



A realistic path towards net-zero energy buildings

Stephen Pope, OAA, MRAIC

Natural Resources Canada

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Outline

- Scope
- Starting point
- 35% better
- 60% better
- Renewable Energy Platform (REP)
- Applying renewables to the REP
- How far did we go?



Scope

Seven Commercial Buildings

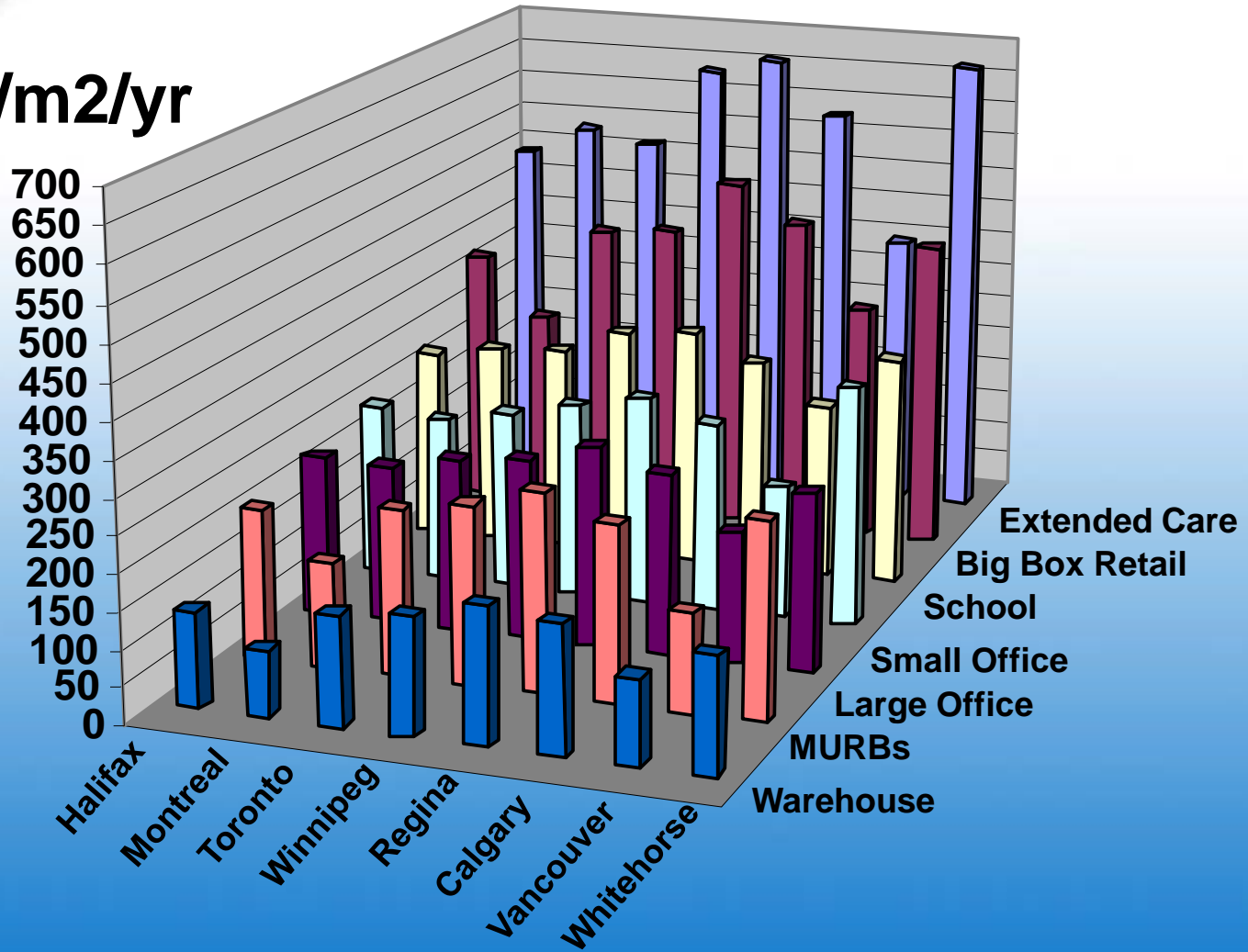
- Large Offices;
- Small Offices;
- Big Box Retail;
- Warehouses;
- Schools;
- Extended Care Homes;
- MURBS.





The starting point: Energy Code 97

ekW/m²/yr



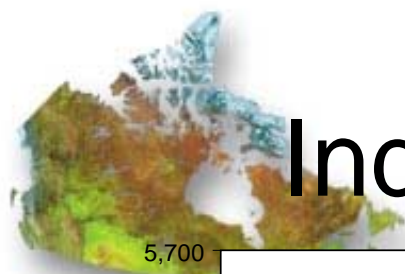


Step Approach towards NZE

- The 35% platform
 - Represents current good practice under BAU
 - Required change in design process after 35% target
 - A 2012 policy target
- The 60% platform
 - Represents current best practice
 - A 2030 policy target
- The RE Platform
 - Provides the basis for maximizing the realization of renewables potential
 - About equivalent to the 60% platform
 - But forces to adopt a new perspective beyond EE
- The NZE ~~platform~~ target

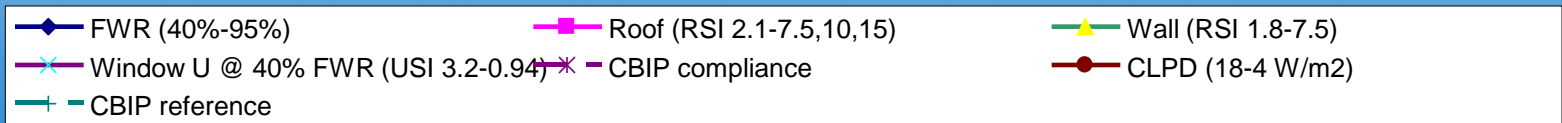
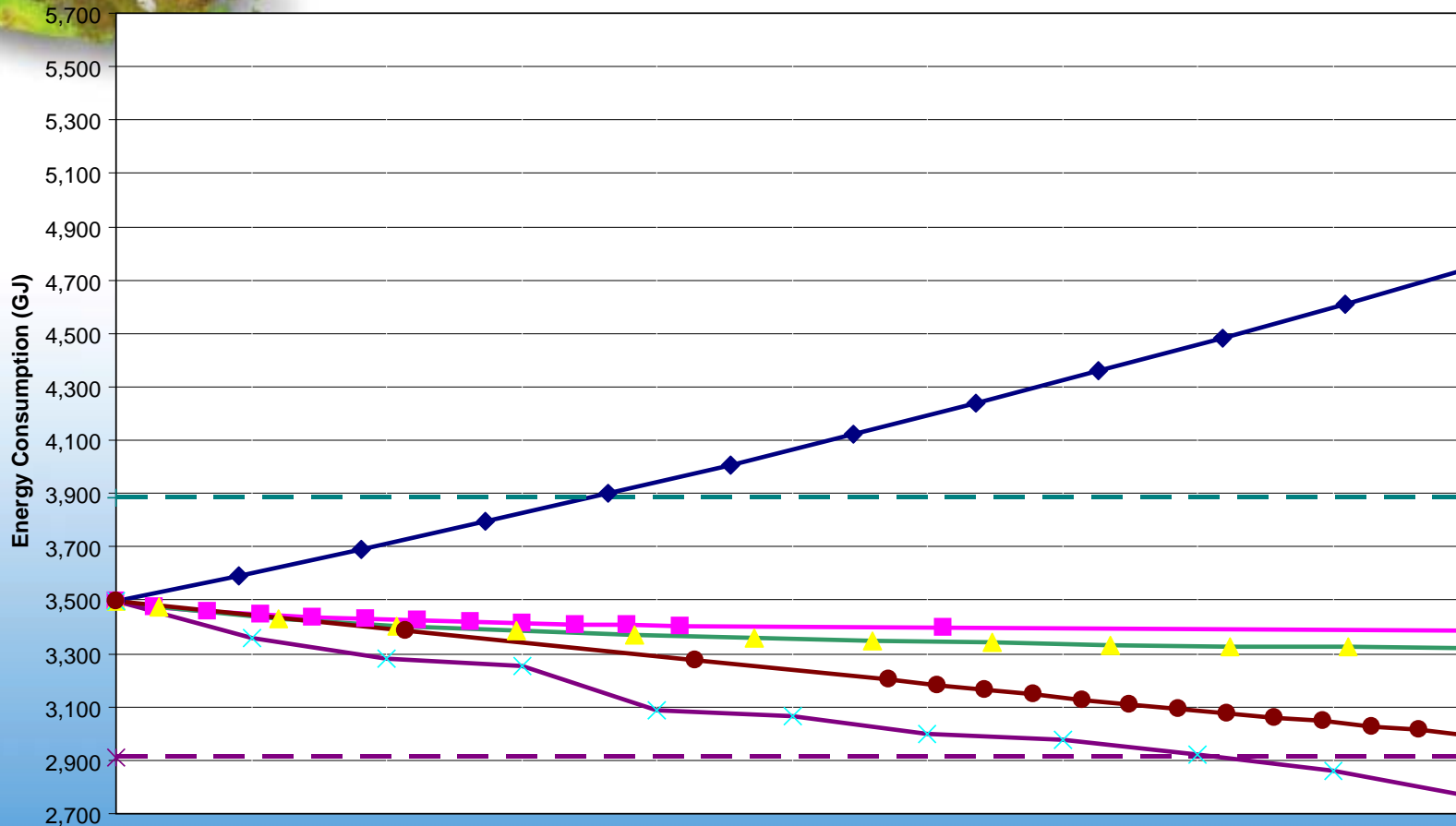


The 35% step



Individual Measure Impact

CBIP Archetype Small Office in Ottawa w/ 4PFC - Envelope & Lighting





The 60% step

- 60% represents “Best Practice” positions
- Possible with currently available equipment, but requires improved design process (IDP);
- & challenge of assumptions behind codes and standards (lighting and ventilation).



The 60% step

- FWR limited to 60%
- Increased window thermal resistance and visual transmittance (highest insulating low-e DG or TG);
- Moderate upgrades to envelope insulation (MNECB + RSI 1.5-2.5);
- Aggressively reduced connected lighting power using personal and occupancy based controls;
- High performance condensing boilers (eff. 92%-95%);
- Low volume, low pressure ventilation delivery mandatory;
- High performance chillers (COP above 5.0);
- Ground-source heat pumps or distributed water-loop heat pumps.



The REP step

- Assess 60% platform for an optimal use of renewables
- within the ability to capture solar energy by the building envelope (“on site”).
- In order to maximize the ability of PV to provide building electricity, approach for 60% target cannot be used.



The REP step

- FWR limited to 40%;
- Best window thermal resistance and visual transmittance (triple glazed systems);
- Small upgrades to envelope insulation values from 35% target;
- Aggressively reduced connected lighting power using personal and occupancy based controls;
- High performance condensing boilers;
- Low volume, low pressure ventilation delivery mandatory;
- Aggressive use of demand controlled ventilation using occupancy controls;
- High performance chillers (heat reclaim, etc.);



The NZE goal

- NZsE (net-zero site energy) is deemed to be achieved if renewable energy can satisfy the electrical and heating demand of the “RE Platform”.



From 60% to REP

Building Type	60% Platform	REP Platform	Performance change
Large Office	GSHP	Fossil fired FPFC	60.1 to 45.3
Small Office	GSHP	Fossil fired FPFC	60.3 to 57.7
Big Box Retail	Dist. HP	Fossil fired FPFC	60 to 62.4
Warehouse	GSHP	Fossil fired CAV	60.3 to 54.1
School	GSHP	Fossil fired FPFC	60.3 to 68.4
Extended Care	GSHP	Fossil fired CAV	58.9 to 57.8
MURB	Dist. HP	Fossil fired FPFC	60 to 61.2

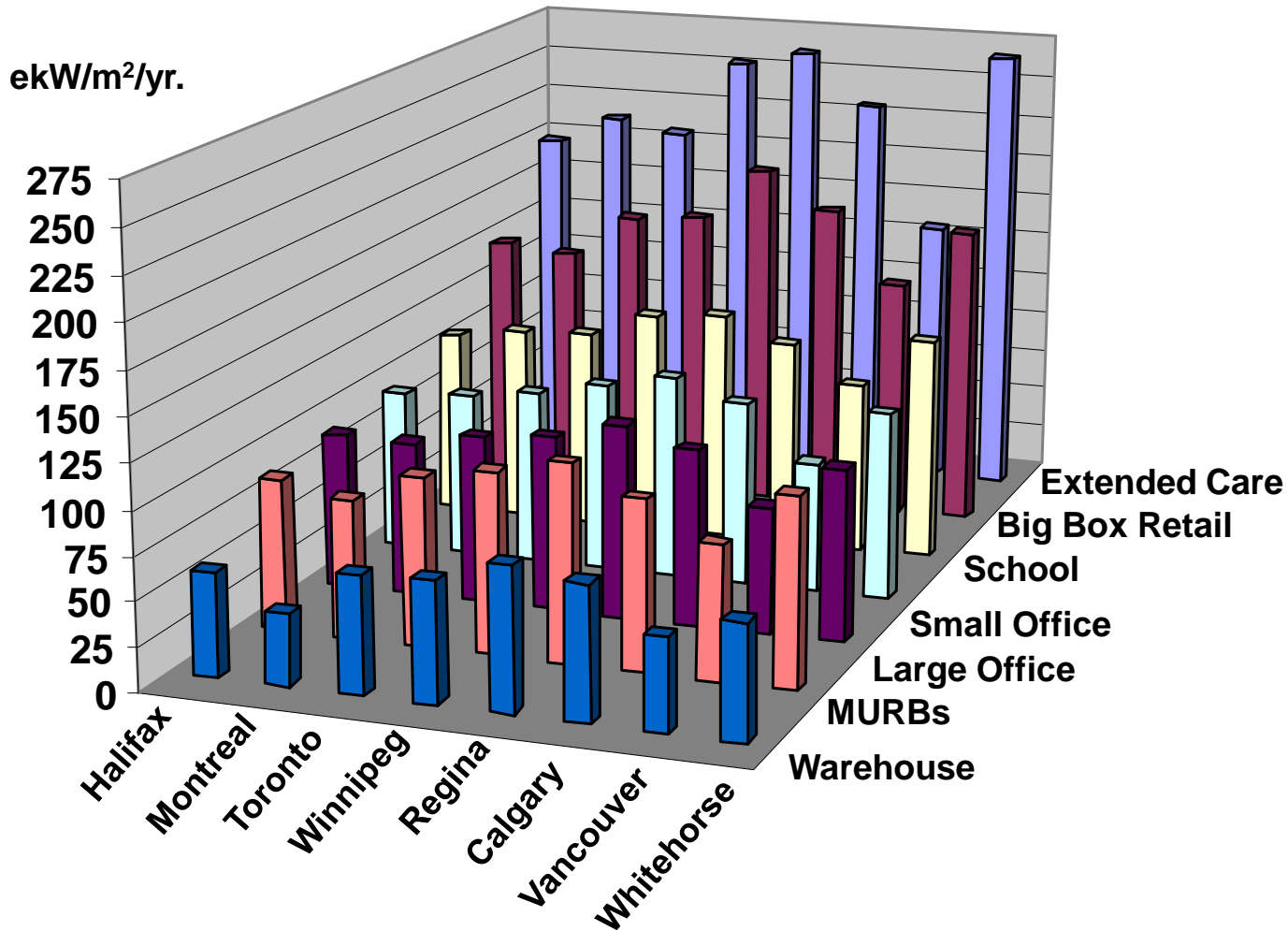


Electricity Consumption (GWh)

Bldg Type	Platform	Actual	% reduction
Large Office	60%: GSHP	2.35	
	REP: Fossil fired FPFC	1.66	29%
Small Office	60%: GSHP	0.41	
	REP: Fossil fired FPFC	0.23	44%
Big Box Retail	60% : DistHP	0.42	
	REP: Fossil fired FPFC	0.23	45%
Warehouse	60%: GSHP	0.3	
	REP: Fossil fired CAV	0.07	77%
School	60%: GSHP	1.82	
	REP: Fossil fired FPFC	0.81	55%
Extended Care	60%: GSHP	0.58	
	REP: Fossil fired CAV	0.41	29%
MURB	60%: DistHP	0.41	
	REP: Fossil fired FPFC	0.27	34%

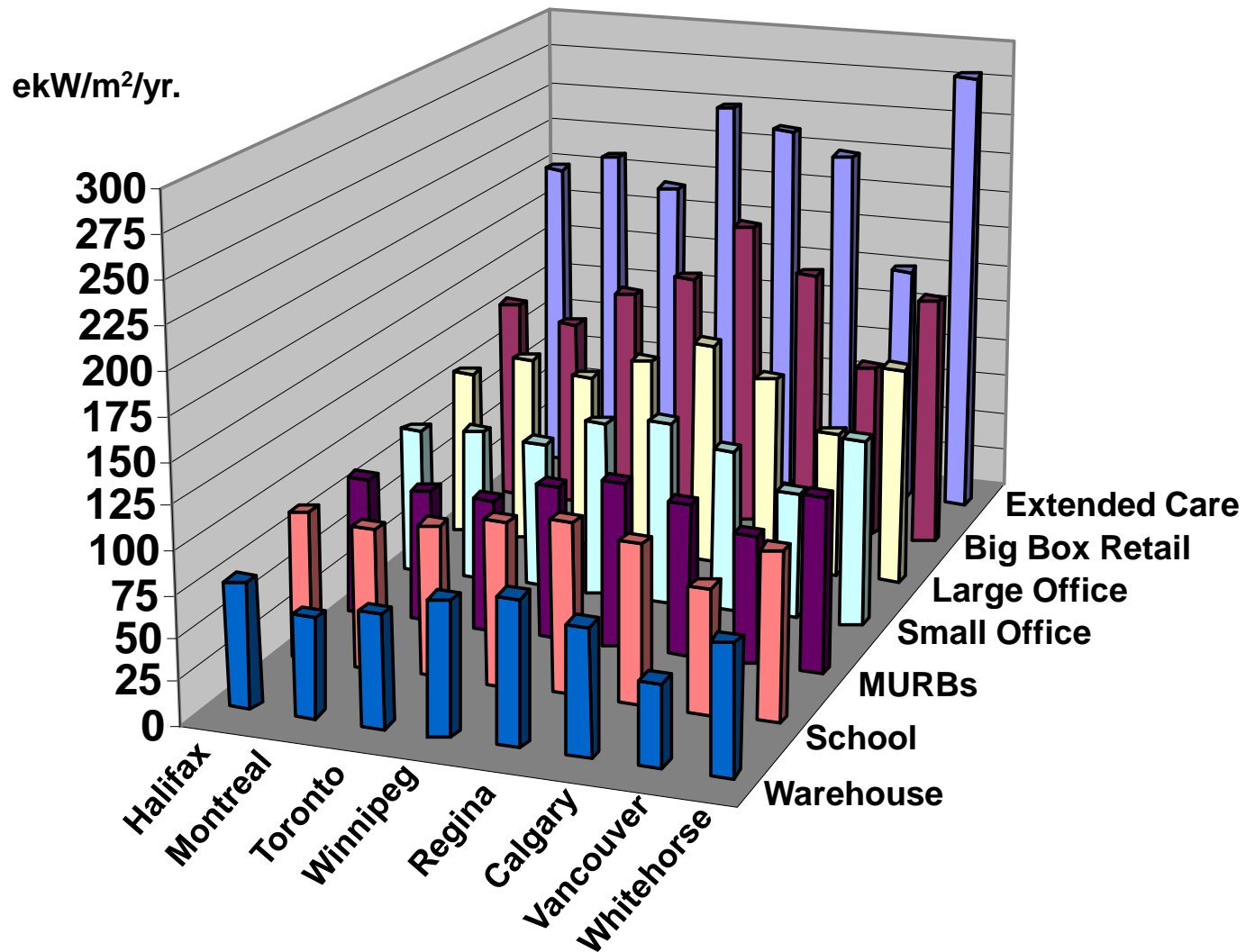


Review current 60% approach





Adjust to REP approach



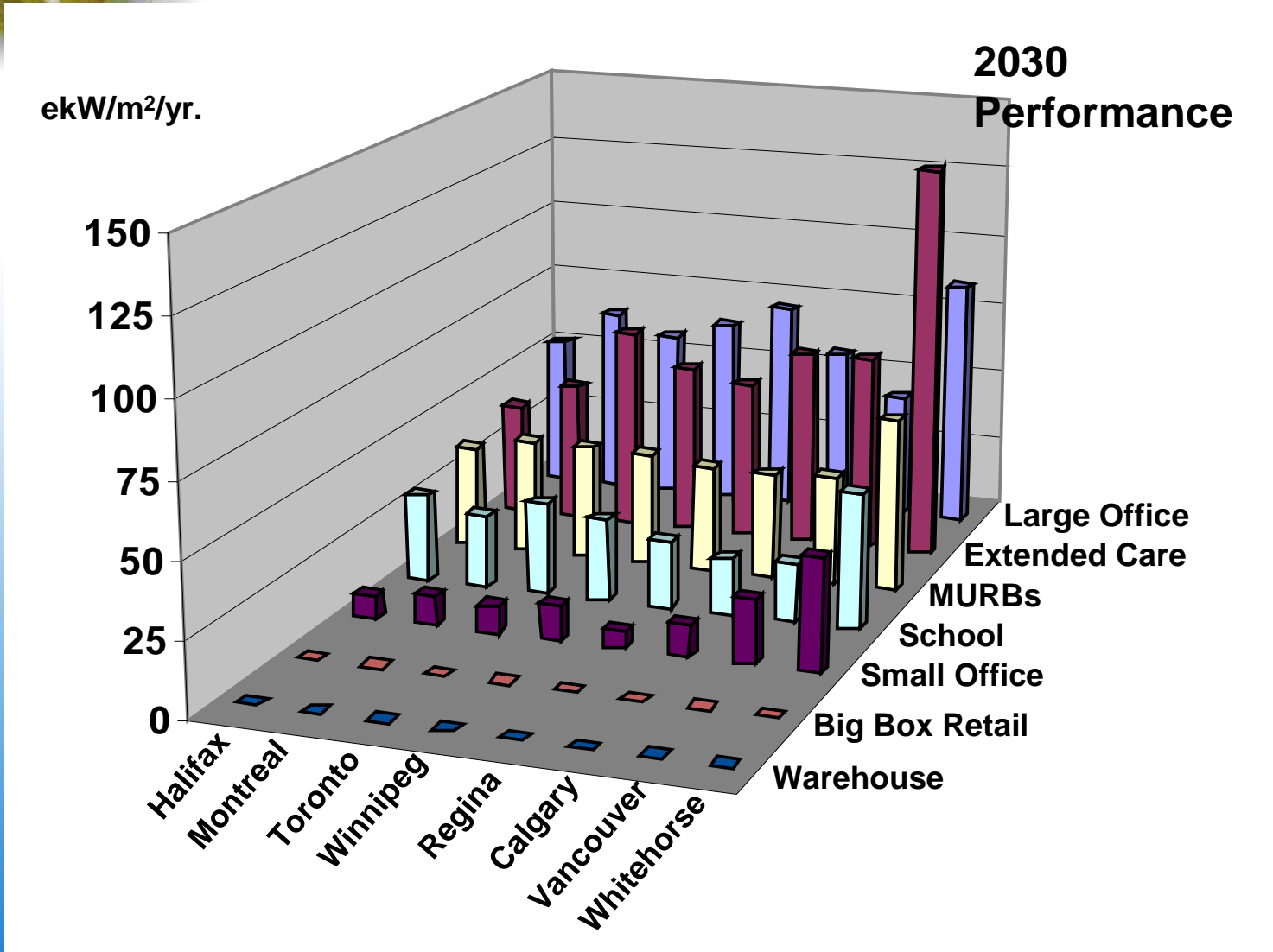


Renewable Energy Equipment

Renewable Energy Equipment Mounting Area		Large Office	Small Office	Big Box Retail	Warehouse	School	Extended Care	MURB
Roof Area (m ²)		1,336	1,336	4,180	4,650	4,650	2,325	972
Net Opaque Wall Area (m ²)		5,779	962	3,414	1,197	1,047	1,943	1,303
PV – BP Poly-crystalline 12.7%	% Mounted on Roof	0	70	73	50	70	30	70
	% Mounted on Wall	0	100	50	100	100	100	0
	Total Area (m ²)	0	845	1,849	701	2,546	717	510
	Capacity (kWp)	0	107	235	89	323	91	65
SDHW – Viessmann evacuated tube	% Mounted on Roof	100	30	27	50	30	70	30
	% Mounted on Wall	0	0	0	0	0	0	0
	Total Area (m ²)	1,002	301	621	581	1,046	1,221	219
	Capacity (kWth)	522	157	323	303	545	636	114
SVAH	Total Area (m ²)	578	0	171	0	0	0	130



Results after applying Renewables





Results Discussion

- High degree of variability in potential – individual designs must be tested;
- Heat pumps are not mandatory for high performance;
- Alternative to heat pumps is extensive heat recovery from ventilation air plus extensive occupancy based ventilation demand control, on top of condensing boilers;
- Most promising renewable energy source is SDHW, used for:
 - Boiler water preheat; Low temperature water for radiant slab heating; Heat source to drive moisture off absorption cooling media; Regular DHW requirements.
- SDHW potential can provide up to triple heating energy demand, even if limited to collection in heating season:
 - but storage is required and storage capacity needs to be tested in relationship to required autonomy.