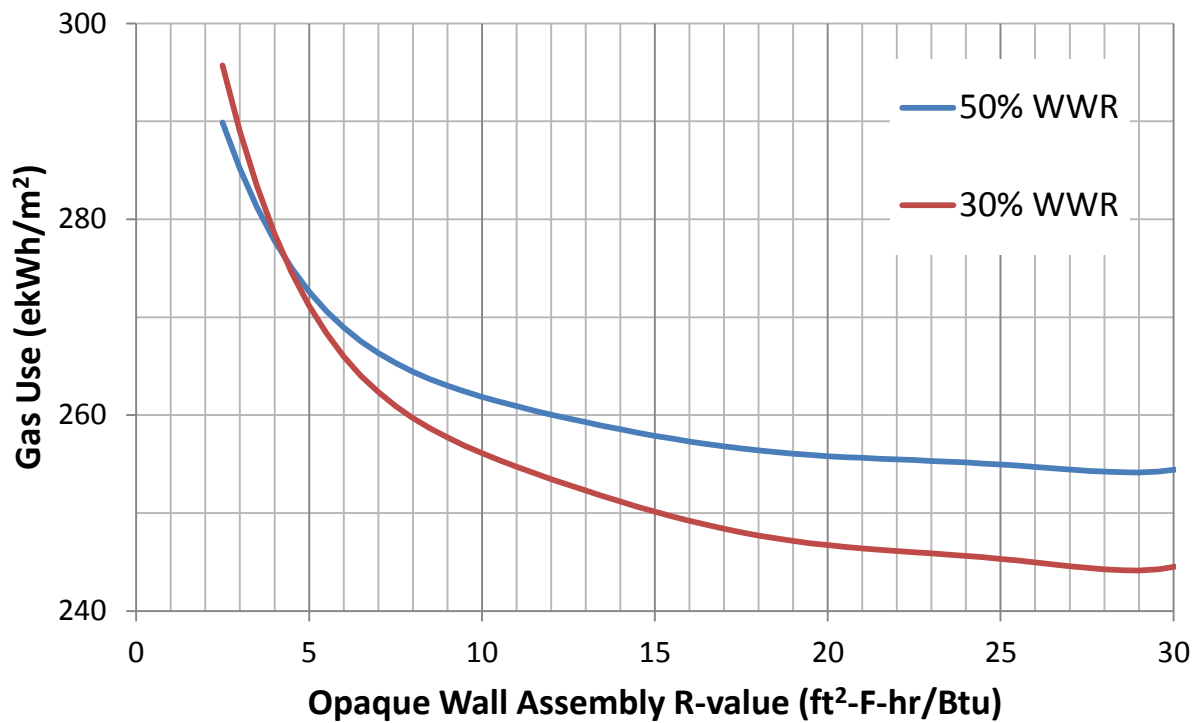


Figure C1.6: Vancouver – Gas Use vs. Opaque Wall Assembly R-Value

2.0 LOW-MID RISE MURB ARCHETYPE SUMMARY

Archetype Summary	Values	Units / Notes
Gross Floor Area (GFA)	51, 200 (4,757)	ft ² (m ²)
Number of Floors	4	
Wall Height	9 (2.74)	ft (m)
Window:Wall Ratio (WWR)	30% / 50%	
Length:Width Ratio	2:1	
Wall:Roof Ratio	1.35	
Lighting Power Density (LPD)	0.7 (8)	W/ft ² (W/m ²)
Plug Power Density (PPD)	0.5 (6)	W/ft ² (W/m ²)
General System Information	Electric Baseboard, Gas-Fired MUA, Gas DHW	
Performance Details	As per below	According to standard practice
Zoning	15	5/floor, multiplier for middle floors
Notes	Typical of a wood frame MURB	
Building Envelope Components		
Roof (insulated entirely above deck)	20.8 (3.66)	R-value, h.ft ² .F/BTU (m ² .K/W)
Wall	23.7 (4.17)	R-value Curve, h.ft ² .F/BTU (m ² .K/W)
Slab-on-grade (unheated)	0.159 (0.9)	F-factor, BTU/h.ft.F (m.K/W)
Glazing (Double-pane)	0.387 (2.2)	U-value, BTU/h.ft ² .F (m ² .K/W)
	0.45	Solar Heat Gain Coefficient (SHGC)
Internal Loads		
Occupancy	4 (25)	person/100 ft ² (m ² /person)
Lighting	0.7 (8)	W/ft ² (W/m ²)
Receptacle	0.5 (6)	W/ft ² (W/m ²)
Domestic Hot Water Peak	1,707 (500)	BTUh/person (W/person)
Air Infiltration	0.05 (0.25)	cfm/ft ² (L/s/m ²) external surface area
Ventilation Rates		
People Outdoor Air Rate	5 (2.5)	cfm/person (L/s/person)
Area Outdoor Air Rate	0.06 (0.3)	cfm/ft ² (L/s/m ²)
Schedules		
HVAC, Plug Loads, Lighting, Occupancy, Domestic Hot Water	Hotel	ASHRAE 90.1 - User's Manual, Table G-G
Zone Level Equipment		
Heating Equipment		
Equipment Type	Electric Baseboard	
Efficiency	100	%
Building Level Equipment		
System Type	MUA	
Fan Control	Constant Volume	
Fan Efficiency	65	%
Motor Efficiency	90	%
Fan Static Pressure	4 (1,000)	in (Pa)
Total Supply Airflow	Autosized, 100% OA	
Heating Equipment		
Equipment Type	Gas Coil	
Efficiency	80	%
Controls		
Heating Supply Air Temperature	64.4 (18)	F (°C)
Plant Level Equipment		
SHW Equipment		
System Type and Fuel	Gas	
Efficiency	80	%
Peak Demand	1,707 (500)	BTUh/person (W/person)

LOW-MID RISE MURB ANNUAL ENERGY USE

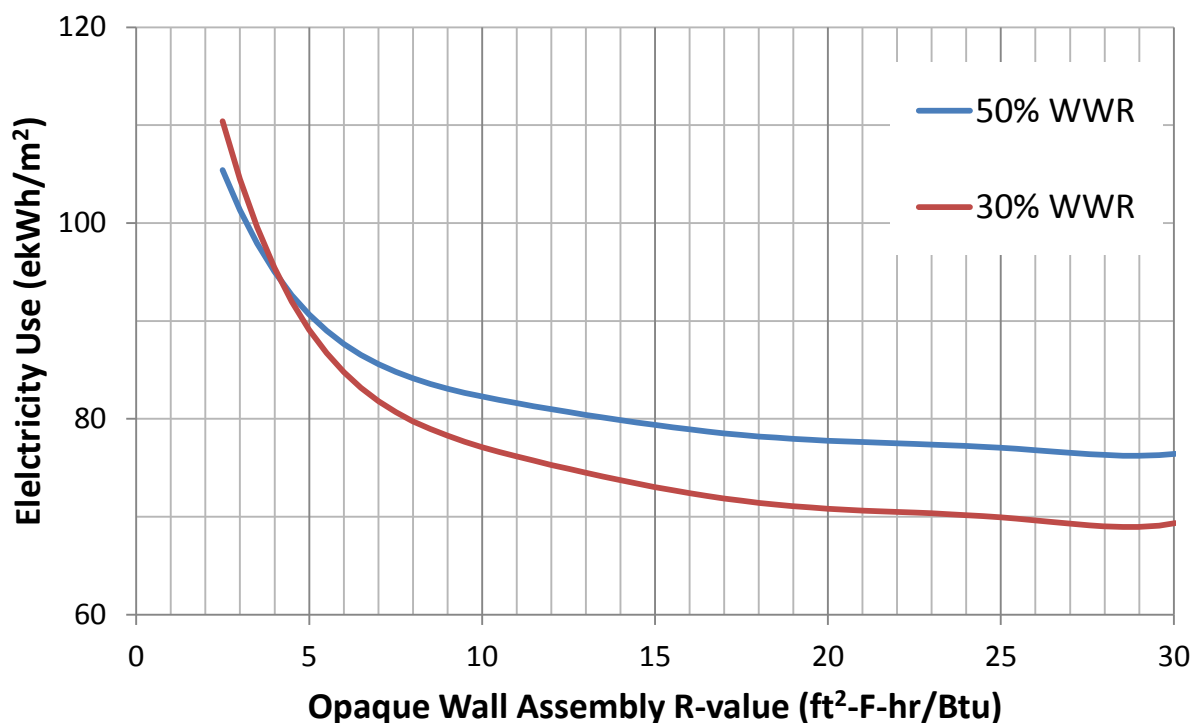


Figure C2.1: Prince George – Electricity Use vs. Opaque Wall Assembly R-Value

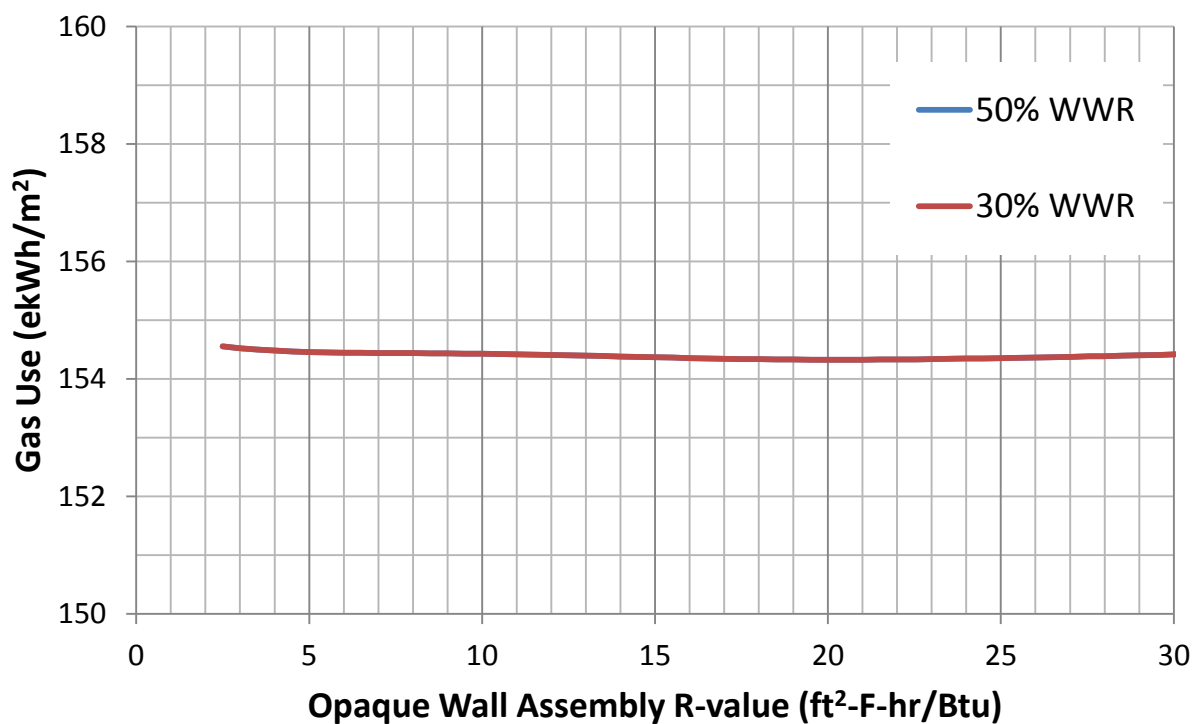


Figure C2.2: Prince George – Gas Use vs. Opaque Wall Assembly R-Value

LOW-MID RISE MURB ANNUAL ENERGY USE

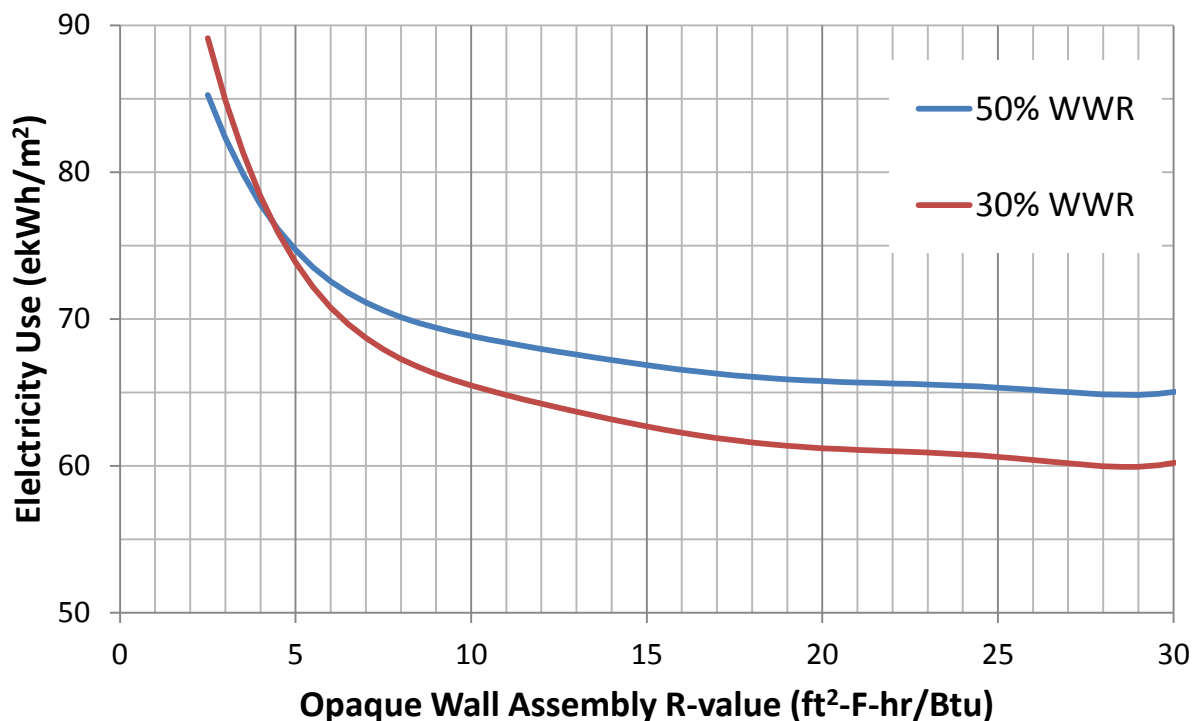


Figure C2.3: Summerland – Electricity Use vs. Opaque Wall Assembly R-Value

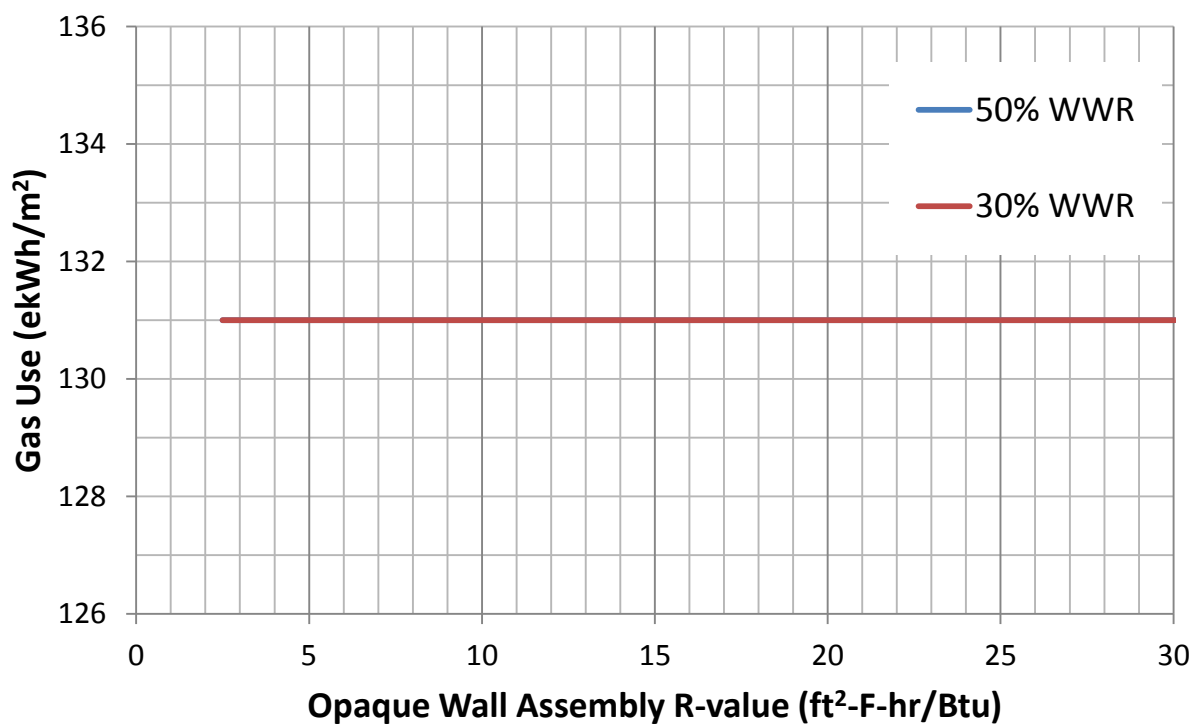


Figure C2.4: Summerland – Gas Use vs. Opaque Wall Assembly R-Value

LOW-MID RISE MURB ANNUAL ENERGY USE

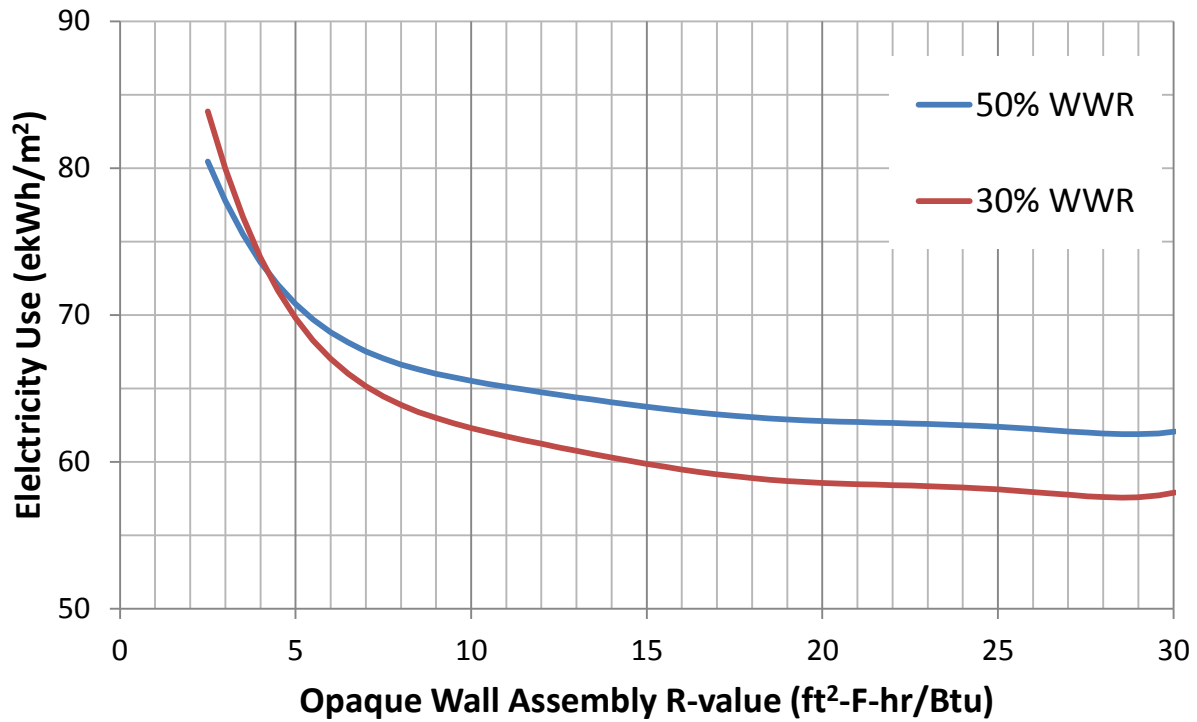


Figure C2.5: Vancouver – Electricity Use vs. Opaque Wall Assembly R-Value

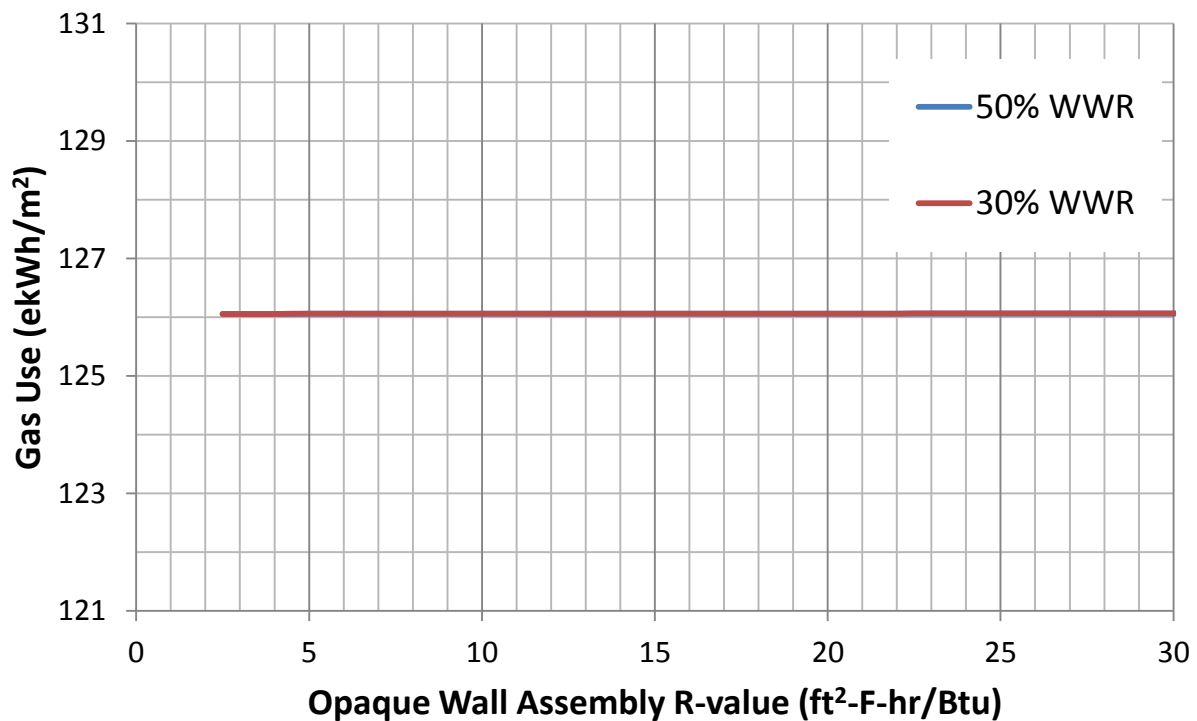


Figure C2.6: Vancouver – Gas Use vs. Opaque Wall Assembly R-Value

3.0 HIGH RISE MURB ARCHETYPE SUMMARY

Archetype Summary	Values	Units / Notes
Gross Floor Area (GFA)	300,000 (27,871)	ft ² (m ²)
Number of Floors	30	
Wall Height	9 (2.74)	ft (m)
Window:Wall Ratio (WWR)	40% / 70%	
Length:Width Ratio	1:1	
Wall:Roof Ratio	10.80	
Lighting Power Density (LPD)	0.7 (8)	W/ft ² (W/m ²)
Plug Power Density (PPD)	0.5 (6)	W/ft ² (W/m ²)
General System Information	Electric Baseboard, Gas-Fired MUA, Gas DHW.	
Performance Details	As per below	According to standard practice
Zoning	15	5/floor, multiplier for middle floors
Notes	Representative of point tower	
Building Envelope Components		
Roof (insulated entirely above deck)	20.8 (3.66)	R-value, h.ft ² .F/BTU (m ² .K/W)
Wall	23.7 (4.17)	R-value Curve, h.ft ² .F/BTU (m ² .K/W)
Slab-on-grade (unheated)	0.159 (0.9)	F-factor, BTU/h.ft.F (m.K/W)
Glazing (Double-pane)	0.387 (2.2)	U-value, BTU/h.ft ² .F (m ² .K/W)
	0.45	Solar Heat Gain Coefficient (SHGC)
Glazing (Triple-pane)	0.282 (1.6)	U-value, BTU/h.ft ² .F (m ² .K/W)
	0.45	Solar Heat Gain Coefficient (SHGC)
Internal Loads		
Occupancy	4 (25)	person/100 ft ² (m ² /person)
Lighting	0.7 (8)	W/ft ² (W/m ²)
Receptacle	0.5 (6)	W/ft ² (W/m ²)
Domestic Hot Water Peak	1,707 (500)	BTU/h/person (W/person)
Air Infiltration	0.05 (0.25)	cfm/ft ² (L/s/m ²) external surface area
Ventilation Rates		
People Outdoor Air Rate	5 (2.5)	cfm/person (L/s/person)
Area Outdoor Air Rate	0.06 (0.3)	cfm/ft ² (L/s/m ²)
Schedules		
HVAC, Plug Loads, Lighting, Occupancy, Domestic Hot Water	Hotel	ASHRAE 90.1 - User's Manual, Table G-G
Zone Level Equipment		
Heating Equipment		
Equipment Type	Electric Baseboard	
Efficiency	100	%
Building Level Equipment		
System Type	MUA	
Fan Control	Constant Volume	
Fan Efficiency	65	%
Motor Efficiency	90	%
Fan Static Pressure	4 (1,000)	in (Pa)
Total Supply Airflow	Autosized, 100% OA	
Heating Equipment		
Equipment Type	Gas Coil	
Efficiency	80	%
Controls		
Heating Supply Air Temperature	64.4 (18)	F (°C)
Plant Level Equipment		
SHW Equipment		
System Type and Fuel	Gas	
Efficiency	80	%
Peak Demand	1,707 (500)	BTU/h/person (W/person)

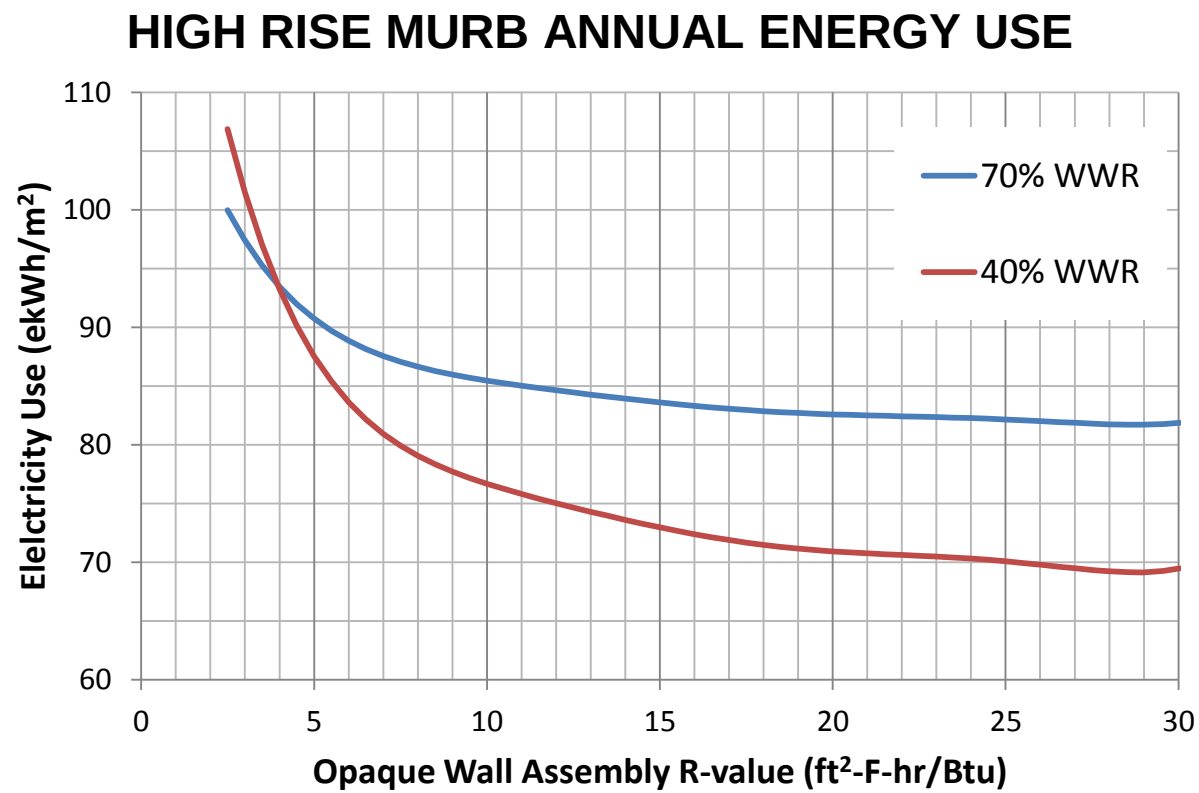


Figure C3.1: Prince George – Electricity Use vs. Opaque Wall Assembly R-Value

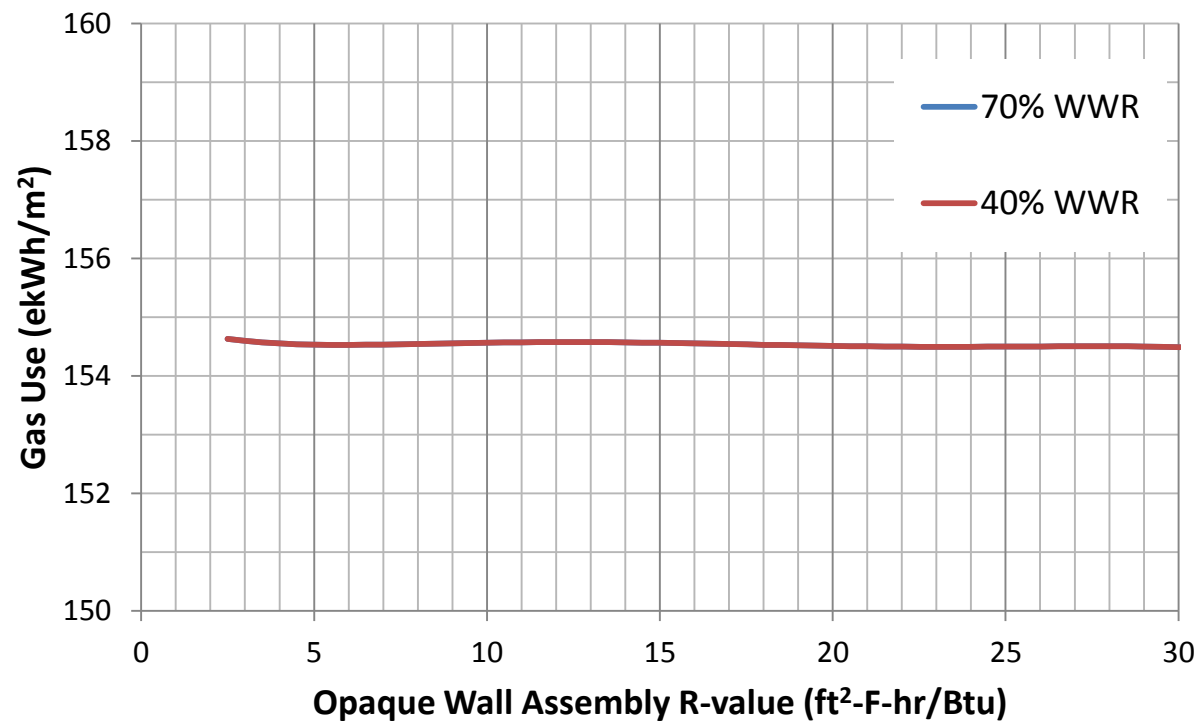


Figure C3.2: Prince George – Gas Use vs. Opaque Wall Assembly R-Value

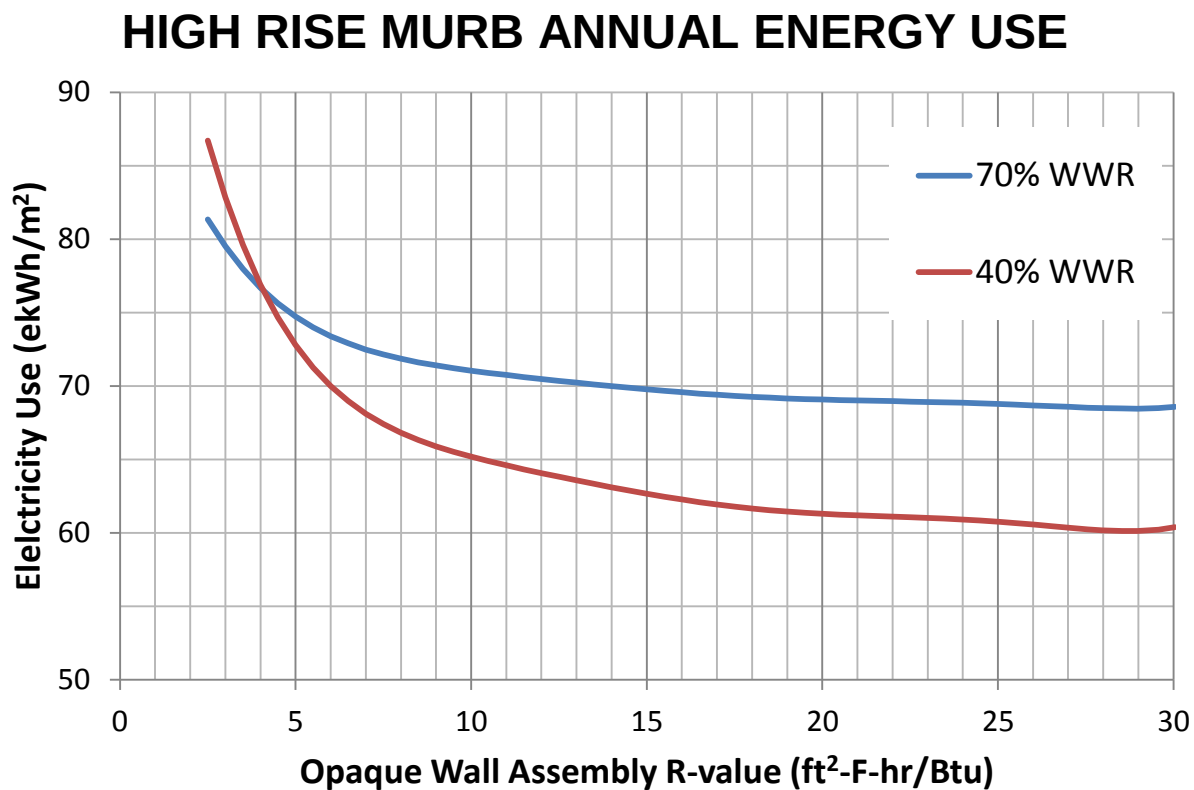


Figure C3.3: Summerland – Electricity Use vs. Opaque Wall Assembly R-Value

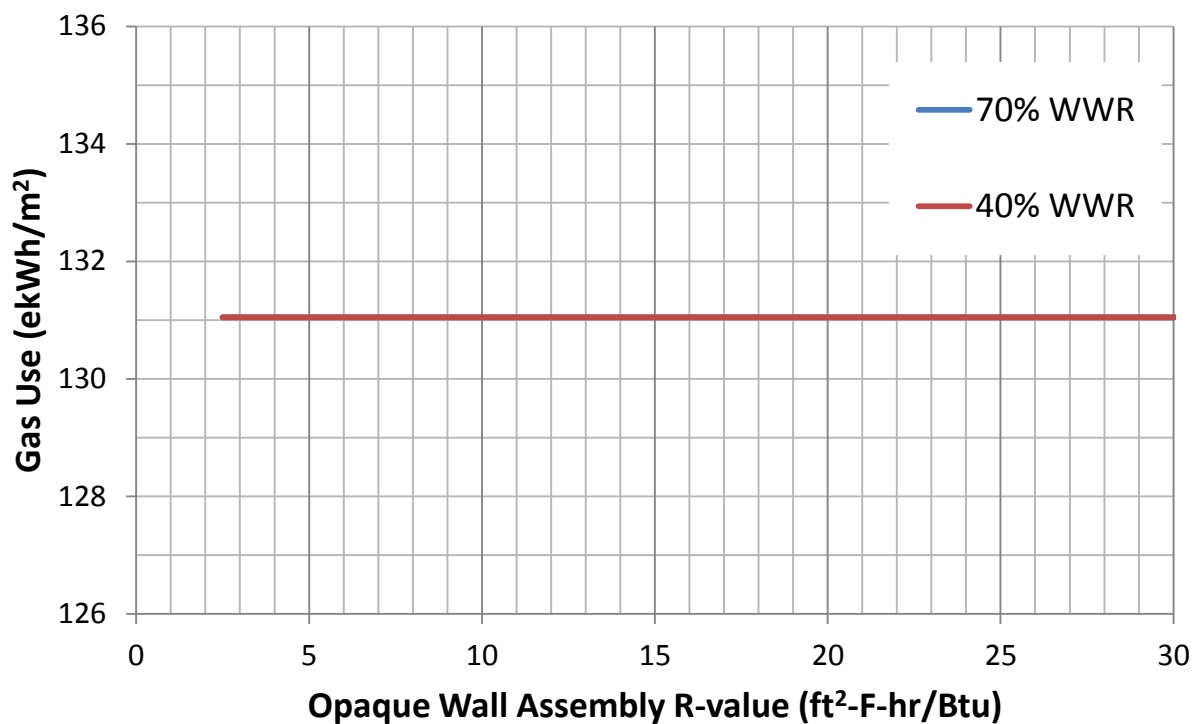


Figure C3.4: Summerland – Gas Use vs. Opaque Wall Assembly R-Value

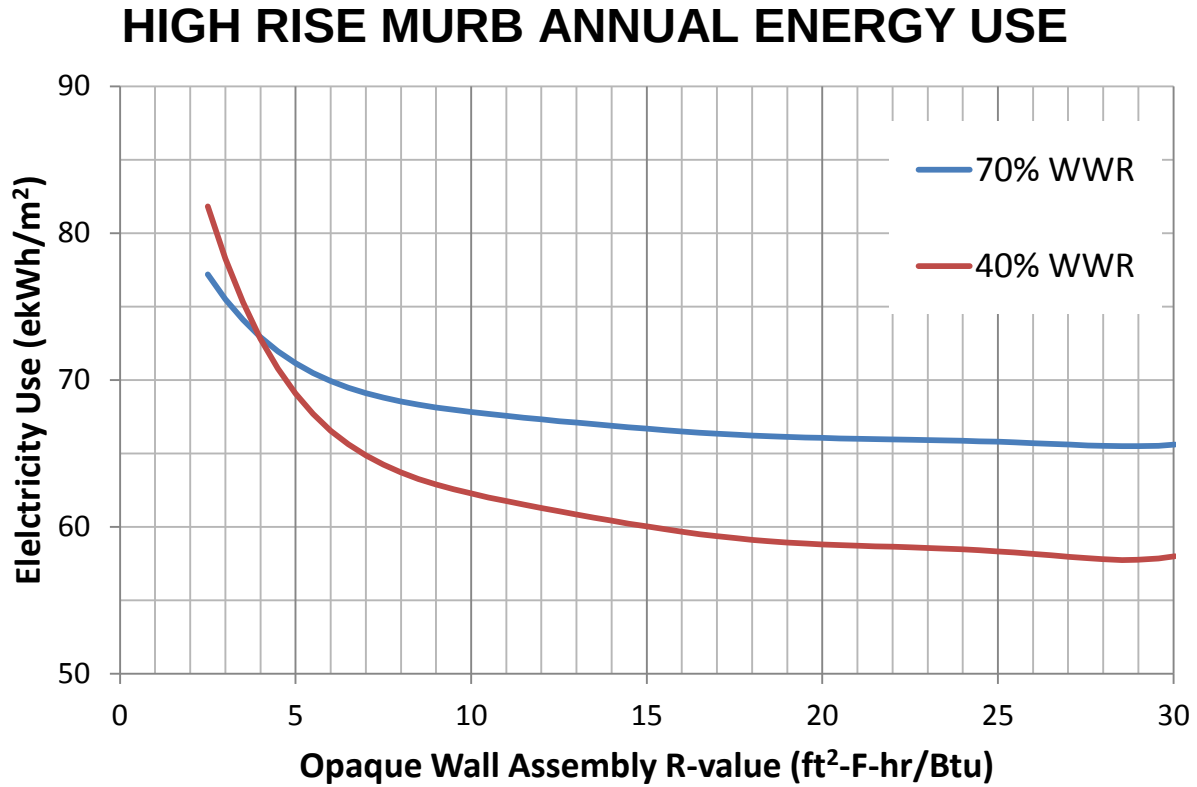


Figure C3.5: Vancouver – Electricity Use vs. Opaque Wall Assembly R-Value

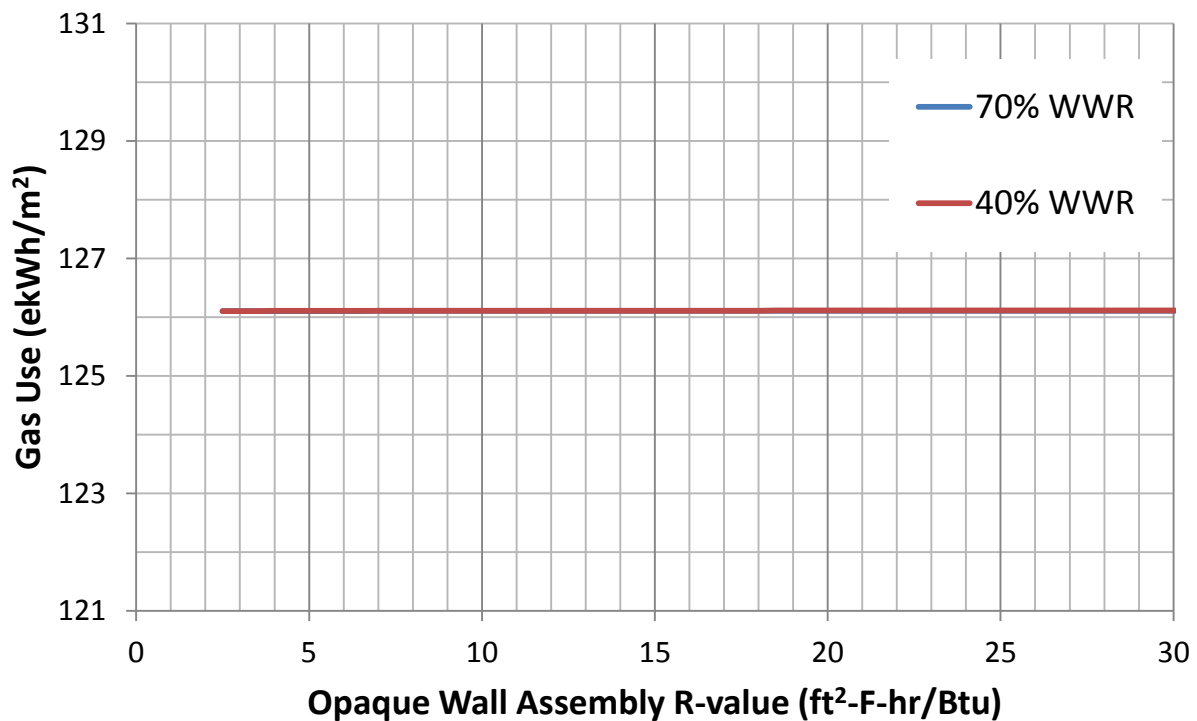


Figure C3.6: Vancouver – Gas Use vs. Opaque Wall Assembly R-Value

HIGH RISE MURB (TRIPLE-GLAZING) ANNUAL ENERGY USE

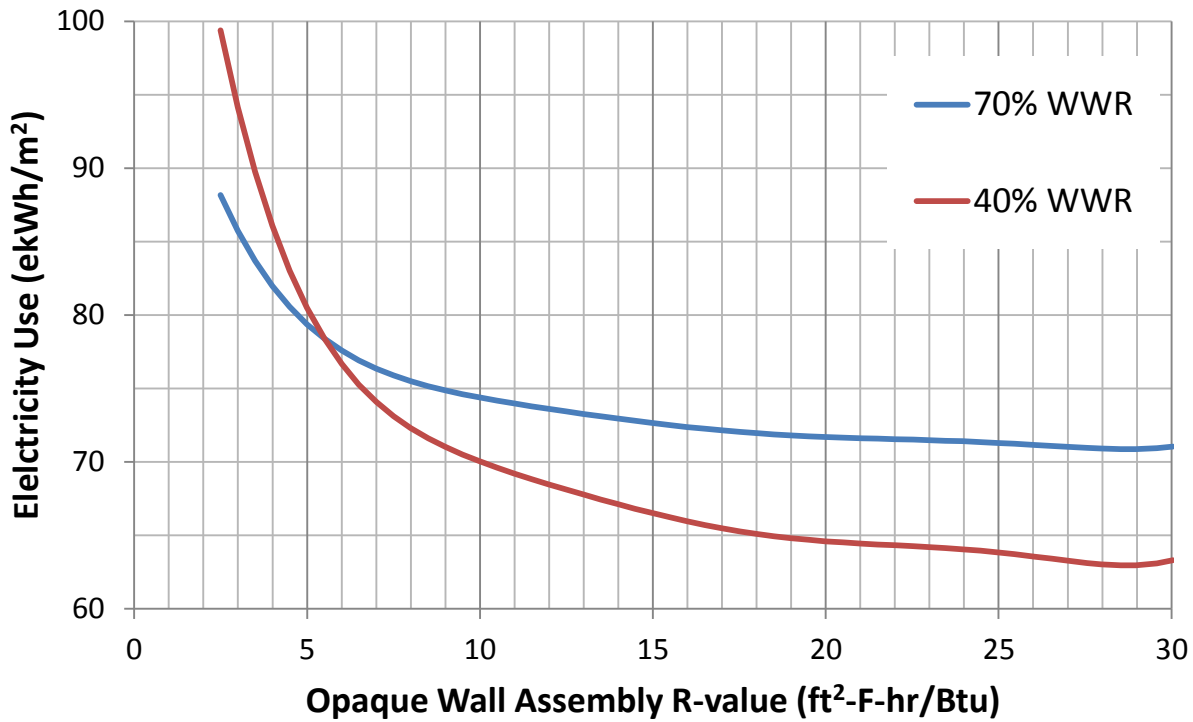


Figure C3.7: Prince George – Electricity Use vs. Opaque Wall Assembly R-Value

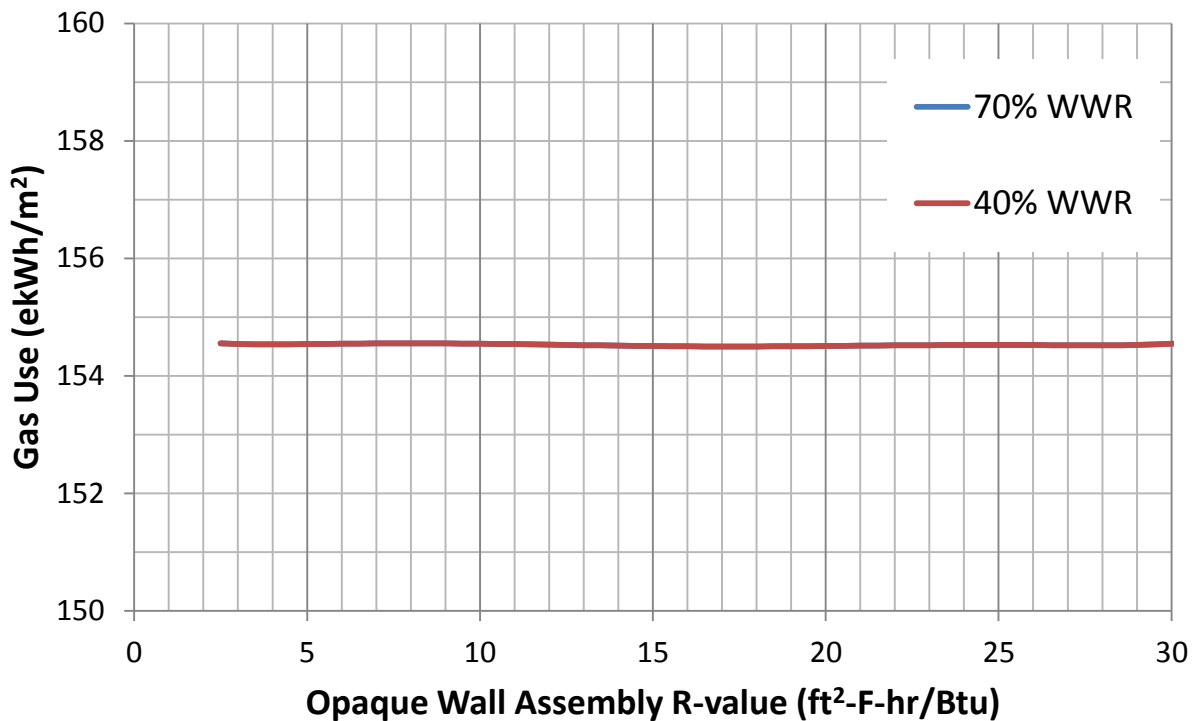


Figure C3.8: Prince George – Gas Use vs. Opaque Wall Assembly R-Value

HIGH RISE MURB (TRIPLE-GLAZING) ANNUAL ENERGY USE

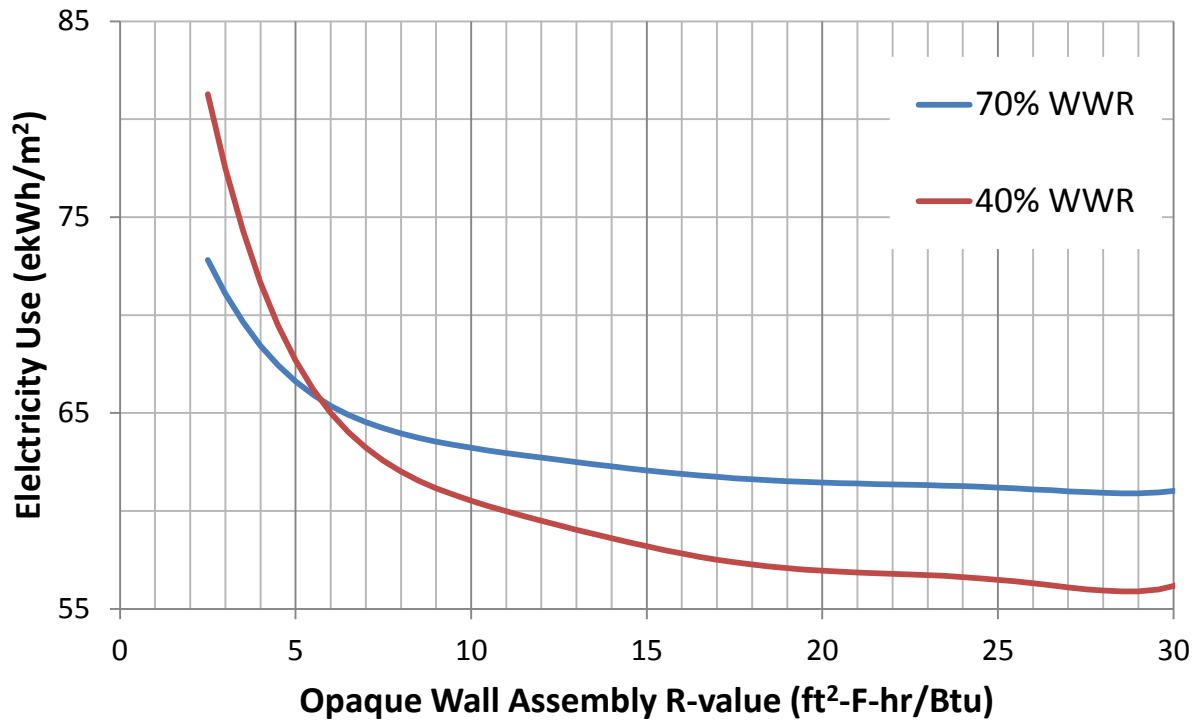


Figure C3.9: Summerland – Electricity Use vs. Opaque Wall Assembly R-Value

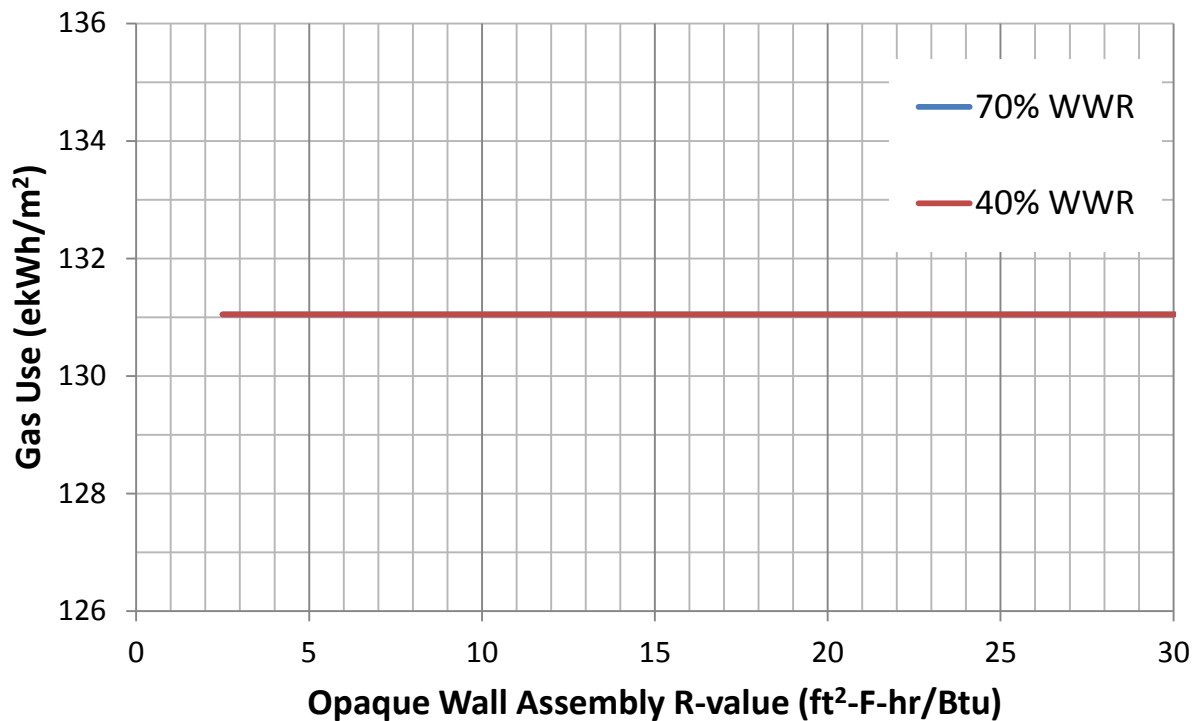


Figure C3.10: Summerland – Gas Use vs. Opaque Wall Assembly R-Value

HIGH RISE MURB (TRIPLE-GLAZING) ANNUAL ENERGY USE

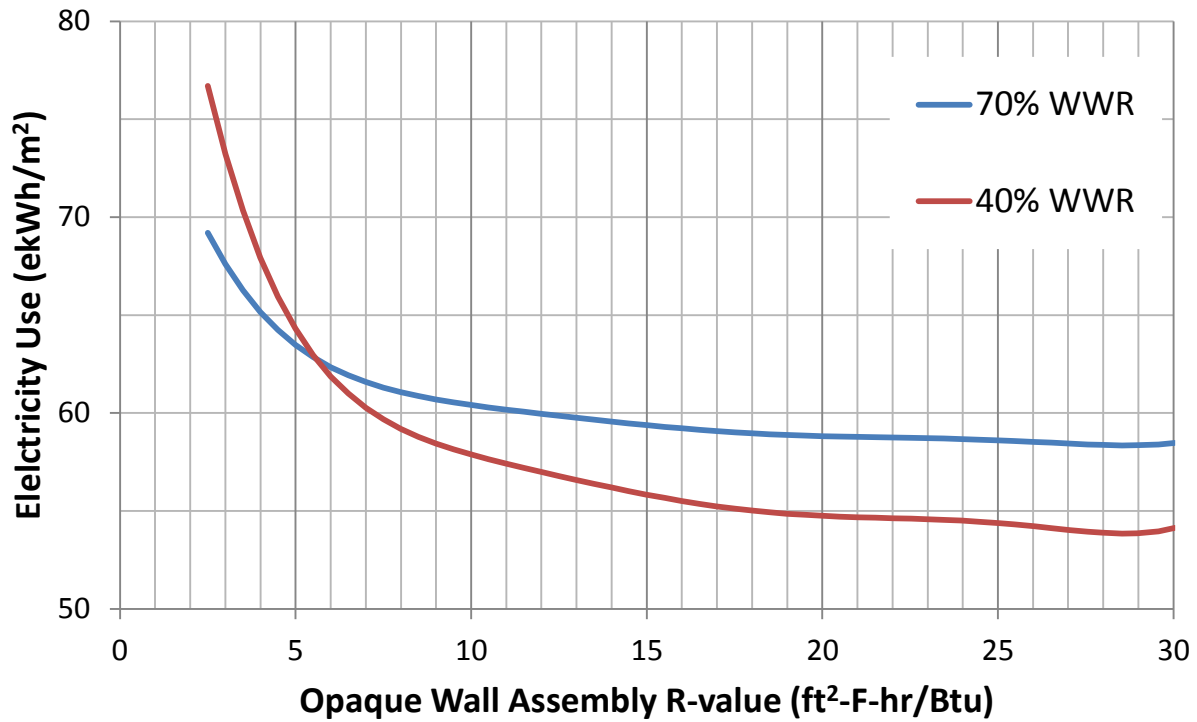


Figure C3.11: Vancouver – Electricity Use vs. Opaque Wall Assembly R-Value

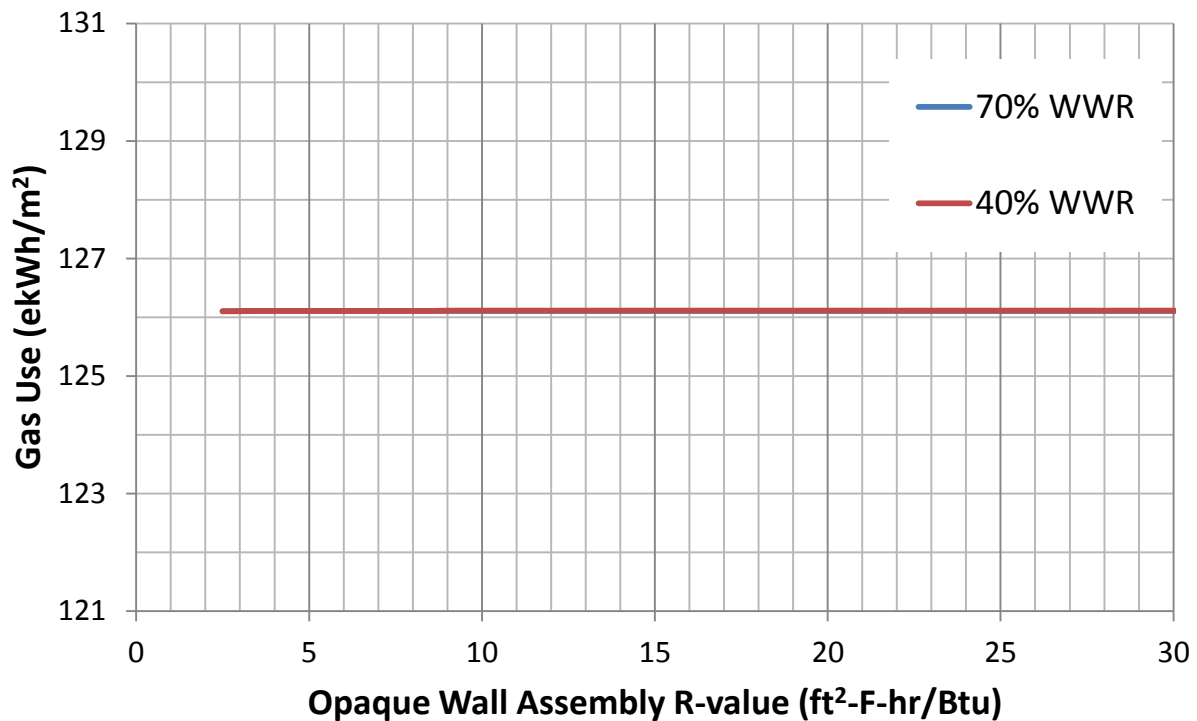


Figure C3.12: Vancouver – Gas Use vs. Opaque Wall Assembly R-Value

4.0 SECONDARY SCHOOL ARCHETYPE SUMMARY

Archetype Summary	Values	Units / Notes
Gross Floor Area (GFA)	78,400 (7,284)	ft ² (m ²)
Number of Floors	2	
Wall Height	12 (3.6)	ft (m)
Window:Wall Ratio (WWR)	20% / 40%	
Length:Width Ratio	2:1	
Wall:Roof Ratio	0.51	
Lighting Power Density (LPD)	1.2 (13)	W/ft ² (W/m ²)
Plug Power Density (PPD)	0.5 (6)	W/ft ² (W/m ²)
General System Information	Packaged VAV, HW reheat, PSZ in gym	
Performance Details	As per below	According to standard practice
Zoning	10	5/floor
Building Envelope Components		
Roof (insulated entirely above deck)	20.8 (3.66)	R-value, h.ft ² .F/BTU (m ² .K/W)
Wall	23.7 (4.17)	R-value Curve, h.ft ² .F/BTU (m ² .K/W)
Slab-on-grade (unheated)	0.159 (0.9)	F-factor, BTU/h.ft.F (m.K/W)
Glazing (Double-pane)	0.387 (2.2)	U-value, BTU/h.ft ² .F (m ² .K/W)
	0.45	Solar Heat Gain Coefficient (SHGC)
Internal Loads		
Occupancy	35 (3)	person/100 ft ² (m ² /person)
Lighting	1.2 (13)	W/ft ² (W/m ²)
Receptacle	0.5 (6)	W/ft ² (W/m ²)
Domestic Hot Water Peak	205 (60)	BTUh/person (W/person)
Air Infiltration	0.05 (0.25)	cfm/ft ² (L/s/m ²) external surface area
Ventilation Rates		
People Outdoor Air Rate	5 (2.5)	cfm/person (L/s/person)
Area Outdoor Air Rate	0.06 (0.3)	cfm/ft ² (L/s/m ²)
Schedules		
HVAC, Plug Loads, Lighting, Occupancy, Domestic Hot Water	School	ASHRAE 90.1 - User's Manual, Table G-M
Zone Level Equipment		
Heating Equipment		
Equipment Type	Hot Water Reheat Coil	
Controls		
Heating Design Supply Air Temperature	20 (11.1)	Above Space Temperature, F (°C)
Building Level Equipment - General		
System Type	PVAV	
Fan Control	ASHRAE VFD Curve	Variable
Fan Efficiency	65	%
Motor Efficiency	90	%
Total Static Pressure	3 (750)	in (Pa)
Total Supply Airflow	Autosized	
Heating Equipment		
Equipment Type	Hot Water Coil	
Heating Coil Inlet Water Temperature	180 (82.2)	F (°C)
Heating Coil Outlet Water Temperature	130 (54.4)	F (°C)
Heating Coil Inlet Air Temperature	62 (16.6)	F (°C)
Heating Coil Outlet Air Temperature	90 (32.2)	F (°C)
Cooling Equipment		
Equipment Type	Two-speed DX	
Efficiency	2.78	COP
Equipment Type	Single-speed DX	
Efficiency	3.22	COP
Controls		
Heating Supply Air Temperature	50 (10)	F (°C)
Cooling Supply Air Temperature	Min 55, Max 64.4 (Min 12.8, Max 18)	Reset for Warmest Zone, F (°C)
Outdoor Air Economizer	75 (24)	Fixed Dry Bulb, F (°C)

Building Level Equipment - Gym		
System Type	PSZ (Unitary)	
Fan Control	On/Off	
Fan Efficiency	65	%
Motor Efficiency	90	%
Total Static Pressure	3 (750)	in (Pa)
Total Supply Airflow	Autosized	
Heating Equipment		
Equipment Type	Hot Water Coil	
Heating Coil Inlet Water Temperature	180 (82.2)	F (°C)
Heating Coil Outlet Water Temperature	130 (54.4)	F (°C)
Heating Coil Inlet Air Temperature	62 (16.6)	F (°C)
Heating Coil Outlet Air Temperature	90 (32.2)	F (°C)
Cooling Equipment		
Equipment Type	Single-speed DX	
Efficiency	3.22	COP
Controls		
Heating Supply Air Temperature	Min 55.4, Max 113 (Min 13, Max 45)	Single Zone Reheat Range, F (°C)
Plant Level Equipment		
Heating Equipment		
System Type	Gas Boiler	
Efficiency	80	%
Design Water Outlet Temperature	177.8 (81)	F (°C)
Hot Water Pump		
Pump Control	Riding the Curve	
Pump Configuration	Primary Only	
Pump Motor Efficiency	90	%
Pump Head	60 (180)	ft (kPa)
SHW Equipment		
System Type and Fuel	Gas	
Efficiency	80	%
Peak Demand	205 (60)	BTUh/person (W/person)
Controls		
Hot Water Design Exit Temperature	180 (82)	F (°C)
Hot Water Loop Design Temperature Difference	20 (11)	F (°C)
Hot Water Loop Temperature	Min 150, Max 180 (Min 66, Max 82)	Outdoor Air Reset, F (°C)

SECONDARY SCHOOL ANNUAL ENERGY USE

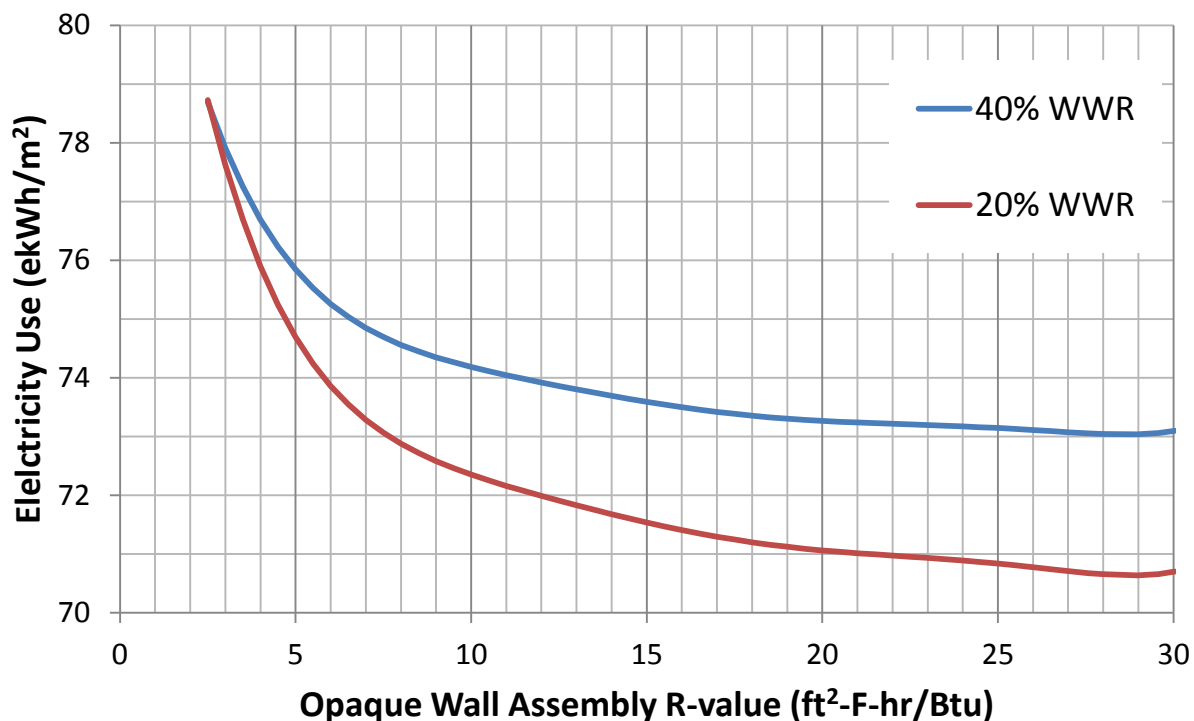


Figure C4.1: Prince George – Electricity Use vs. Opaque Wall Assembly R-Value

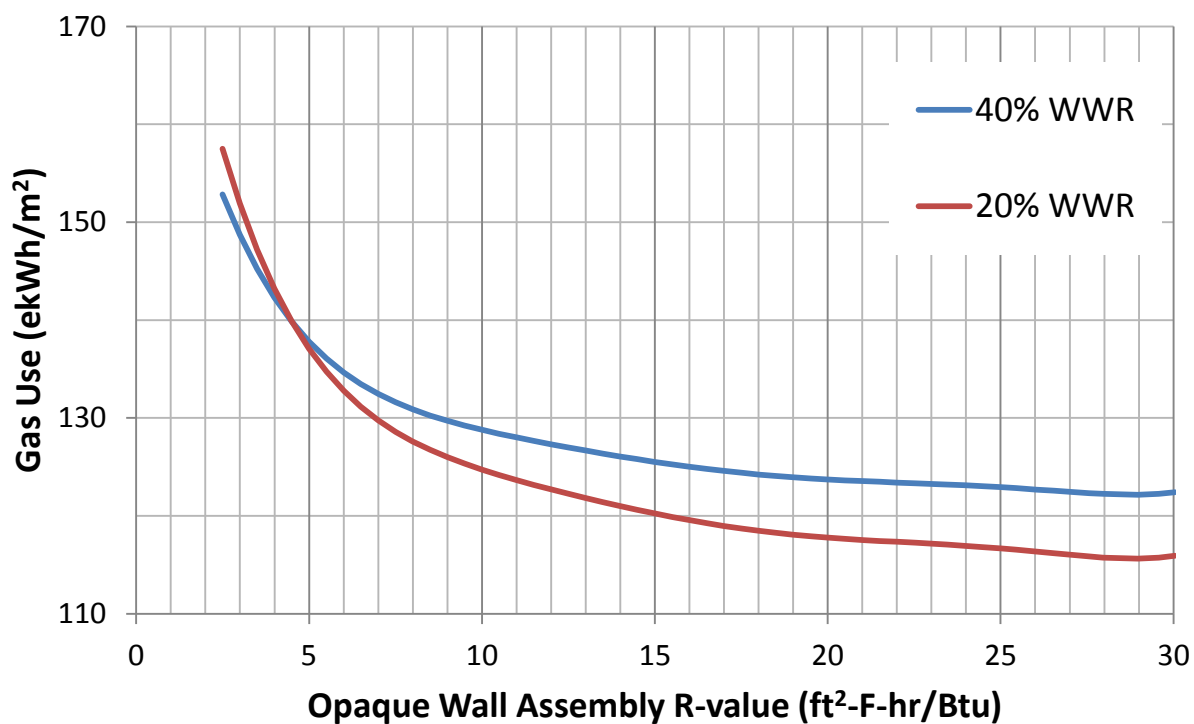


Figure C4.2: Prince George – Gas Use vs. Opaque Wall Assembly R-Value

SECONDARY SCHOOL ANNUAL ENERGY USE

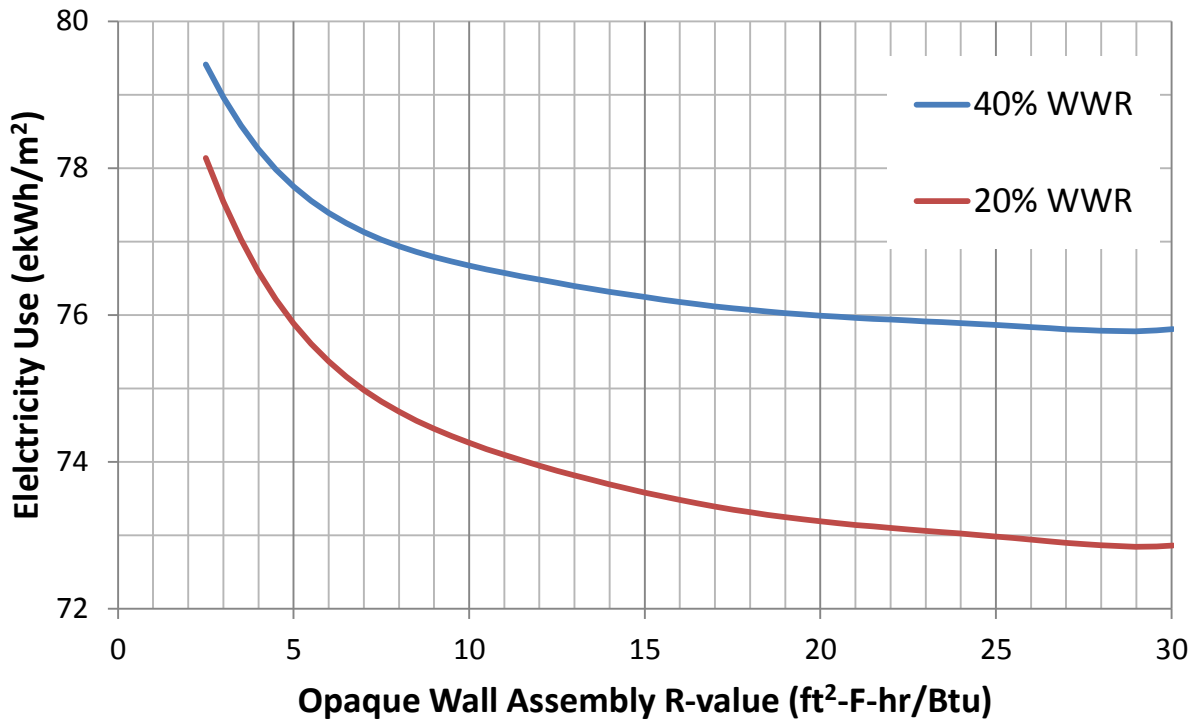


Figure C4.3: Summerland – Electricity Use vs. Opaque Wall Assembly R-Value

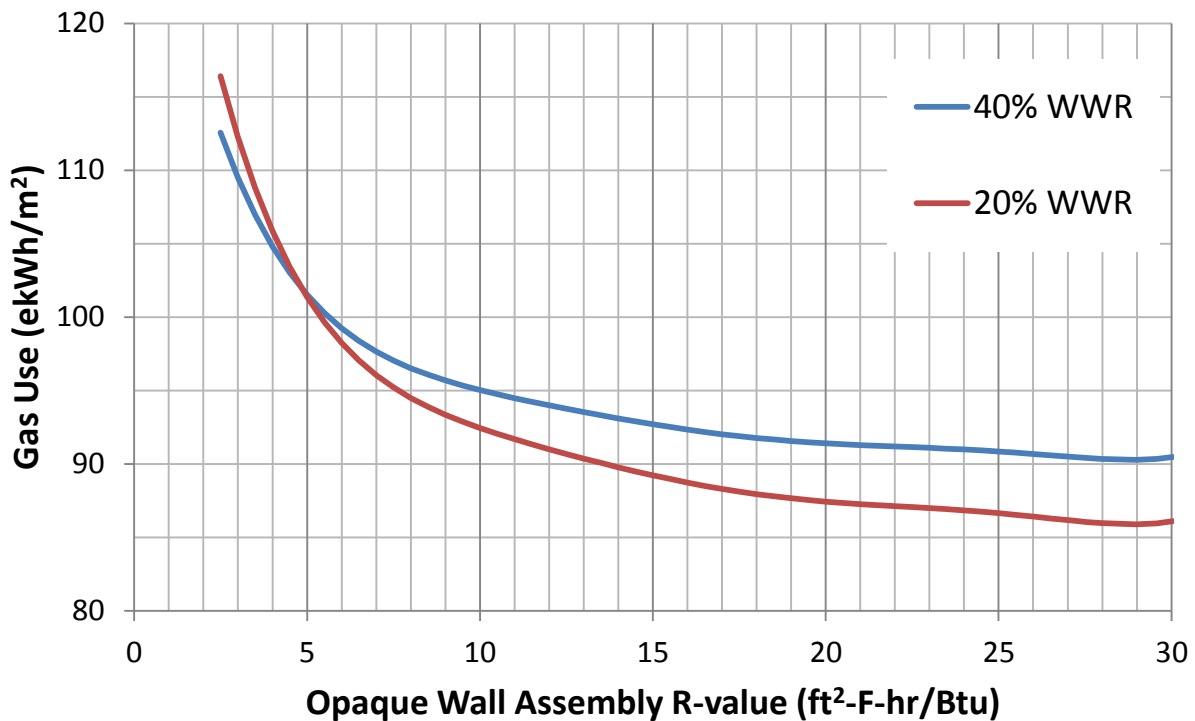


Figure C4.4: Summerland – Gas Use vs. Opaque Wall Assembly R-Value

SECONDARY SCHOOL ANNUAL ENERGY USE

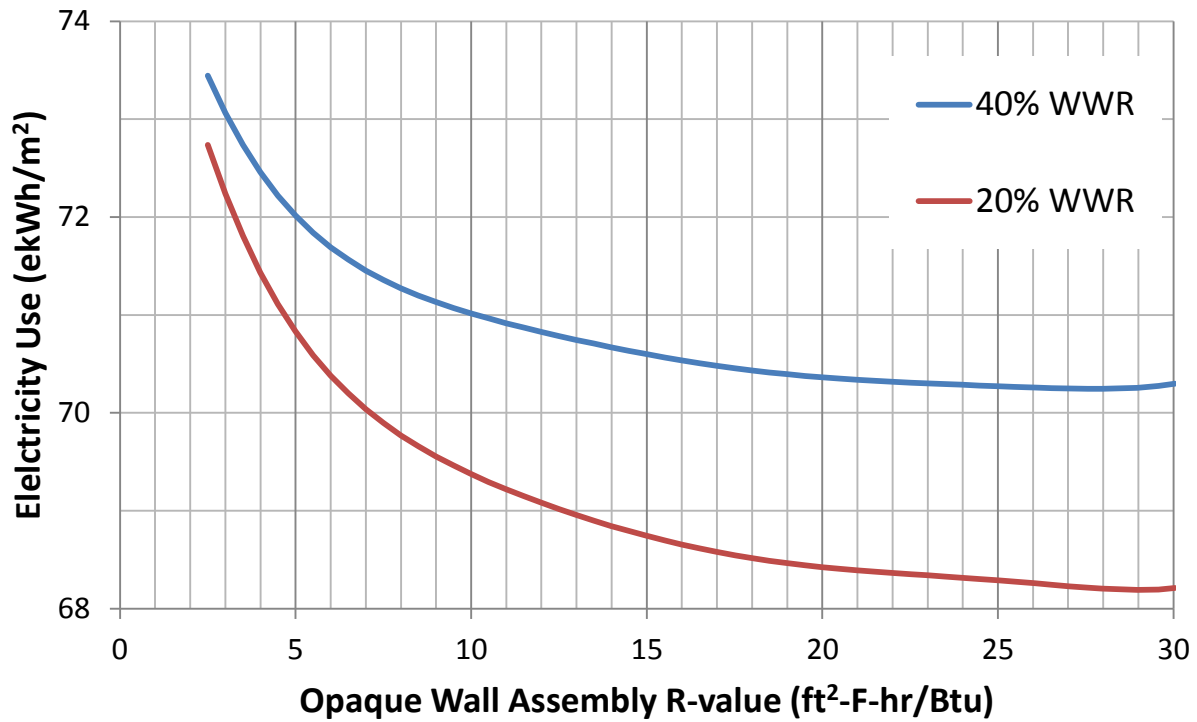


Figure C4.5: Vancouver – Electricity Use vs. Opaque Wall Assembly R-Value

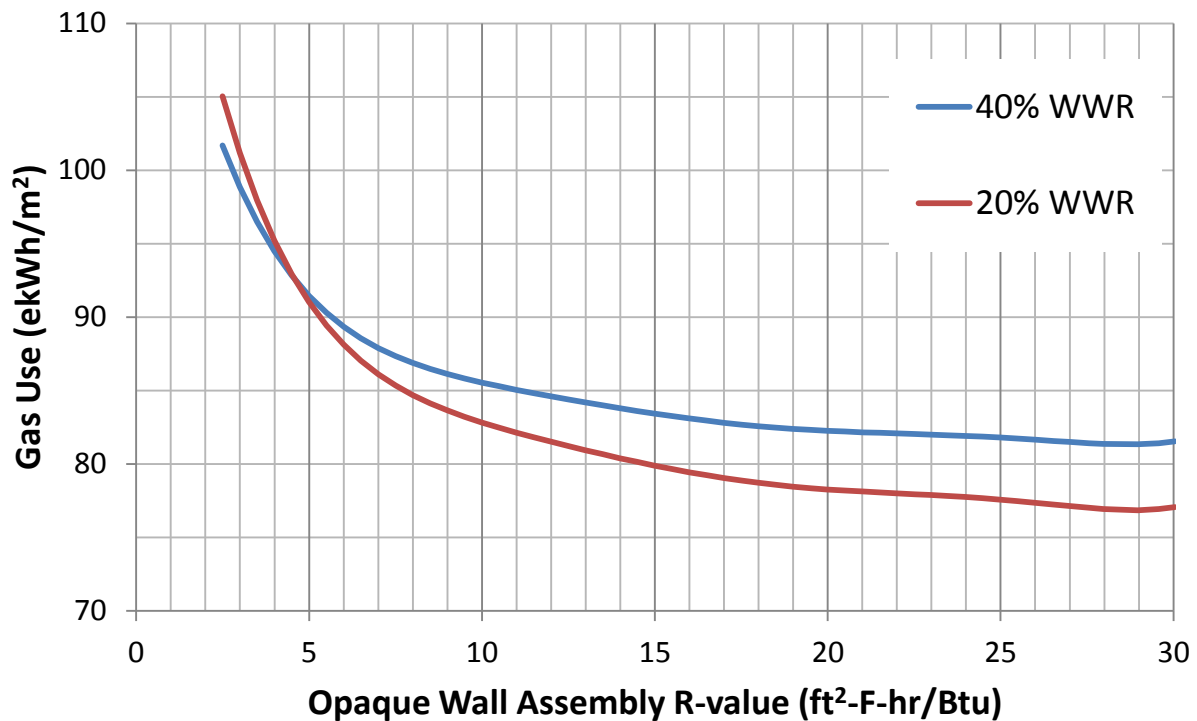


Figure C4.6: Vancouver – Gas Use vs. Opaque Wall Assembly R-Value

5.0 REC CENTRE ARCHETYPE SUMMARY

Archetype Summary	Values	Units / Notes
Gross Floor Area (GFA)	60,000 (5,574)	ft ² (m ²)
Number of Floors	1	
Wall Height	15 (4.57)	ft (m)
Window:Wall Ratio (WWR)	30% / 60%	
Length:Width Ratio	1.5:1	
Wall:Roof Ratio	0.25	
Lighting Power Density (LPD)	1.1 (12)	W/ft ² (W/m ²)
Plug Power Density (PPD)	0.75 (9)	W/ft ² (W/m ²)
General System Information	Pool System (dry-o-tron or similar), PVAV elsewhere	
Performance Details	As per below	According to standard practice
Zoning	5	Large perimeter zone for pool, 1 for core, 3 perimeter for remaining
Notes	Pool Rec Centre	
Building Envelope Components		
Roof (insulated entirely above deck)	20.8 (3.66)	R-value, h.ft ² .F/BTU (m ² .K/W)
Wall	23.7 (4.17)	R-value Curve, h.ft ² .F/BTU (m ² .K/W)
Slab-on-grade (unheated)	0.159 (0.9)	F-factor, BTU/h.ft.F (m.K/W)
Glazing (Double-pane)	0.387 (2.2)	U-value, BTU/h.ft ² .F (m ² .K/W)
	0.45	Solar Heat Gain Coefficient (SHGC)
Internal Loads		
Occupancy	20 (5)	person/100 ft ² (m ² /person)
Lighting	1.1 (12)	W/ft ² (W/m ²)
Receptacle	0.75 (9)	W/ft ² (W/m ²)
Domestic Hot Water Peak	307 (90)	BTUh/person (W/person)
Air Infiltration	0.05 (0.25)	cfm/ft ² (L/s/m ²) external surface area
Ventilation Rates		
People Outdoor Air Rate	5 (2.5)	cfm/person (L/s/person)
Area Outdoor Air Rate	0.06 (0.3)	cfm/ft ² (L/s/m ²)
Schedules		
HVAC, Plug Loads, Lighting, Occupancy, Domestic Hot Water	Assembly	ASHRAE 90.1 - User's Manual, Table G-E
Zone Level Equipment		
Heating Equipment		
Equipment Type	Hot Water Reheat Coil	
Controls		
Heating Design Supply Air Temperature	20 (11.1)	Above Space Temperature, F (°C)
Building Level Equipment - General		
System Type	PVAV	
Fan Control	ASHRAE VFD Curve	Variable
Fan Efficiency	65	%
Motor Efficiency	90	%
Total Static Pressure	3 (750)	in (Pa)
Total Supply Airflow	Autosized	
Heating Equipment		
Equipment Type	Hot Water Coil	
Heating Coil Inlet Water Temperature	180 (82.2)	F (°C)
Heating Coil Outlet Water Temperature	130 (54.4)	F (°C)
Heating Coil Inlet Air Temperature	62 (16.6)	F (°C)
Heating Coil Outlet Air Temperature	90 (32.2)	F (°C)
Cooling Equipment		
Equipment Type	Two-speed DX	
Efficiency	2.87	COP
Controls		
Heating Supply Air Temperature	50 (10)	F (°C)
Cooling Supply Air Temperature	Min 55, Max 64.4 (Min 12.8, Max 18)	Reset for Warmest Zone, F (°C)
Outdoor Air Economizer	75 (24)	Fixed Dry Bulb, Maximum Temperature, F (°C)

Building Level Equipment - Gym		
System Type	PSZ (Unitary)	
Fan Control	On/Off	
Fan Efficiency	65	%
Motor Efficiency	90	%
Total Static Pressure	3 (750)	in (Pa)
Total Supply Airflow	Autosized	
Heating Equipment		
Equipment Type	Hot Water Coil	
Heating Coil Inlet Water Temperature	180 (82.2)	F (°C)
Heating Coil Outlet Water Temperature	130 (54.4)	F (°C)
Heating Coil Inlet Air Temperature	62 (16.6)	F (°C)
Heating Coil Outlet Air Temperature	90 (32.2)	F (°C)
Cooling Equipment		
Equipment Type	Single-speed DX	
Efficiency	3.22	COP
Controls		
Heating Supply Air Temperature	Min 55.4, Max 113 (Min 13, Max 45)	Single Zone Reheat Range, F (°C)
Building Level Equipment - Pool		
System Type	PSZ (Unitary)	
Fan Control	On/Off	
Fan Efficiency	65	%
Motor Efficiency	90	%
Total Static Pressure	3 (750)	in (Pa)
Total Supply Airflow	Autosized	
Heating Equipment		
Equipment Type	Hot Water Coil	
Heating Coil Inlet Water Temperature	180 (82.2)	F (°C)
Heating Coil Outlet Water Temperature	130 (54.4)	F (°C)
Heating Coil Inlet Air Temperature	62 (16.6)	F (°C)
Heating Coil Outlet Air Temperature	90 (32.2)	F (°C)
Cooling Equipment		
Equipment Type	Single-speed DX	
Efficiency	2.87	COP
Controls		
Dehumidification Setpoint	60	% RH
Dehumidification Control Type	Cool Reheat	
Heating Supply Air Temperature	Min 55.4, Max 113 (Min 13, Max 45)	Single Zone Reheat Range, F (°C)
Plant Level Equipment		
Heating Equipment		
Equipment Type	Gas Boiler	
Efficiency	80	%
Design Water Outlet Temperature	177.8 (81)	F (°C)
Hot Water Pump		
Pump Control	Riding the Curve	
Pump Configuration	Primary Only	
Pump Motor Efficiency	90	%
Pump Head	60 (180)	ft (kPa)
SHW Equipment		
System Type and Fuel	Gas	
Efficiency	80	%
Peak Demand	307 (90)	BTUh/person (W/person)
Controls		
Hot Water Design Exit Temperature	180 (82)	F (°C)
Hot Water Loop Design Temperature Difference	20 (11)	F (°C)
Hot Water Loop Temperature	Min 150, Max 180 (Min 66, Max 82)	Outdoor Air Reset, F (°C)

REC CENTRE ANNUAL ENERGY USE

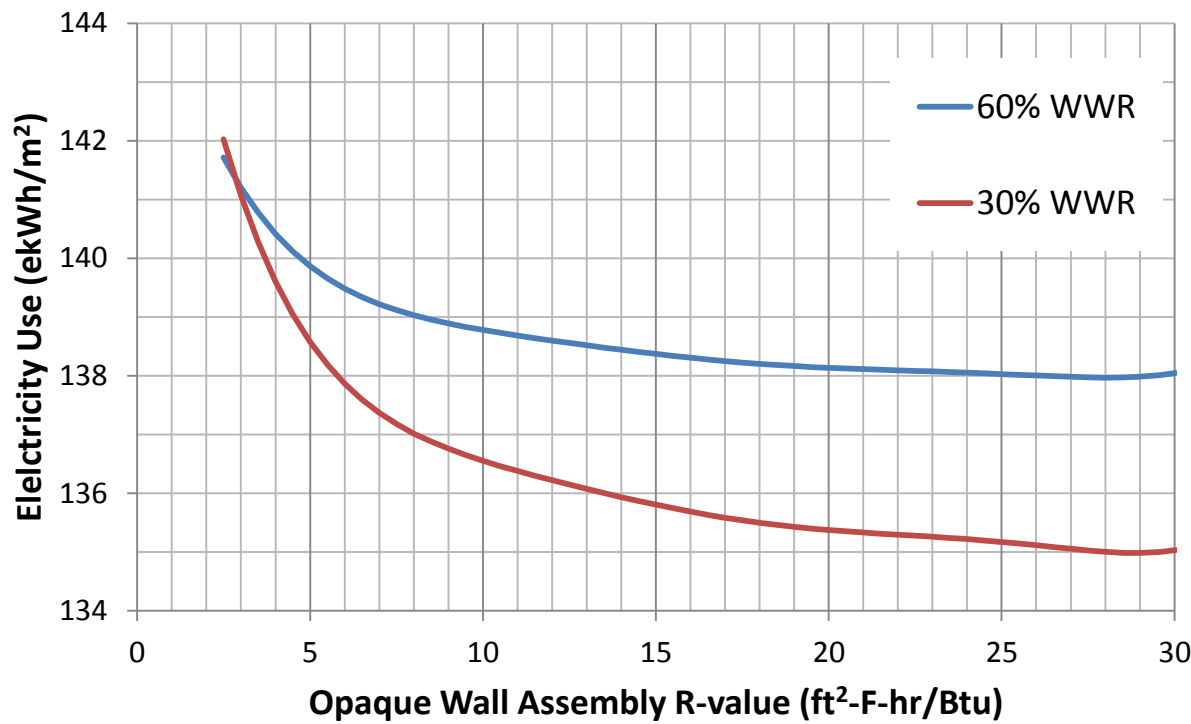


Figure C5.1: Prince George – Electricity Use vs. Opaque Wall Assembly R-Value

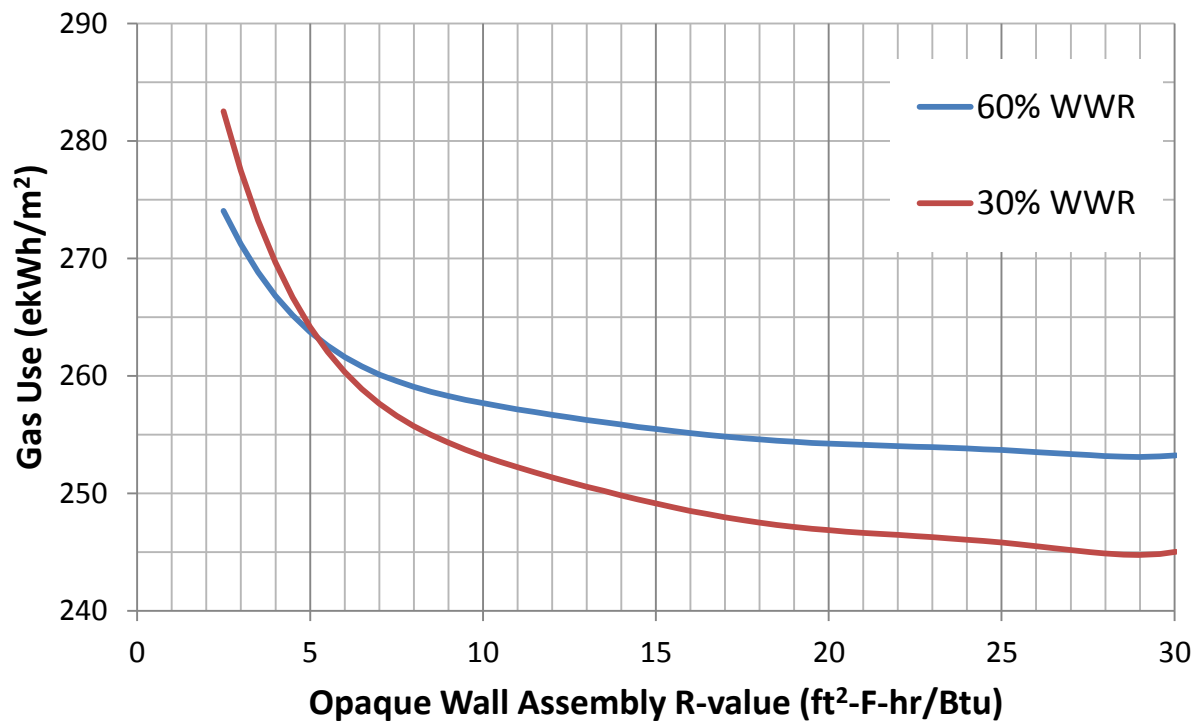


Figure C5.2: Prince George – Gas Use vs. Opaque Wall Assembly R-Value

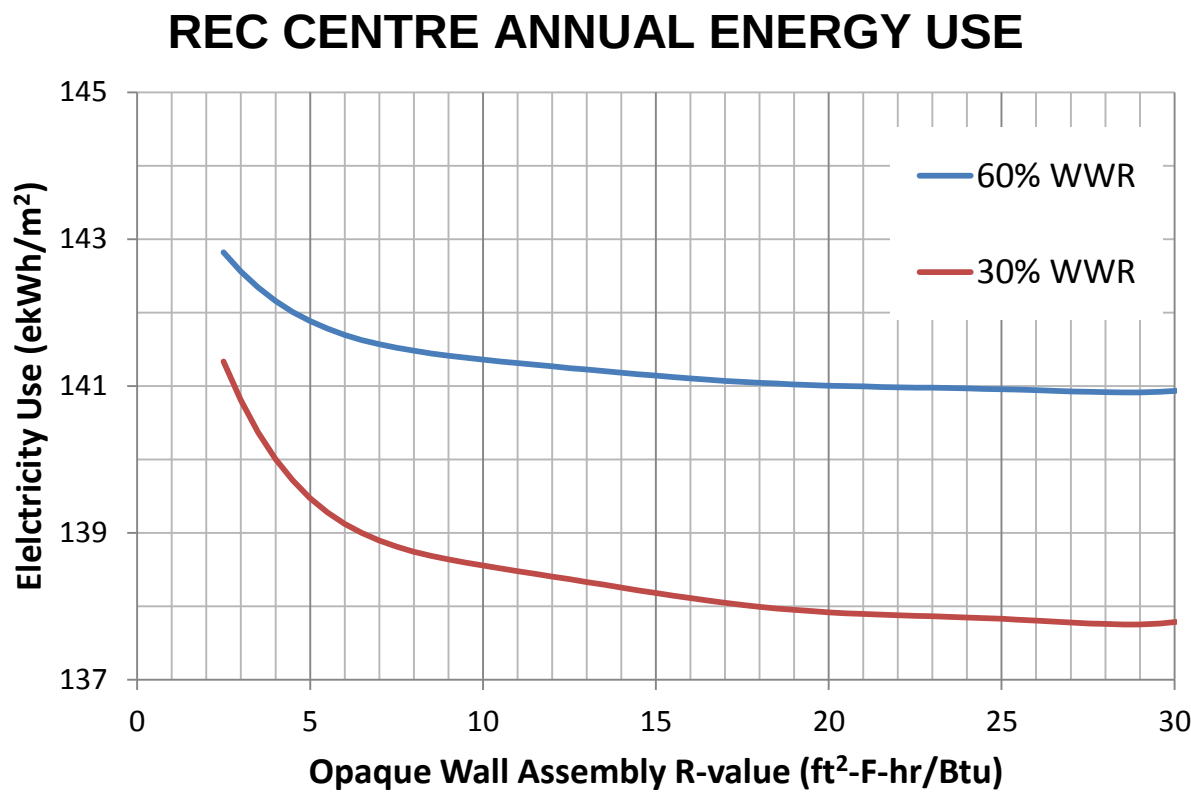


Figure C5.3: Summerland – Electricity Use vs. Opaque Wall Assembly R-Value

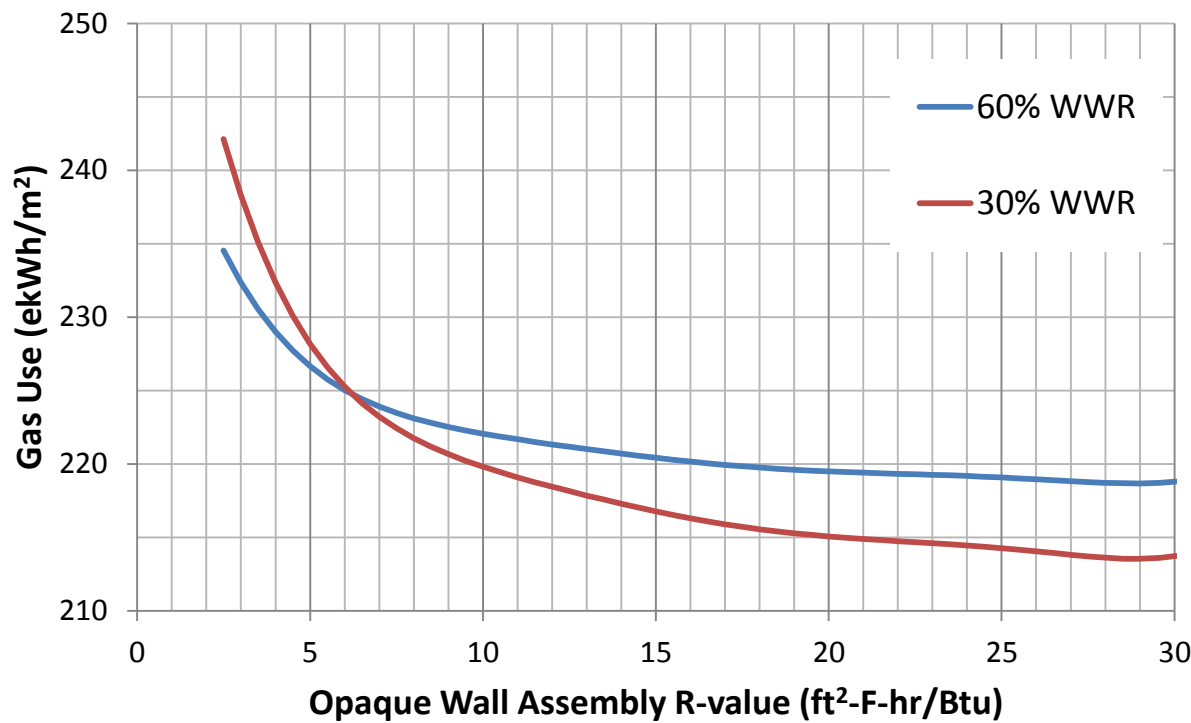


Figure C5.4: Summerland – Gas Use vs. Opaque Wall Assembly R-Value



REC CENTRE ANNUAL ENERGY USE

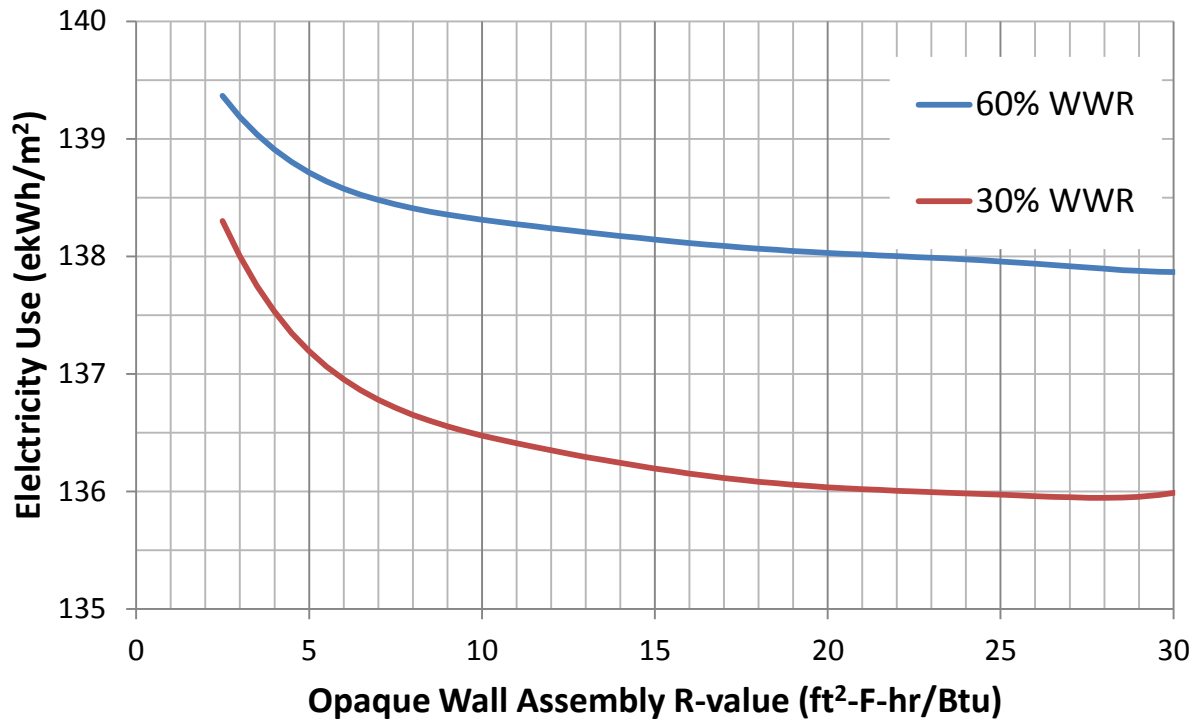


Figure C5.5: Vancouver – Electricity Use vs. Opaque Wall Assembly R-Value

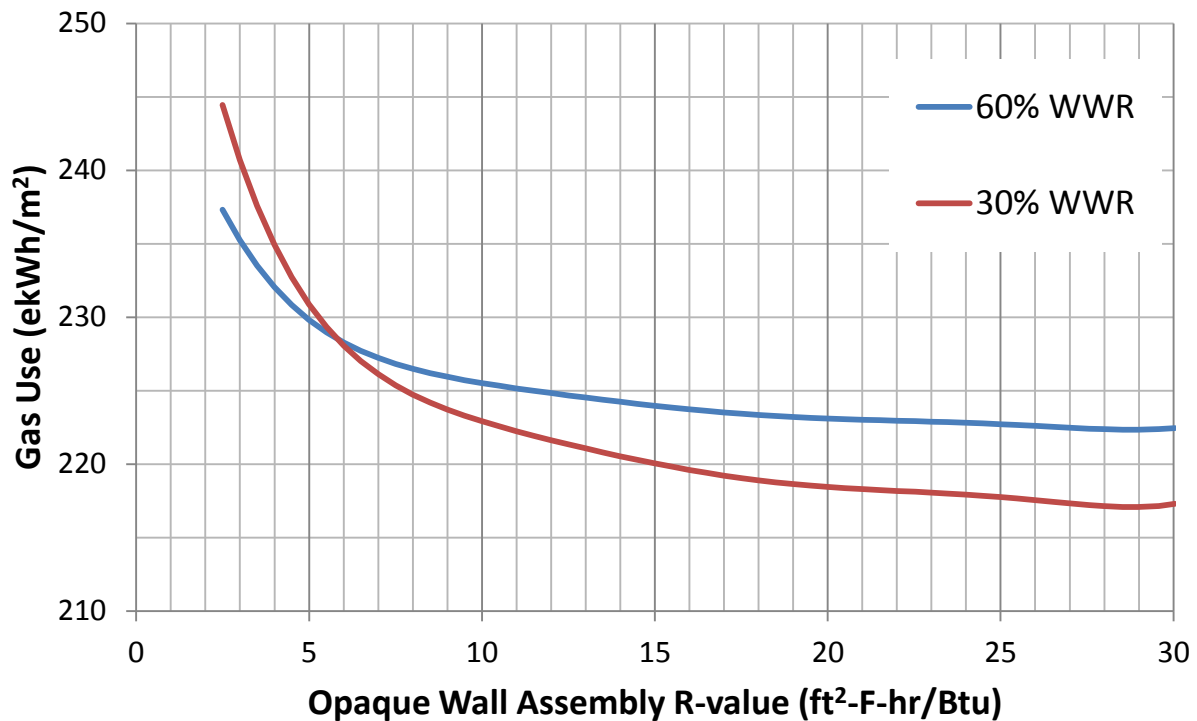


Figure C5.6: Vancouver – Gas Use vs. Opaque Wall Assembly R-Value

6.0 COMMERCIAL OFFICE ARCHETYPE SUMMARY

Archetype Summary	Values	Units / Notes
Gross Floor Area (GFA)	196,000 (18,209)	ft ² (m ²)
Number of Floors	10	
Wall Height	12 (3.6)	ft (m)
Window:Wall Ratio (WWR)	40% / 70%	
Length:Width Ratio	1:1	
Wall:Roof Ratio	3.43	
Lighting Power Density (LPD)	1 (11)	W/ft ² (W/m ²)
Plug Power Density (PPD)	0.75 (9)	W/ft ² (W/m ²)
General System Information	Boiler/Chiller/CT Plant, VAV Reheat	
Performance Details	As per below	According to standard practice
Zoning	15	5/floor, multiplier for middle floors
Building Envelope Components		
Roof (insulated entirely above deck)	20.8 (3.66)	R-value, h.ft ² .F/BTU (m ² .K/W)
Wall	23.7 (4.17)	R-value Curve, h.ft ² .F/BTU (m ² .K/W)
Slab-on-grade (unheated)	0.159 (0.9)	F-factor, BTU/h.ft ² .F (m.K/W)
Glazing (Double-pane)	0.387 (2.2)	U-value, BTU/h.ft ² .F (m ² .K/W)
	0.45	Solar Heat Gain Coefficient (SHGC)
Glazing (Triple-pane)	0.282 (1.6)	U-value, BTU/h.ft ² .F (m ² .K/W)
	0.45	Solar Heat Gain Coefficient (SHGC)
Internal Loads		
Occupancy	5 (20)	person/100 ft ² (m ² /person)
Lighting	1 (11)	W/ft ² (W/m ²)
Receptacle	0.75 (9)	W/ft ² (W/m ²)
Domestic Hot Water Peak	307 (90)	BTUh/person (W/person)
Air Infiltration	0.05 (0.25)	cfm/ft ² (L/s/m ²) external surface area
Ventilation Rates		
People Outdoor Air Rate	5 (2.5)	cfm/person (L/s/person)
Area Outdoor Air Rate	0.06 (0.3)	cfm/ft ² (L/s/m ²)
Schedules		
HVAC, Plug Loads, Lighting, Occupancy, Domestic Hot Water	Office	ASHRAE 90.1 - User's Manual, Table G-1
Zone Level Equipment		
Heating Equipment		
Equipment Type	Hot Water Reheat Coil	
Controls		
Heating Design Supply Air Temperature	20 (11.1)	Above Space Temperature, F (°C)
Building Level Equipment		
System Type	VAV	
Fan Control	ASHRAE VFD Curve	Variable
Fan Efficiency	70	%
Motor Efficiency	90	%
Total Static Pressure	4 (1000)	in (Pa)
Total Supply Airflow	Autosized	
Heating Equipment		
Equipment Type	Hot Water Coil	
Heating Coil Inlet Water Temperature	180 (82.2)	F (°C)
Heating Coil Outlet Water Temperature	130 (54.4)	F (°C)
Heating Coil Inlet Air Temperature	62 (16.6)	F (°C)
Heating Coil Outlet Air Temperature	90 (32.2)	F (°C)
Cooling Equipment		
Equipment Type	Chilled Water Coil	
Controls		
Heating Supply Air Temperature	50 (10)	F (°C)
Cooling Supply Air Temperature	Min 55, Max 64.4 (Min 12.8, Max 18)	Reset for Warmest Zone, F (°C)
Outdoor Air Economizer	75 (24)	Fixed Dry Bulb, Maximum Temperature, F (°C)

Plant Level Equipment		
Heating Equipment		
Equipment Type	Gas Boiler	
Efficiency	80	%
Design Water Outlet Temperature	177.8 (81)	F (°C)
Hot Water Pump		
Pump Control	Constant Speed	
Pump Configuration	Primary Only	
Pump Motor Efficiency	90	%
Pump Head	60 (180)	ft (kPa)
Cooling Equipment		
Equipment Type	Electric Chiller	
Efficiency	5.67	COP
Condenser Type	Water Cooled	
Chiller Flow Mode	Constant	
Leaving Chilled Water Temperature	44 (6.67)	F (°C)
Entering Condenser Fluid Temperature	85 (29.4)	F (°C)
Chilled Water Pump		
Pump Control	Constant Speed	
Pump Configuration	Primary Only	
Pump Motor Efficiency	90	%
Pump Head	60 (180)	ft (kPa)
Heat Rejection Equipment		
Equipment Type	Cooling Tower	
Design Inlet Air Wet-Bulb Temperature	78 (25.6)	F (°C)
Design Approach Temperature	7 (3.9)	Difference, F (°C)
Design Range Temperature	10 (5.6)	Difference, F (°C)
Condenser Pump		
Pump Control	VFD	
Pump Configuration	Primary Only	
Pump Motor Efficiency	90	%
Pump Head	60 (180)	ft (kPa)
SHW Equipment		
System Type and Fuel	Gas	
Efficiency	80	%
Peak Demand	307 (90)	BTUh/person (W/person)
Controls		
Hot Water Design Exit Temperature	180 (82)	F (°C)
Hot Water Loop Design Temperature Difference	20 (11)	F (°C)
Chilled Water Design Exit Temperature	45 (7.22)	F (°C)
Chilled Water Loop Design Temperature Difference	44 (6.67)	F (°C)
Condenser Water Design Exit Temperature	85 (29.4)	F (°C)
Condenser Loop Design Temperature Difference	42 (5.6)	F (°C)
Hot Water Loop Temperature	Min 150, Max 180 (Min 66, Max 82)	Outdoor Air Reset, F (°C)
Chilled Water Loop Temperature	Min 45, Max 54 (Min 7, Max 12)	Outdoor Air Reset, F (°C)
Condenser Water Loop Temperature	Min 70, Max 84 (Min 21, Max 29)	Follow Outdoor Air, F (°C)

COMMERCIAL OFFICE ANNUAL ENERGY USE

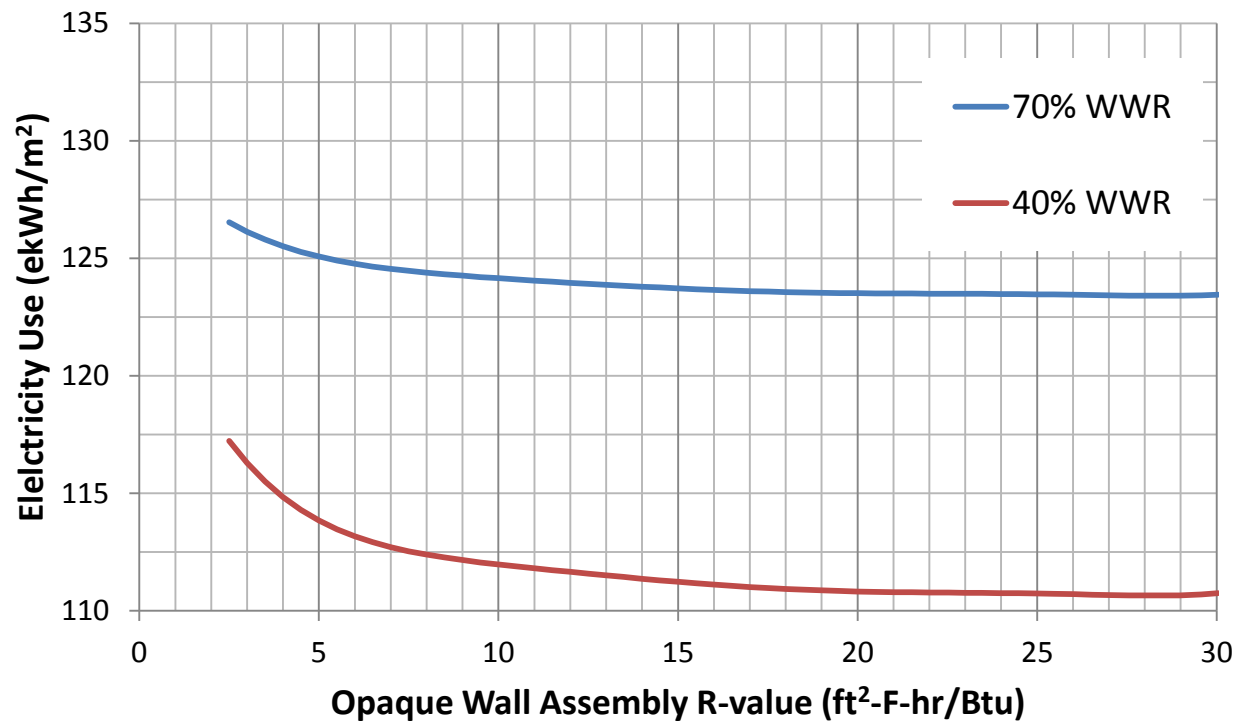


Figure C6.1: Prince George – Electricity Use vs. Opaque Wall Assembly R-Value

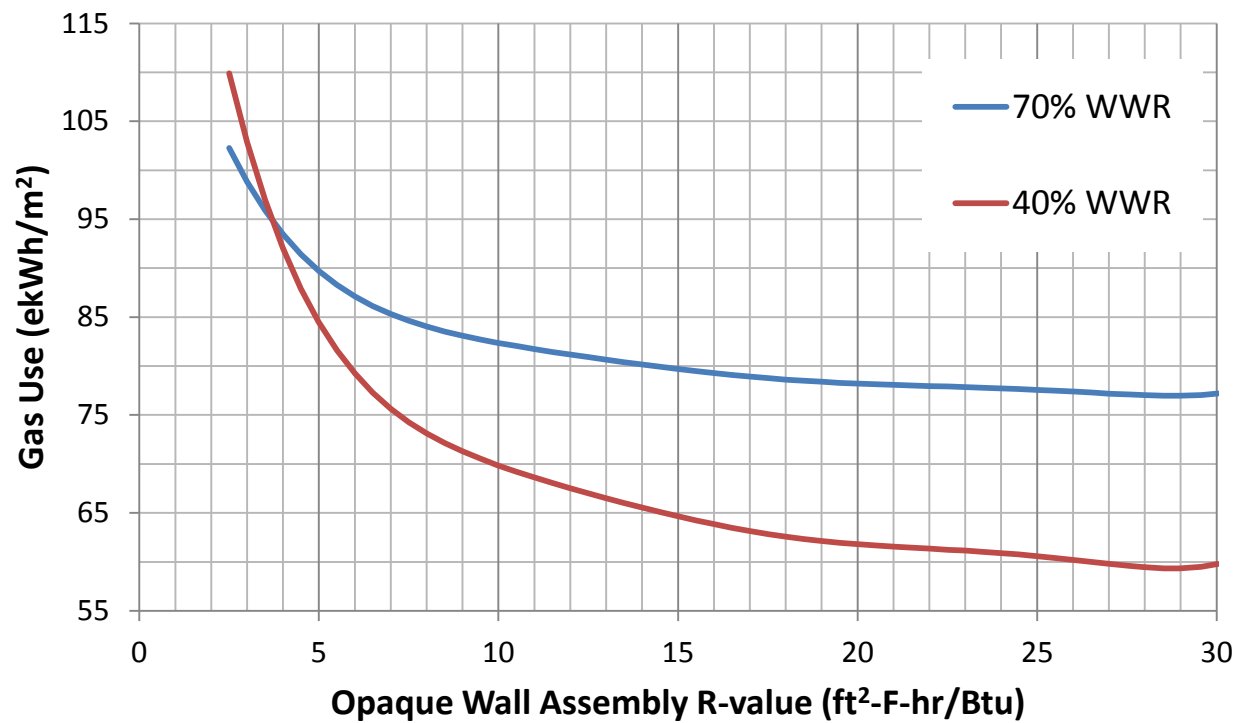


Figure C6.2: Prince George – Gas Use vs. Opaque Wall Assembly R-Value

COMMERCIAL OFFICE ANNUAL ENERGY USE

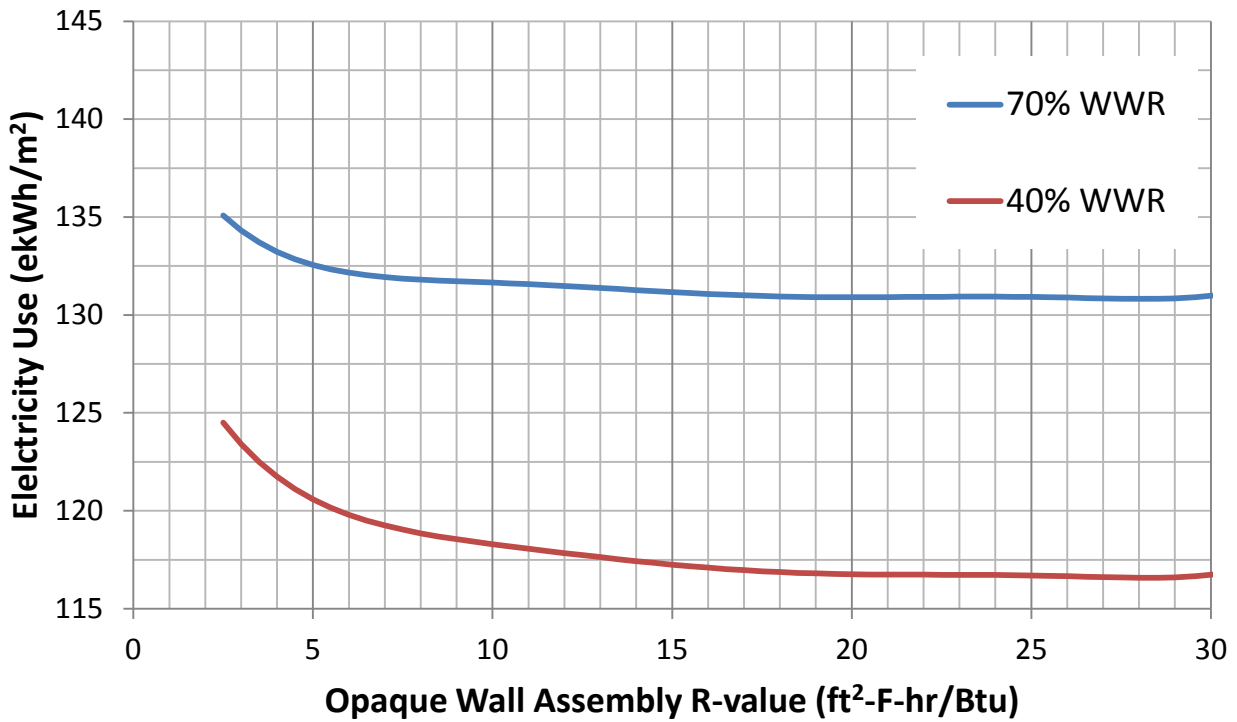


Figure C6.3: Summerland – Electricity Use vs. Opaque Wall Assembly R-Value

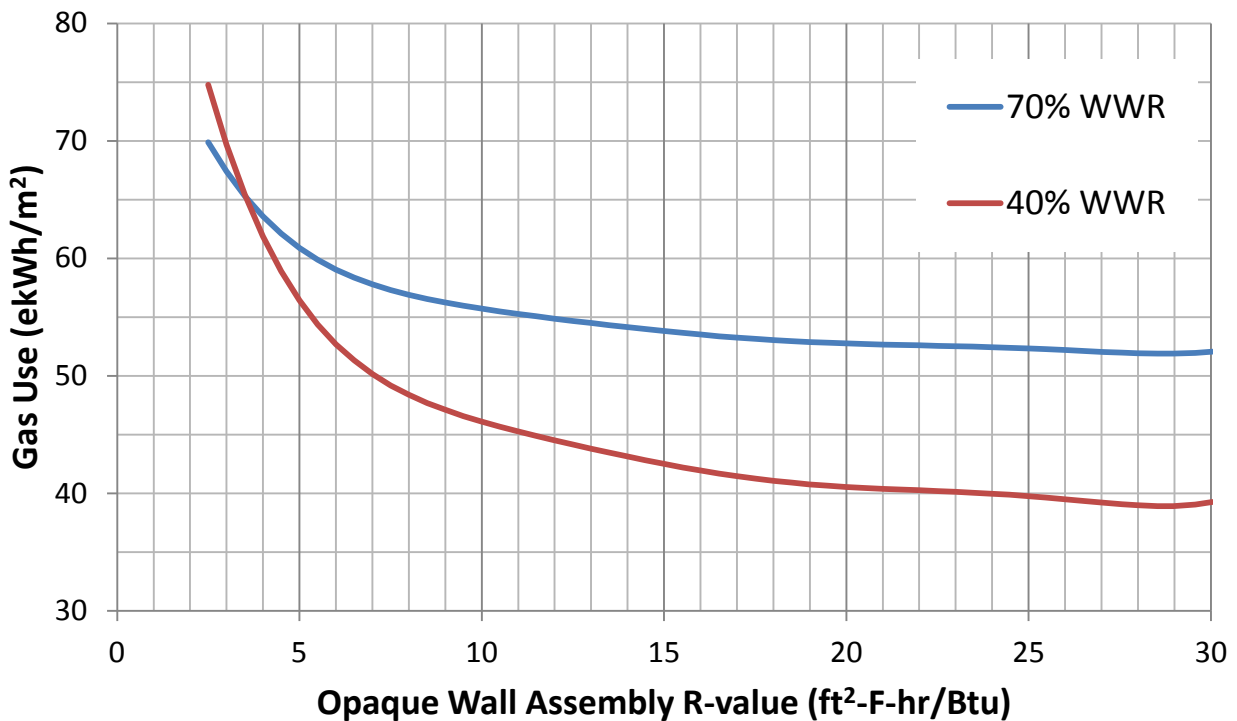


Figure C6.4: Summerland – Gas Use vs. Opaque Wall Assembly R-Value

COMMERCIAL OFFICE ANNUAL ENERGY USE

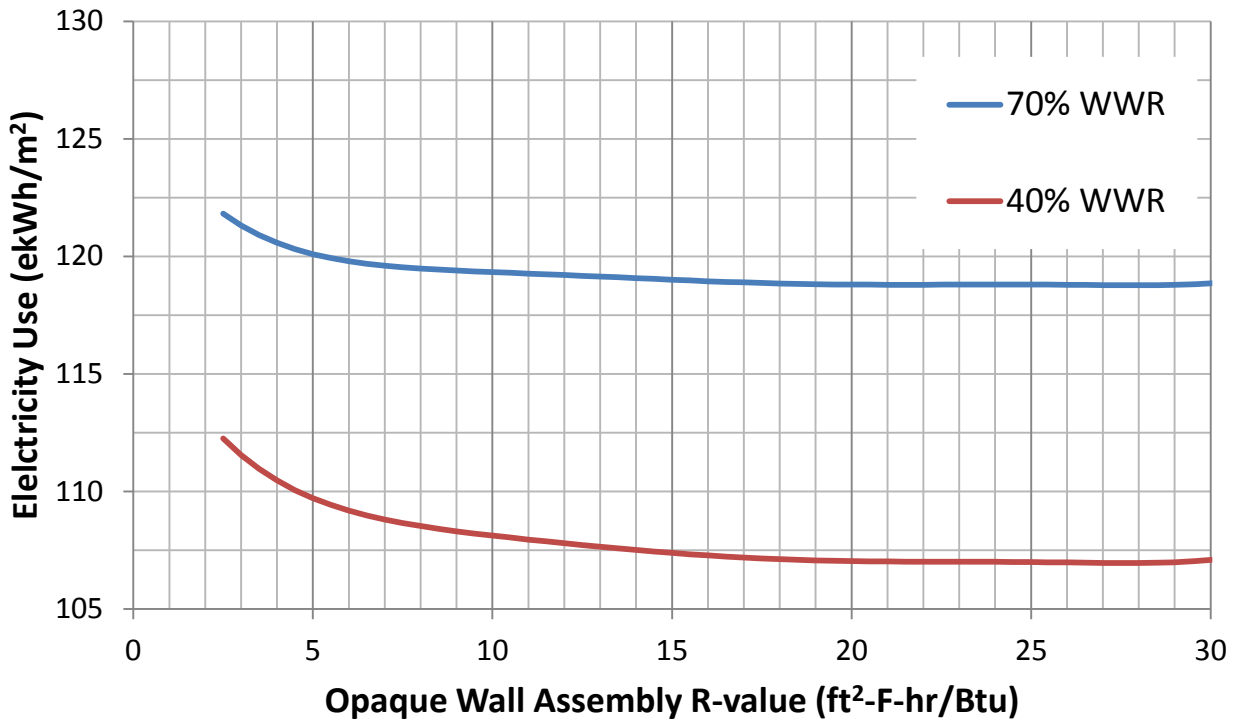


Figure C6.5: Vancouver – Electricity Use vs. Opaque Wall Assembly R-Value

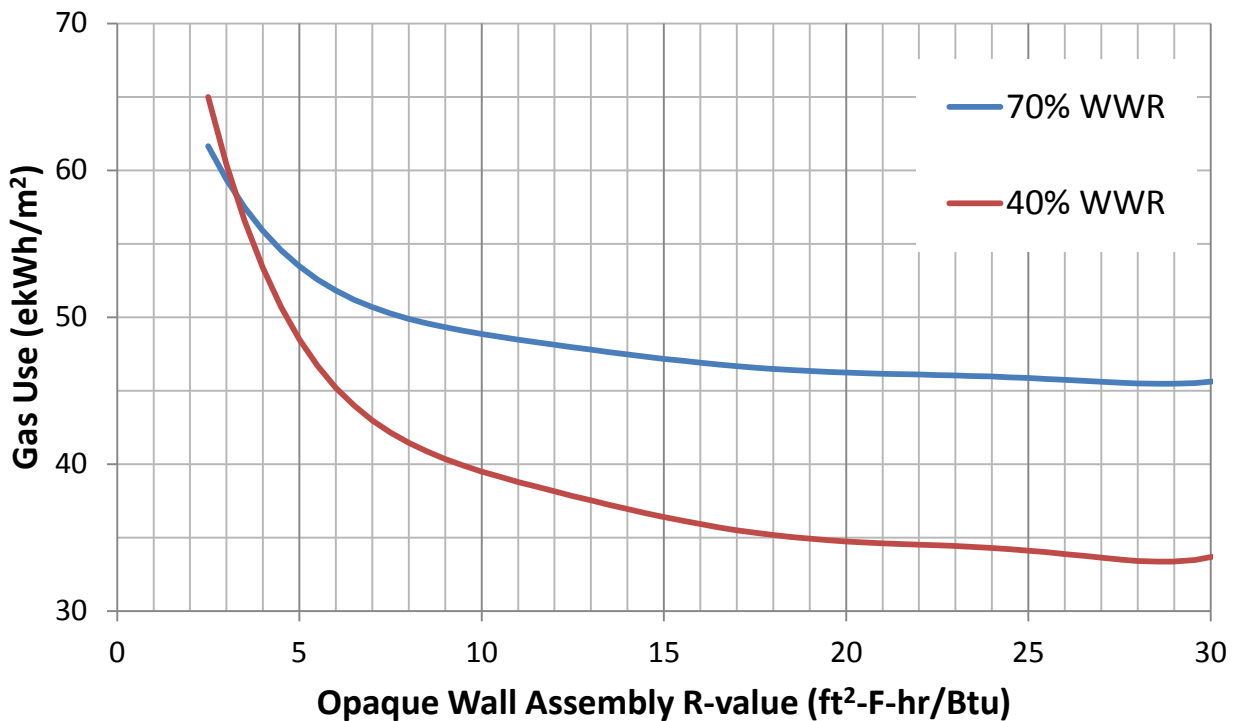


Figure C6.6: Vancouver – Gas Use vs. Opaque Wall Assembly R-Value

COMMERCIAL OFFICE (TRIPLE-GLAZING) ANNUAL ENERGY USE

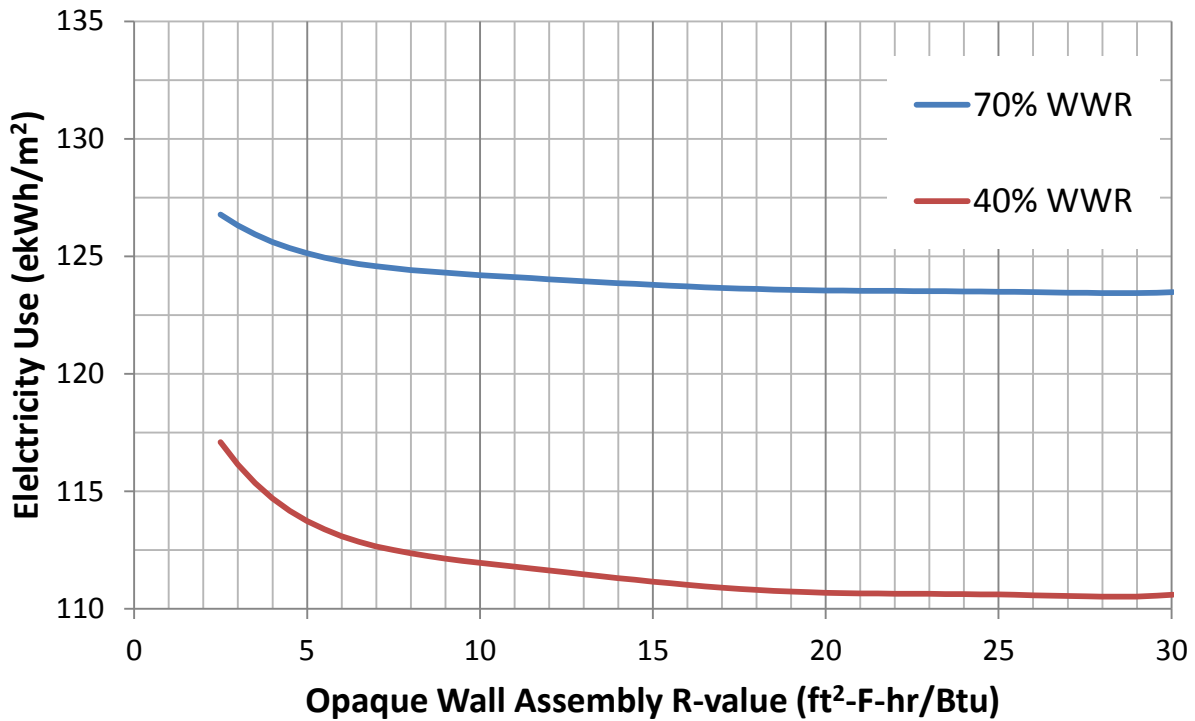


Figure C6.7: Prince George – Electricity Use vs. Opaque Wall Assembly R-Value

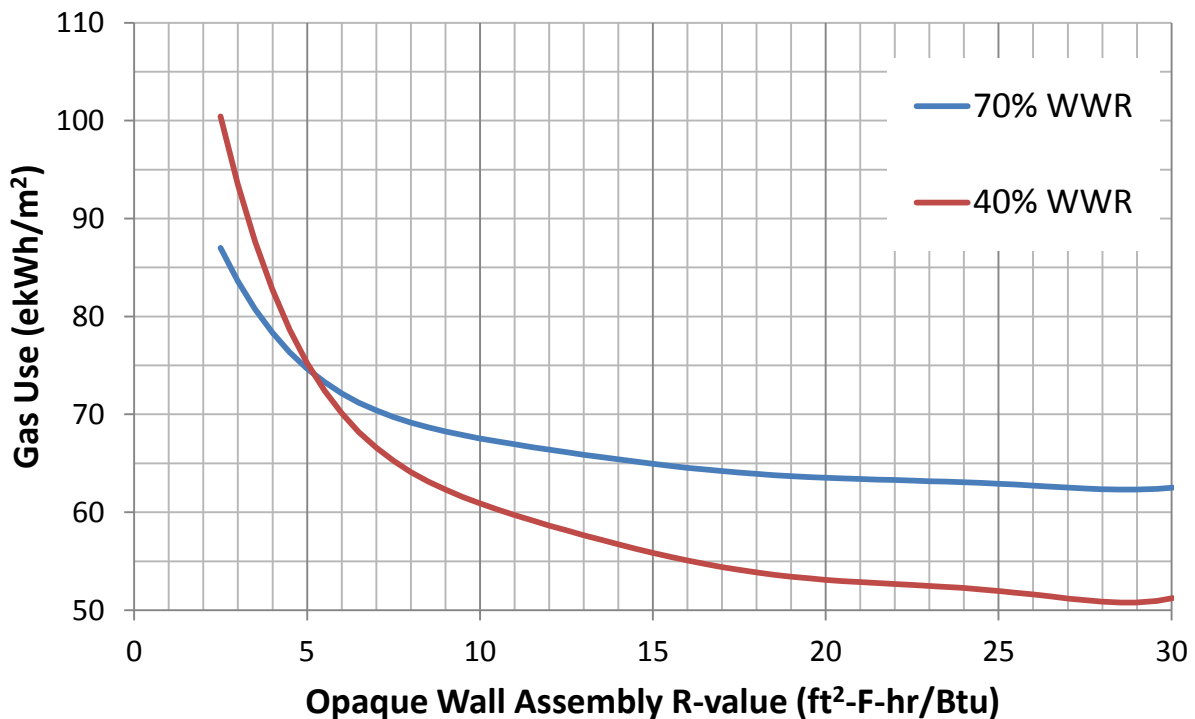


Figure C6.8: Prince George – Gas Use vs. Opaque Wall Assembly R-Value

COMMERCIAL OFFICE (TRIPLE-GLAZING) ANNUAL ENERGY USE

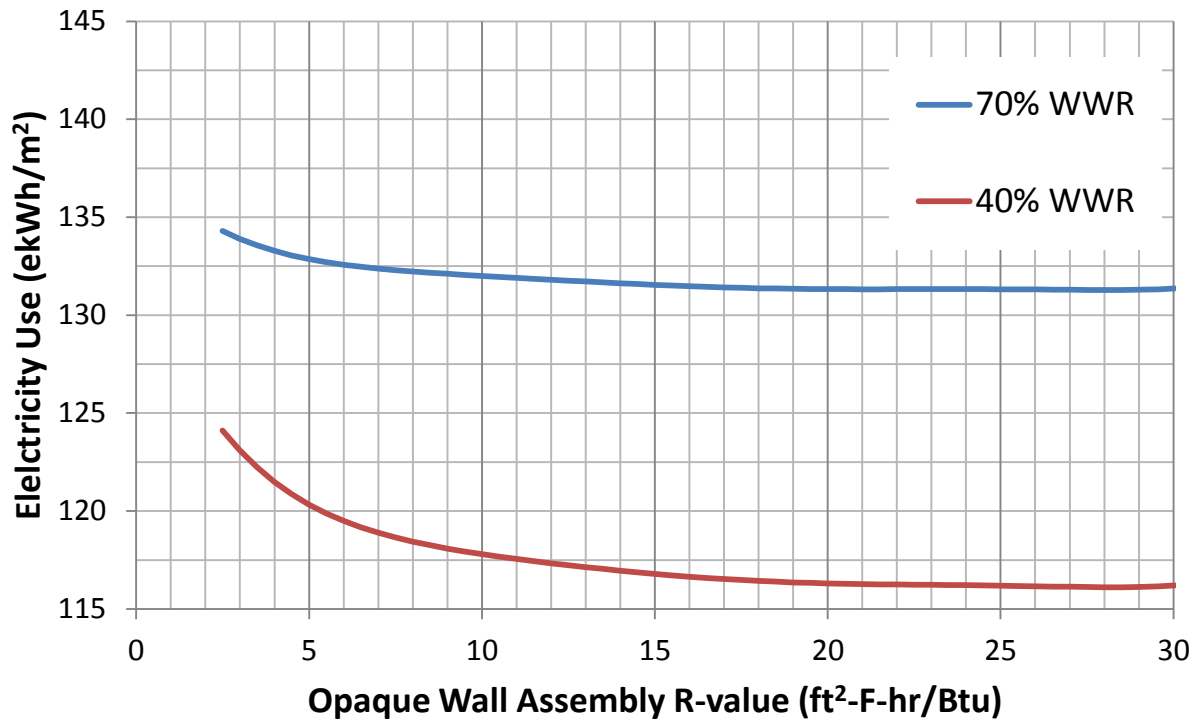


Figure C6.9: Summerland – Electricity Use vs. Opaque Wall Assembly R-Value

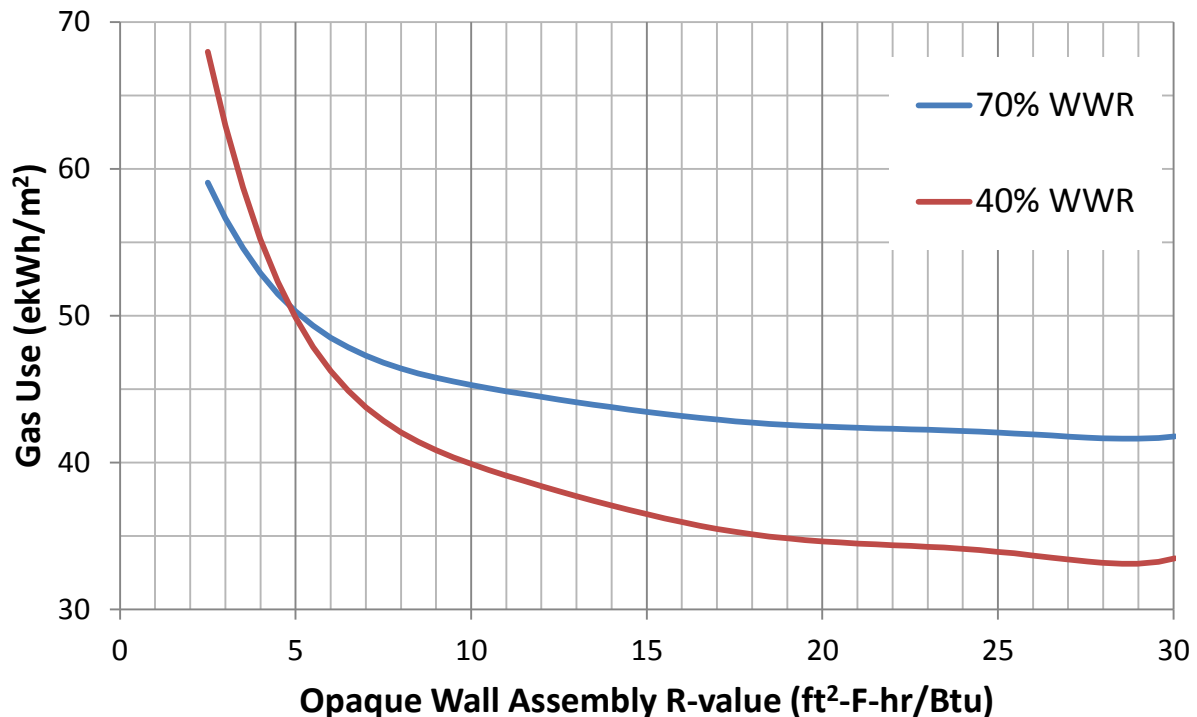


Figure C6.10: Summerland – Gas Use vs. Opaque Wall Assembly R-Value

COMMERCIAL OFFICE (TRIPLE-GLAZING) ANNUAL ENERGY USE

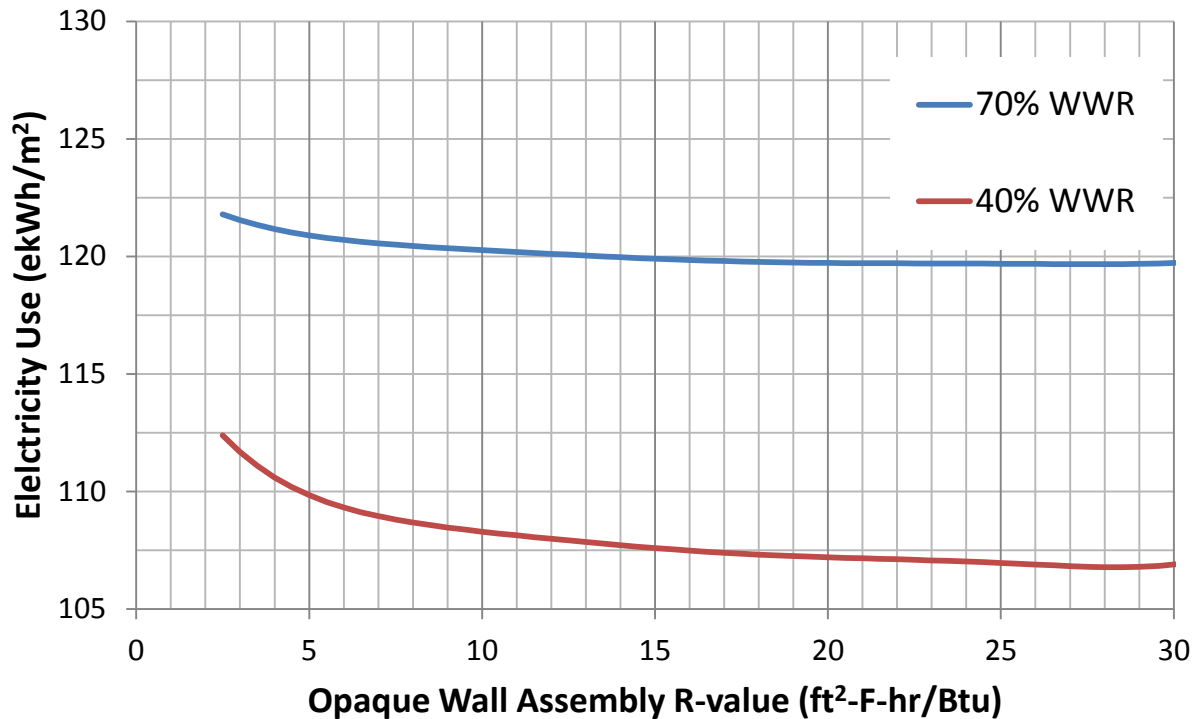


Figure C6.11: Vancouver – Electricity Use vs. Opaque Wall Assembly R-Value

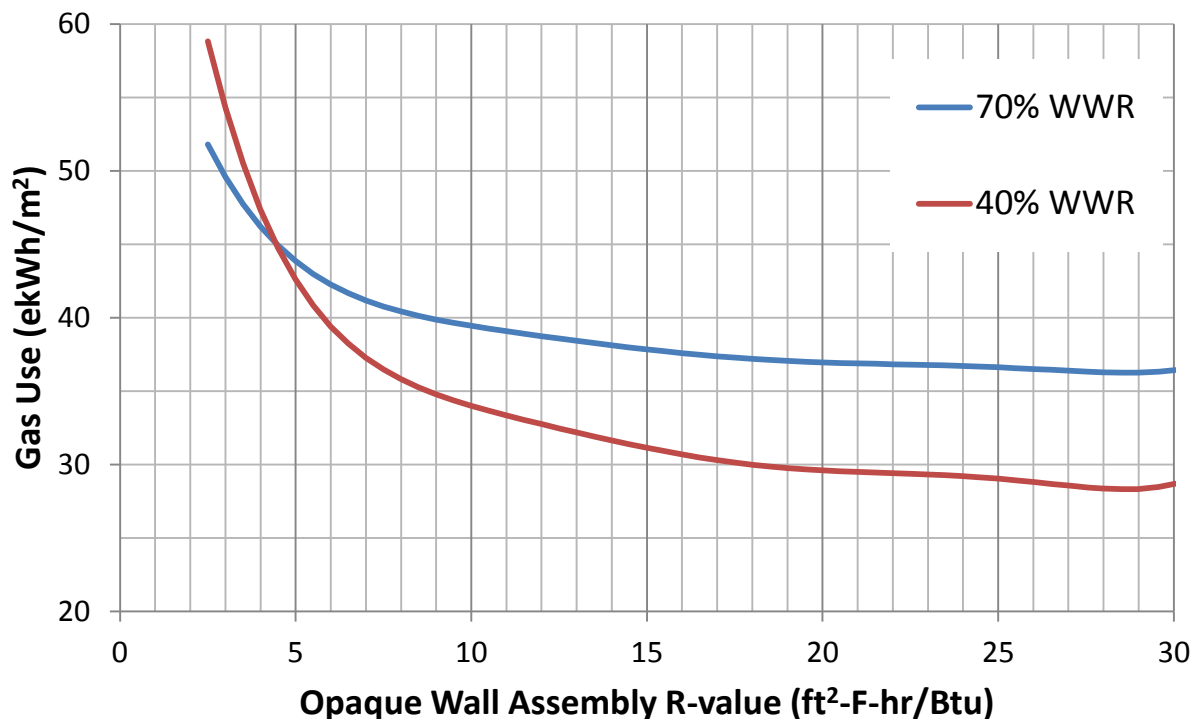


Figure C6.12: Vancouver – Gas Use vs. Opaque Wall Assembly R-Value

7.0 HOTEL ARCHETYPE SUMMARY

Archetype Summary	Values	Units / Notes
Gross Floor Area (GFA)	121,000 (11,241)	ft ² (m ²)
Number of Floors	10	
Wall Height	10 (3.1)	ft (m)
Window:Wall Ratio (WWR)	40% / 70%	
Length:Width Ratio	1:1	
Wall:Roof Ratio	3.64	
Lighting Power Density (LPD)	1 (11)	W/ft ² (W/m ²)
Plug Power Density (PPD)	0.25 (3)	W/ft ² (W/m ²)
General System Information	FPFC, Boiler, AC Chiller	
Performance Details	As per below	According to standard practice
Zoning	15	5/floor, multiplier for middle floors
Building Envelope Components		
Roof (insulated entirely above deck)	20.8 (3.66)	R-value, h.ft ² .F/BTU (m ² .K/W)
Wall	23.7 (4.17)	R-value Curve, h.ft ² .F/BTU (m ² .K/W)
Slab-on-grade (unheated)	0.159 (0.9)	F-factor, BTU/h.ft.F (m.K/W)
Glazing (Double-pane)	0.387 (2.2)	U-value, BTU/h.ft ² .F (m ² .K/W)
	0.45	Solar Heat Gain Coefficient (SHGC)
Internal Loads		
Occupancy	5 (20)	person/100 ft ² (m ² /person)
Lighting	1 (11)	W/ft ² (W/m ²)
Receptacle	0.25 (3)	W/ft ² (W/m ²)
Domestic Hot Water Peak	1,707 (500)	BTUh/person (W/person)
Air Infiltration	0.05 (0.25)	cfm/ft ² (L/s/m ²) external surface area
Ventilation Rates		
People Outdoor Air Rate	5 (2.5)	cfm/person (L/s/person)
Area Outdoor Air Rate	0.06 (0.3)	cfm/ft ² (L/s/m ²)
Schedules		
HVAC, Plug Loads, Lighting, Occupancy, Domestic Hot Water	Hotel	ASHRAE 90.1 - User's Manual, Table G-G
Zone Level Equipment		
System Type	Four Pipe Fan Coil (FPFC)	
Fan Control	On/Off	
Fan Efficiency	70	%
Motor Efficiency	90	%
Total Static Pressure	0.028 (75)	in (Pa)
Total Supply Airflow	Autosized	
Heating Equipment		
Equipment Type	Hot Water Coil in FPFC	
Cooling Equipment		
Equipment Type	Chilled Water Coil in FPFC	
Controls		
Heating Design Supply Air Temperature	20 (11.1)	Above Space Temperature, F (°C)
Cooling Design Supply Air Temperature	55 (12.8)	F (°C)

Building Level Equipment		
System Type	MUA	
Fan Control	Constant Volume	
Fan Efficiency	65	%
Motor Efficiency	90	%
Total Static Pressure	3 (750)	in (Pa)
Total Supply Airflow	Autosized	
Heating Equipment		
Equipment Type	Hot Water Coil in MUA	
Heating Coil Inlet Water Temperature	180 (82.2)	F (°C)
Heating Coil Outlet Water Temperature	160 (71.1)	F (°C)
Heating Coil Inlet Air Temperature	61 (16.6)	F (°C)
Heating Coil Outlet Air Temperature	90 (32.2)	F (°C)
Cooling Equipment		
MUA Cooling Coil	Chilled Water Coil in MUA	
Controls		
Heating Supply Air Temperature	54 (12.2)	F (°C)
Cooling Supply Air Temperature	Min 55, Max 64.4 (Min 12.8, Max 18)	Reset for Warmest Zone, F (°C)
Outdoor Air Economizer	75 (24)	Fixed Dry Bulb, Maximum Temperature, F (°C)
Plant Level Equipment		
Heating Equipment		
Equipment Type	Gas Boiler	
Efficiency	80	%
Design Water Outlet Temperature	180 (82)	F (°C)
Hot Water Pump		
Pump Control	VFD	
Pump Configuration	Primary Only	
Pump Motor Efficiency	90	%
Pump Head	60 (180)	ft (kPa)
Cooling Equipment		
Equipment Type	Electric Chiller	
Efficiency	2.78	COP
Condenser Type	Air Cooled	
Chiller Flow Mode	Constant	
Leaving Chilled Water Temperature	44 (6.67)	F (°C)
Entering Condenser Fluid Temperature	N/A	Air Cooled
Chilled Water Pump		
Pump Control	VFD	
Pump Configuration	Primary and Secondary	
Pump Motor Efficiency	90	%
Pump Head	60 (180)	ft (kPa)
Heat Rejection Equipment		
Equipment Type	Cooling Tower	
SHW Equipment		
Equipment Type	Gas	
Efficiency	80	%
Peak Demand	1,707 (500)	BTUh/person (W/person)
Controls		
Hot Water Design Exit Temperature	180 (82)	F (°C)
Hot Water Loop Design Temperature Difference	20 (11)	F (°C)
Chilled Water Design Exit Temperature	45 (7.22)	F (°C)
Chilled Water Loop Design Temperature Difference	44 (6.67)	F (°C)
Hot Water Loop Temperature	Min 150, Max 180 (Min 66, Max 82)	Outdoor Air Reset, F (°C)
Chilled Water Loop Temperature	Min 45, Max 54 (Min 7, Max 12)	Outdoor Air Reset, F (°C)

HOTEL ANNUAL ENERGY USE

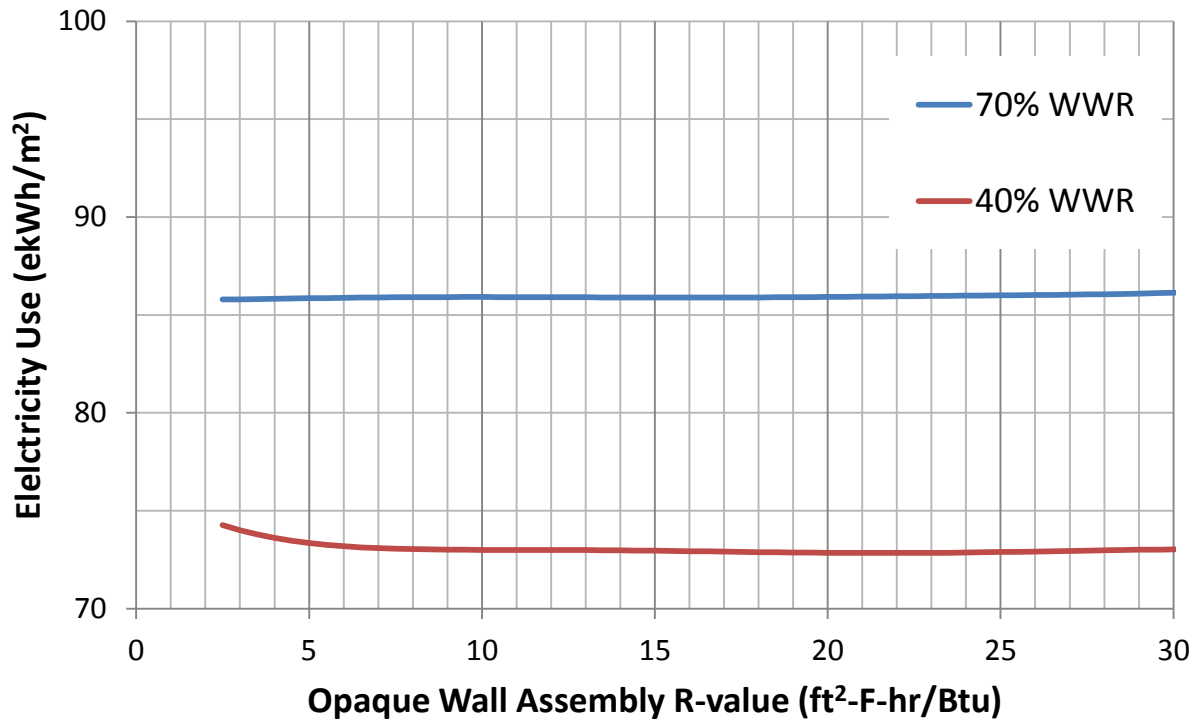


Figure C7.1: Prince George – Electricity Use vs. Opaque Wall Assembly R-Value

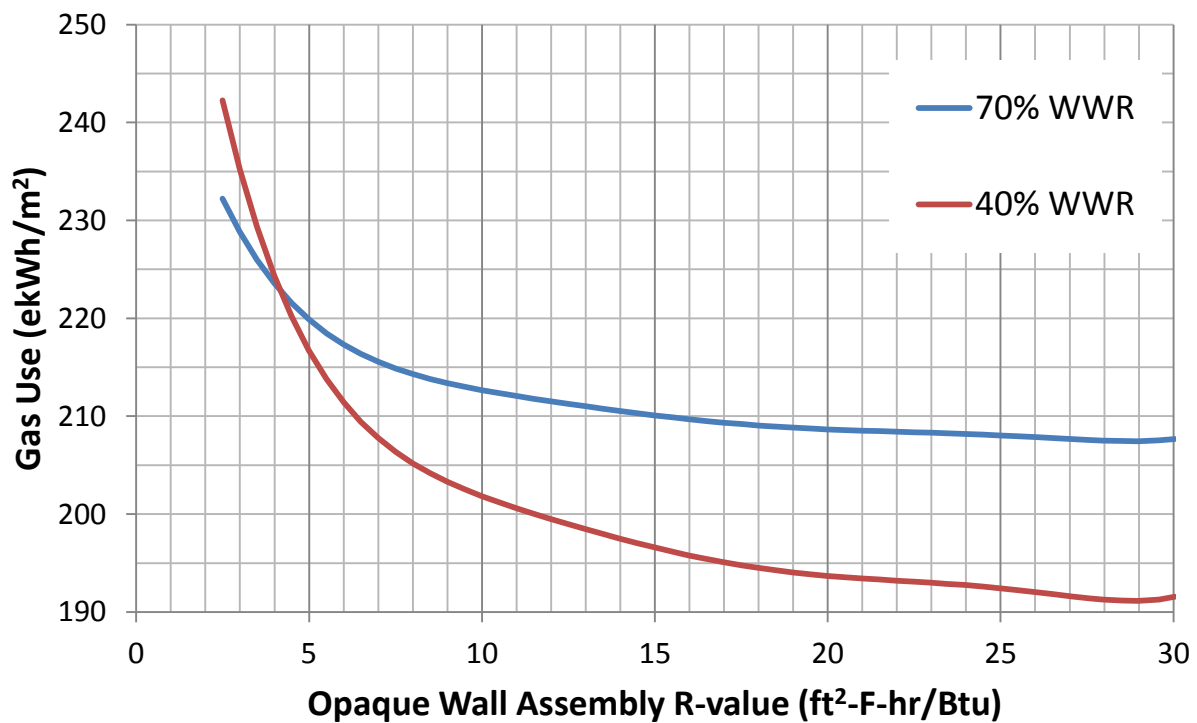


Figure C7.2: Prince George – Gas Use vs. Opaque Wall Assembly R-Value

HOTEL ANNUAL ENERGY USE

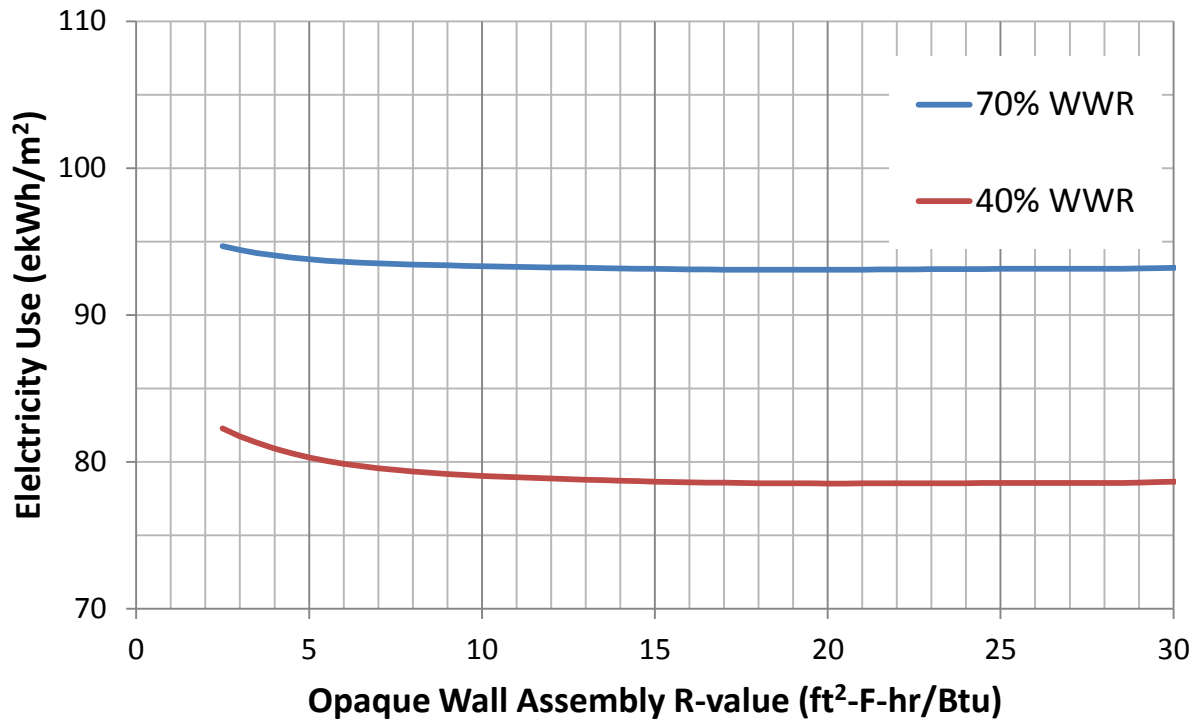


Figure C7.3: Summerland – Electricity Use vs. Opaque Wall Assembly R-Value

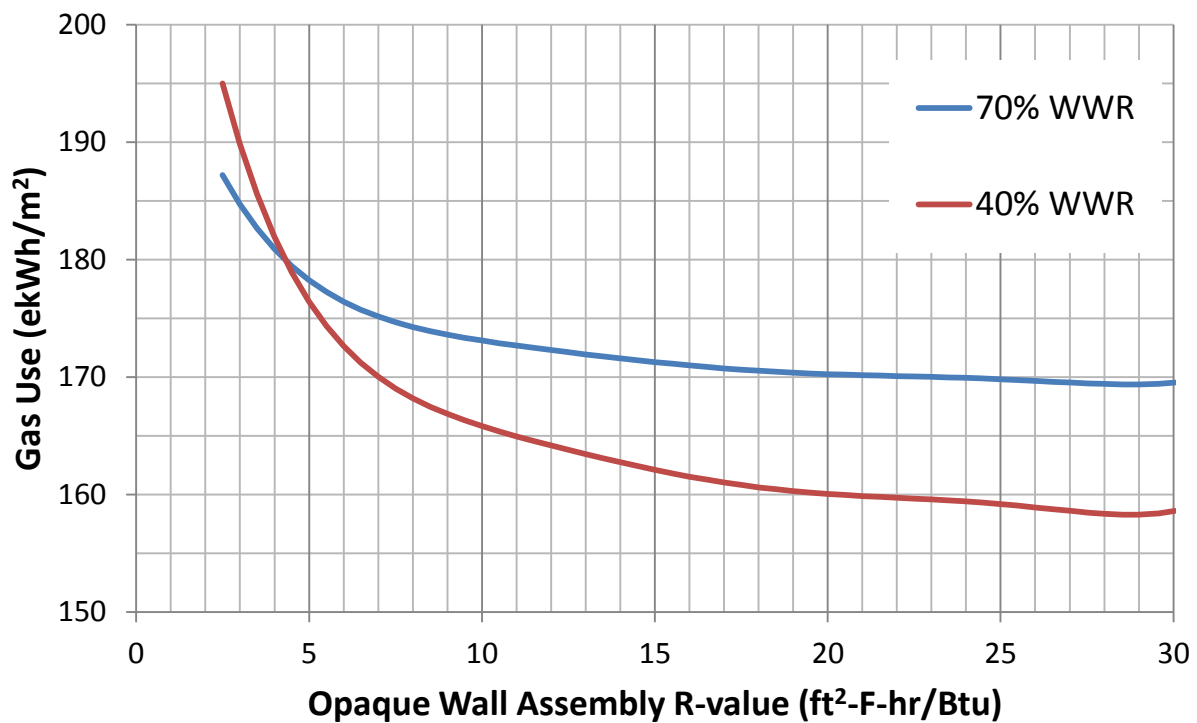


Figure C7.4: Summerland – Gas Use vs. Opaque Wall Assembly R-Value

HOTEL ANNUAL ENERGY USE

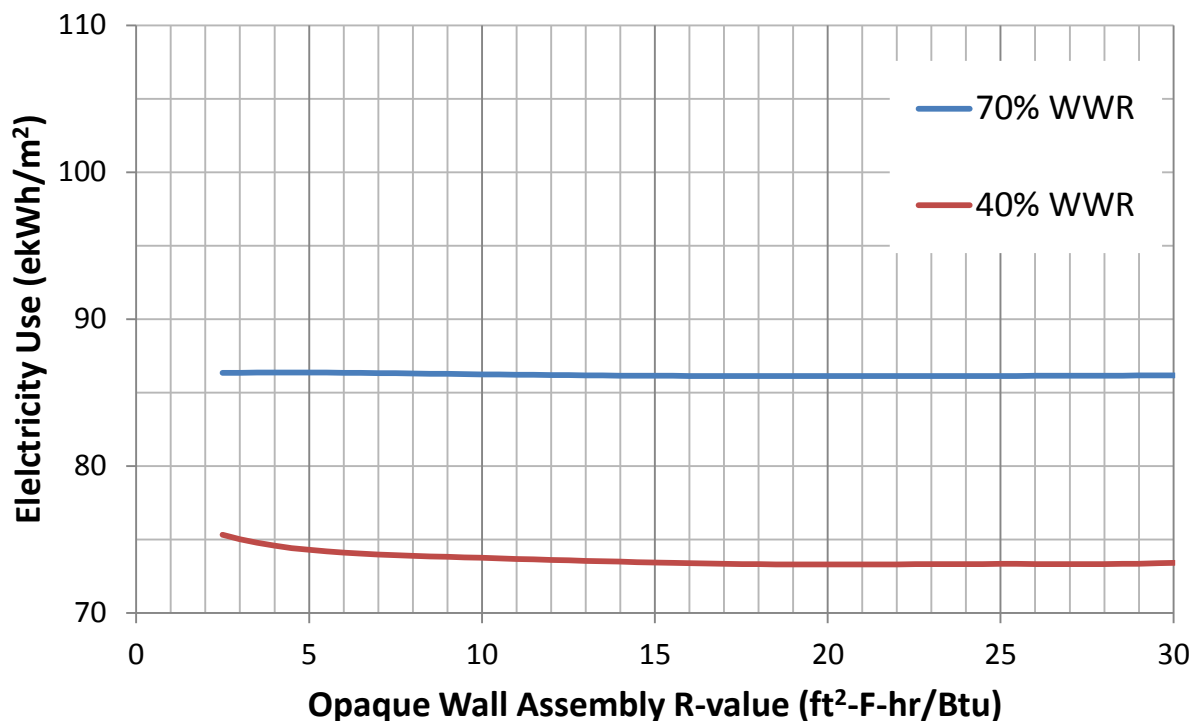


Figure C7.5: Vancouver – Electricity Use vs. Opaque Wall Assembly R-Value

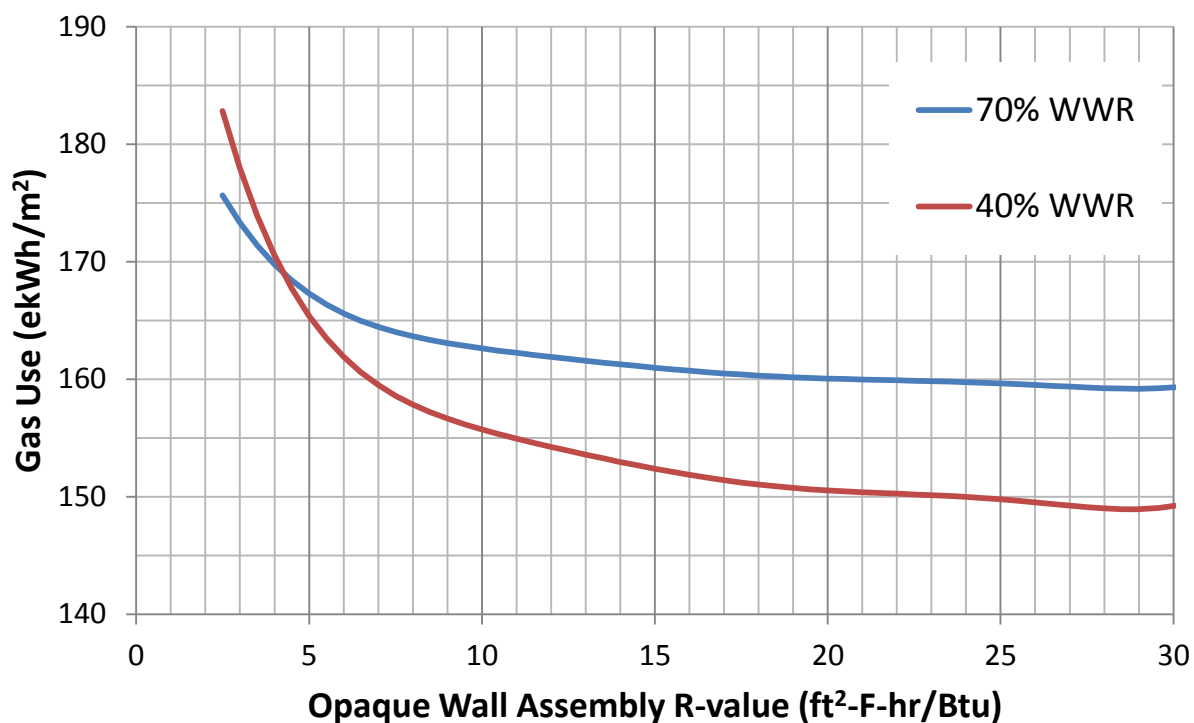


Figure C7.6: Vancouver – Gas Use vs. Opaque Wall Assembly R-Value

8.0 NON-FOOD RETAIL ARCHETYPE SUMMARY

Archetype Summary	Values	Units / Notes
Gross Floor Area (GFA)	48, 400 (4,497)	ft2 (m2)
Number of Floors	1	
Wall Height	20 (6.1)	ft (m)
Window:Wall Ratio (WWR)	30%/60% storefront, 0% other	
Length:Width Ratio	1:1	
Wall:Roof Ratio	0.36	
Lighting Power Density (LPD)	1.5 (17)	W/ft2 (W/m2)
Plug Power Density (PPD)	0.25 (3)	W/ft2 (W/m2)
General System Information	PSZ-AC, gas fired heat	
Performance Details	As per below	According to standard practice
Zoning	5	Core/perimeter
Notes	Big Box Retail Type, glazing ratio is on storefront elevation only, 0% glazing other elevations	
Building Envelope Components		
Roof (insulated entirely above deck)	20.8 (3.66)	R-value, h.ft2.F/BTU (m2.K/W)
Wall	23.7 (4.17)	R-value Curve, h.ft2.F/BTU (m2.K/W)
Slab-on-grade (unheated)	0.159 (0.9)	F-factor, BTU/h.ft.F (m.K/W)
Glazing (Double-pane)	0.387 (2.2)	U-value, BTU/h.ft2.F (m2.K/W)
	0.45	Solar Heat Gain Coefficient (SHGC)
Internal Loads		
Occupancy	15 (6.7)	person/100 ft2 (m2/person)
Lighting	1.5 (17)	W/ft2 (W/m2)
Receptacle	0.25 (3)	W/ft2 (W/m2)
Domestic Hot Water Peak	137 (40)	BTUh/person (W/person)
Air Infiltration	0.05 (0.25)	cfm/ft2 (L/s/m2) external surface area
Ventilation Rates		
People Outdoor Air Rate	5 (2.5)	cfm/person (L/s/person)
Area Outdoor Air Rate	0.06 (0.3)	cfm/ft2 (L/s/m2)
Schedules		
HVAC, Plug Loads, Lighting, Occupancy, Domestic Hot Water	Retail	ASHRAE 90.1 - User's Manual, Table G-L
Zone Level Equipment		
Controls		
Heating Design Supply Air Temperature	122 (50)	F (°C)
Cooling Design Supply Air Temperature	55 (12.8)	F (°C)
Building Level Equipment		
System Type	PSZ-AC (One Per Zone)	Unitary Furnace:HeatCool
Fan Control	Constant Volume	
Fan Efficiency	70	%
Motor Efficiency	90	%
Total Static Pressure	2.4 (600)	in (Pa)
Total Supply Airflow	Autosized	
Heating Equipment		
Equipment Type	Gas	
Efficiency	80	%
Cooling Equipment		
Equipment Type	DX	
Efficiency	3	COP
SHW Equipment		
System Type and Fuel	Gas	
Efficiency	80	%
Peak Demand	137 (40)	BTUh/person (W/person)
Controls		
Heating Supply Air Temperature	Min 55.4, Max 113 (Min 13, Max 45)	Single Zone Reheat Range, F (°C)
Cooling Supply Air Temperature	Min 55, Max 64.4 (Min 12.8, Max 18)	Reset for Warmest Zone, F (°C)
Outdoor Air Economizer	75 (24)	Fixed Dry Bulb, Maximum Temperature, F (°C)

NON-FOOD RETAIL ANNUAL ENERGY USE

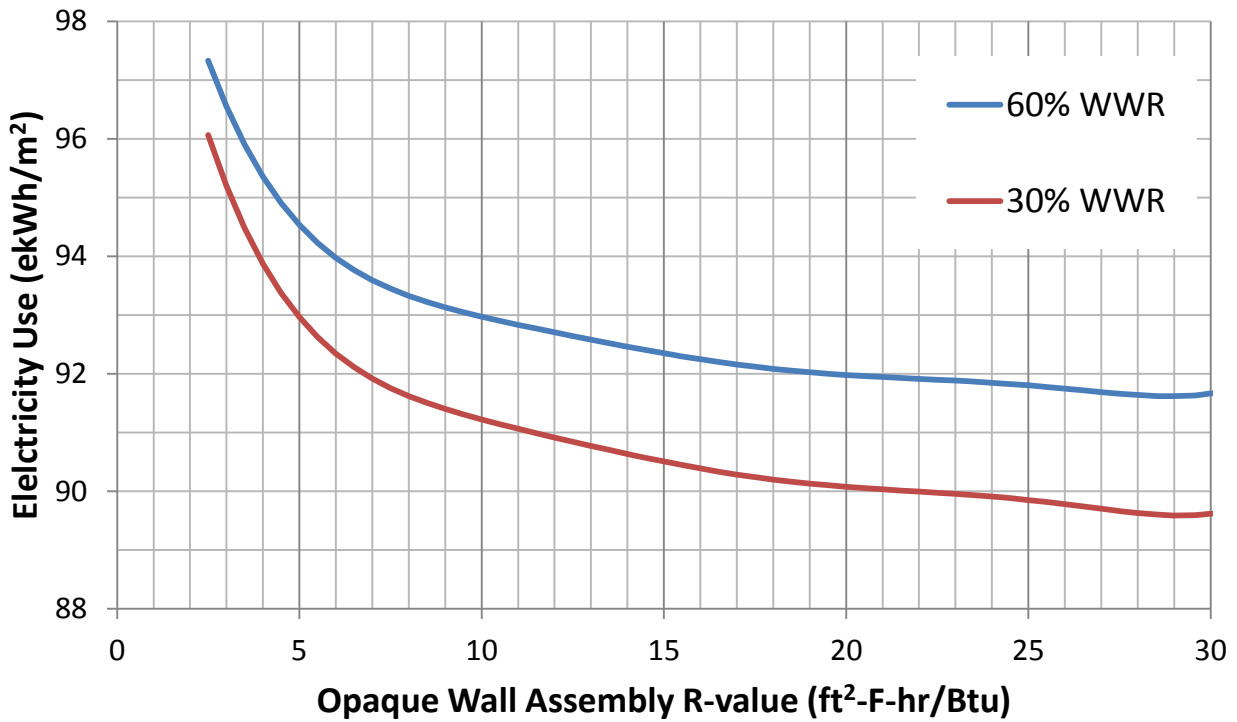


Figure C8.1: Prince George – Electricity Use vs. Opaque Wall Assembly R-Value

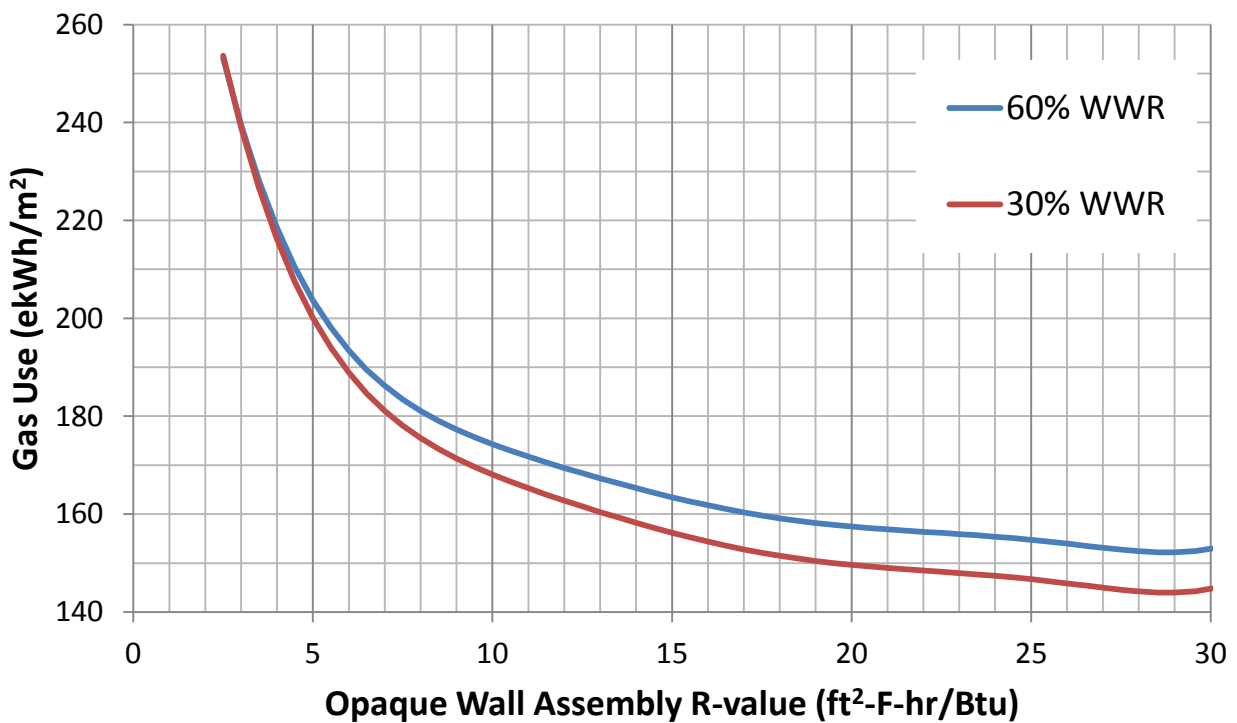


Figure C8.2: Prince George – Gas Use vs. Opaque Wall Assembly R-Value

NON-FOOD RETAIL ANNUAL ENERGY USE

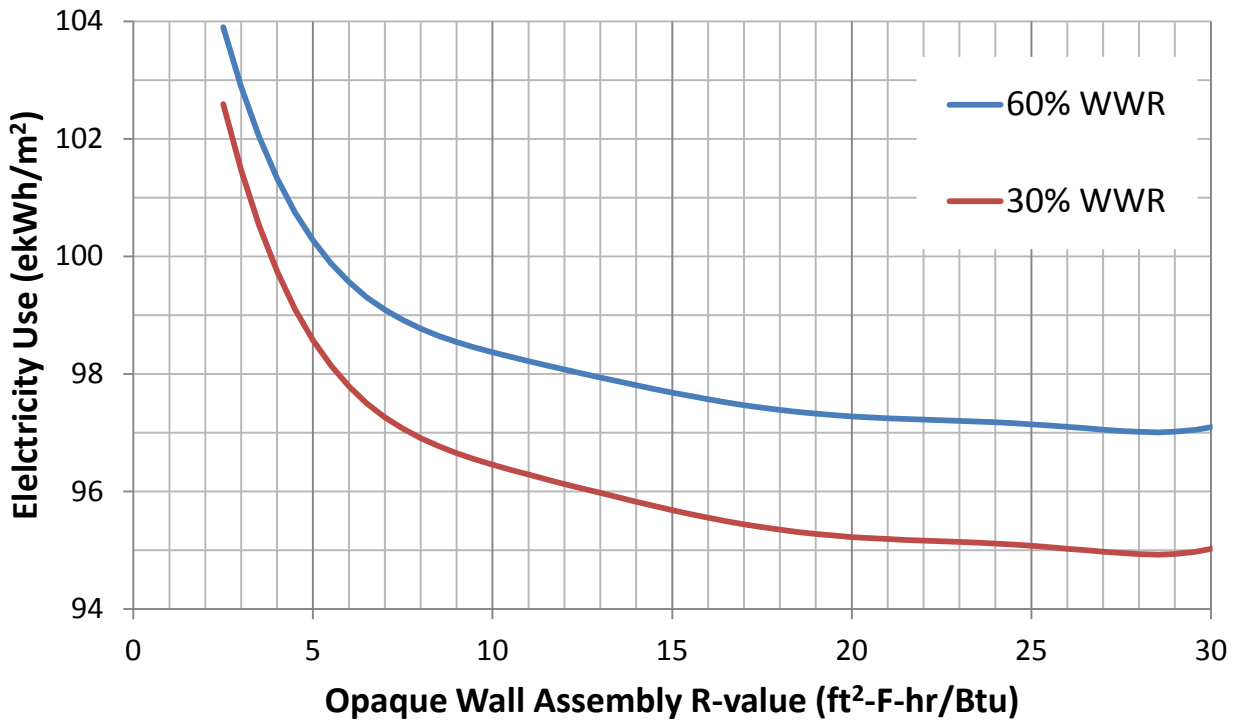


Figure C8.3: Summerland – Electricity Use vs. Opaque Wall Assembly R-Value

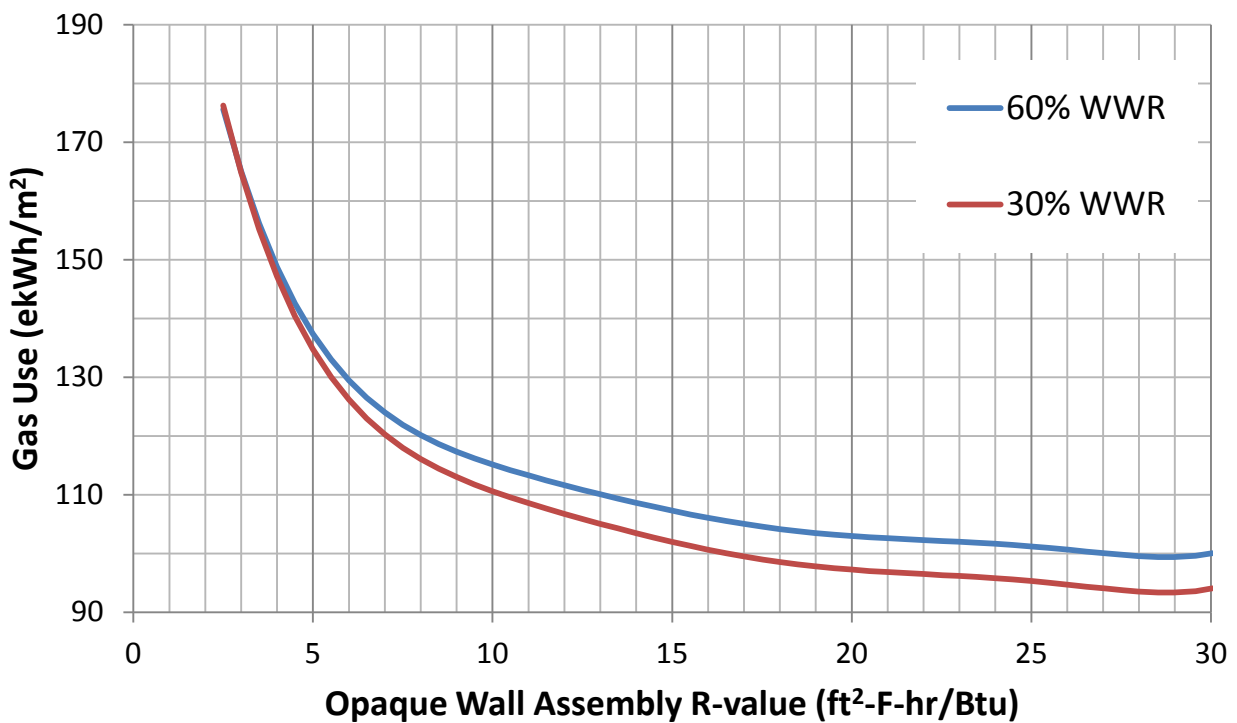


Figure C8.4: Summerland – Gas Use vs. Opaque Wall Assembly R-Value

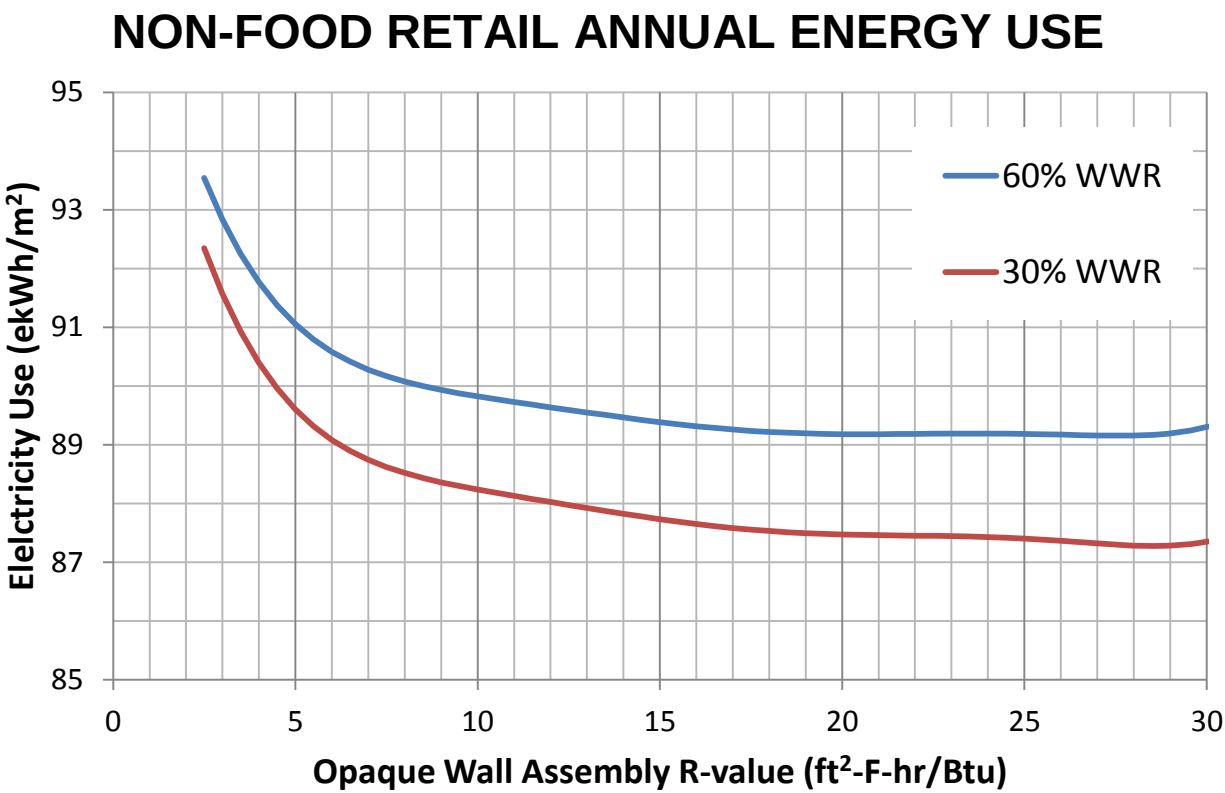


Figure C8.5: Vancouver – Electricity Use vs. Opaque Wall Assembly R-Value

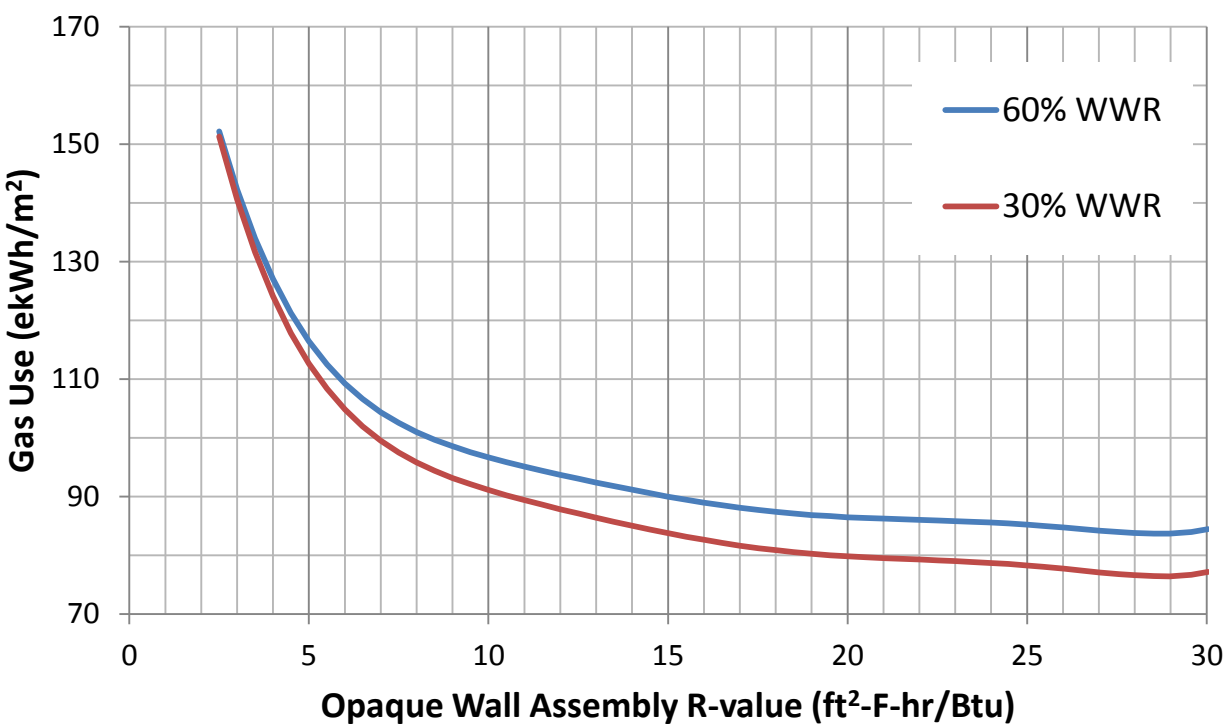


Figure C8.6: Vancouver – Gas Use vs. Opaque Wall Assembly R-Value