The ROLE OF BUILDINGS IN CREATING LOW CARBON COMMUNITIES

Toronto's Zero Emissions Building Framework

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Ontario Climate Symposium

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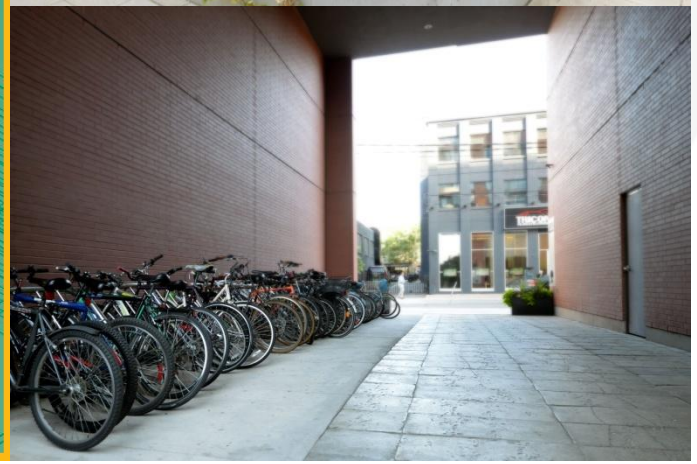
POLICY INNOVATION -Toronto Green Standard



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TORONTO GREEN STANDARD:
Sustainable performance measures for new construction since 2010

Air Quality
GHG Emissions & Energy Efficiency
Water Quality & Quantity
Urban Ecology
Solid Waste Management





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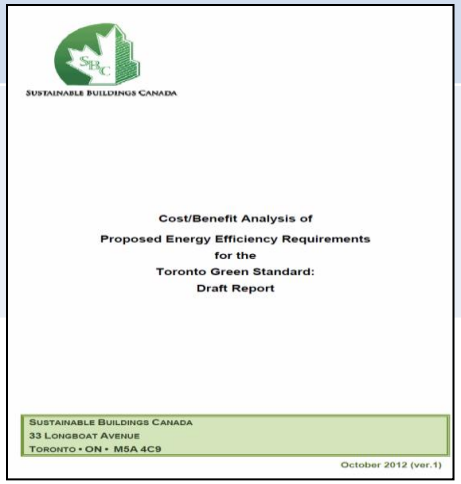
Current TGS V2.0 Energy Performance Package (Pt 3 buildings)

Tier 1	Tier 2
15% above OBC 2012	25% above OBC 2012
City buildings install renewable energy technologies that produce a minimum of 5% of the building's modelled energy use	On-site renewable energy to supply 1% (solar PV, solar thermal or wind) or 20% from ground source heat pumps
	Best practice commissioning
	Thermal metering



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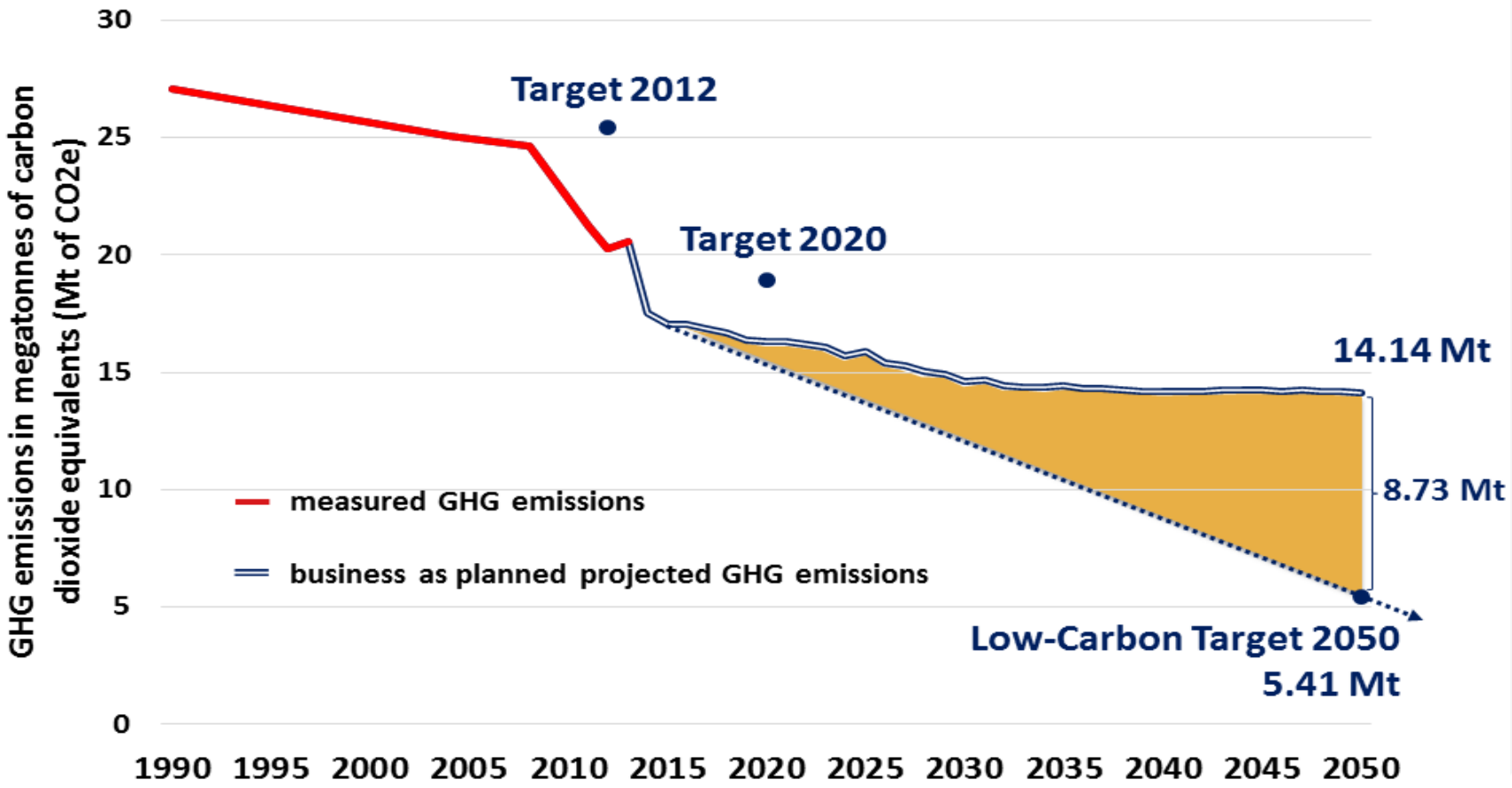
TORONTO BUILDING TRENDS

- More buildings, taller buildings
- No significant correlation between % improvement over OBC and reduction in GHG's
- High rates of thermal energy losses through the building envelope

Toronto's Greenhouse Gas Emissions/Targets

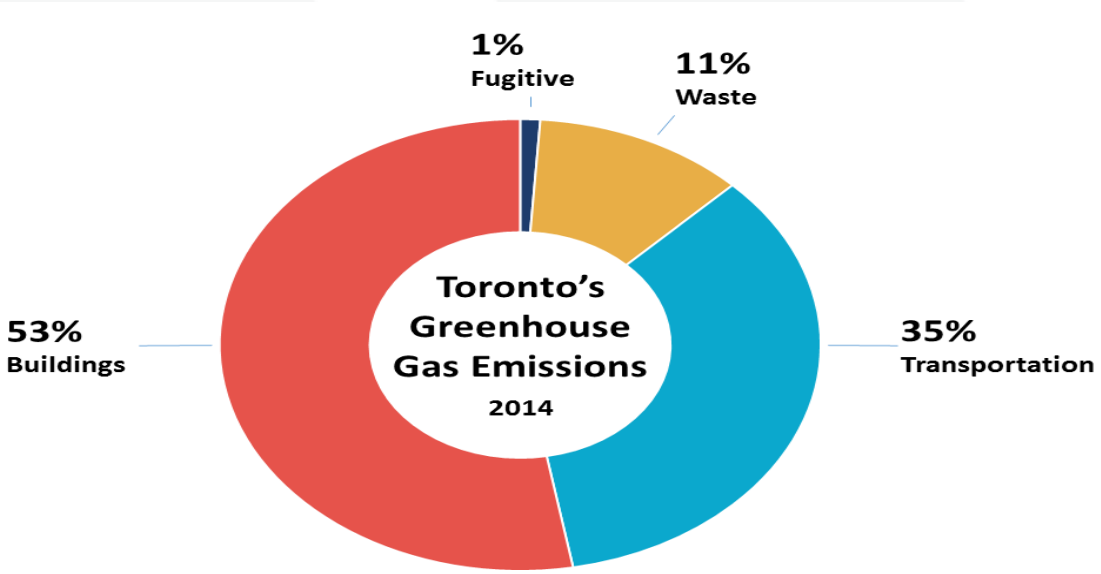
Measured and projected GHG emissions to 2050 (Mt of CO2)



TransformTO

TransformTO

- TransformTO recommended ‘raising the bar’ on the Toronto Green Standard to achieve 2050 GHG targets (new and existing buildings)



TransformTO

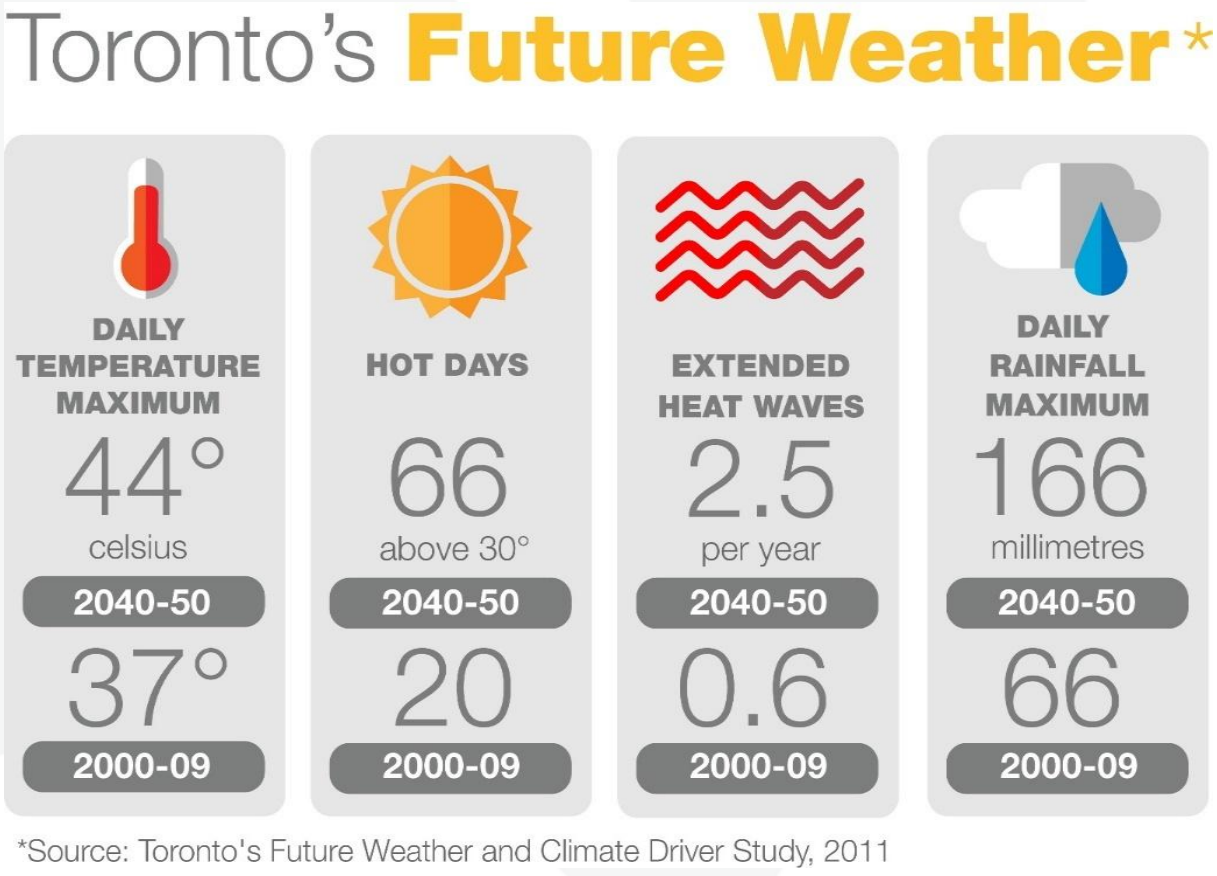
BUILDING RESILIENCE

- *Toronto's Future Weather and Climate Driver Study (2011)*

Flooding events

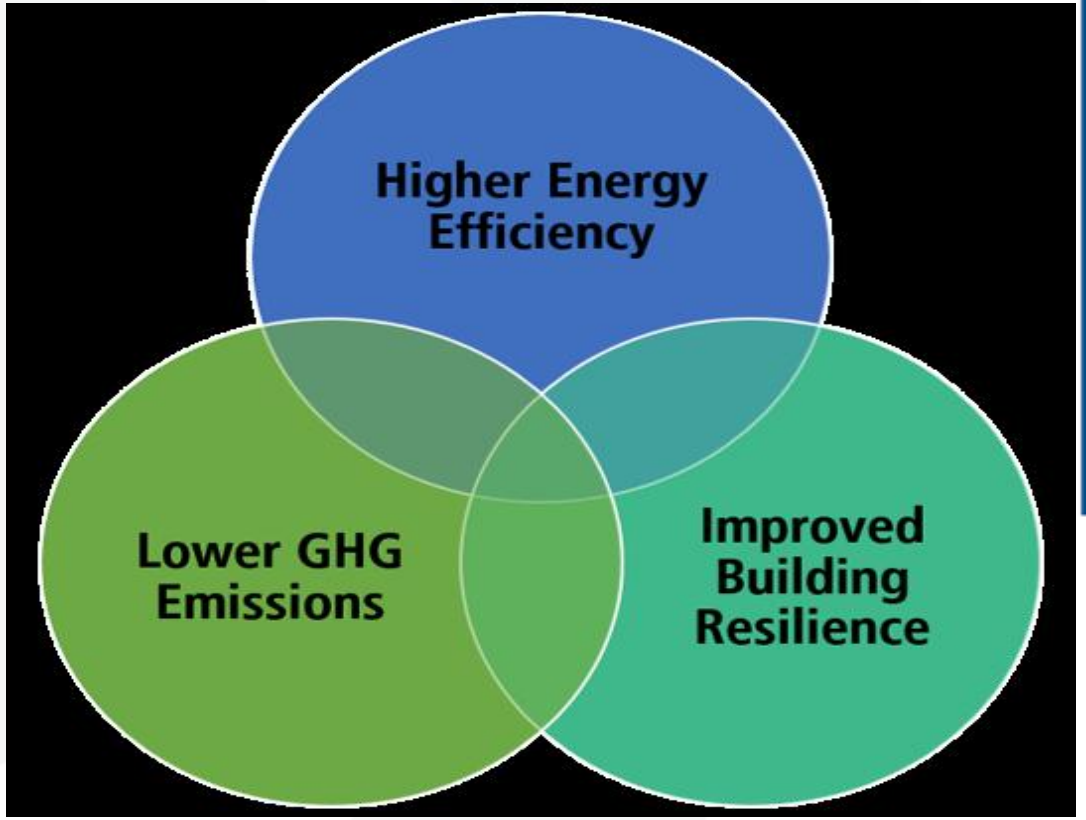
Extreme heat events

Power outages

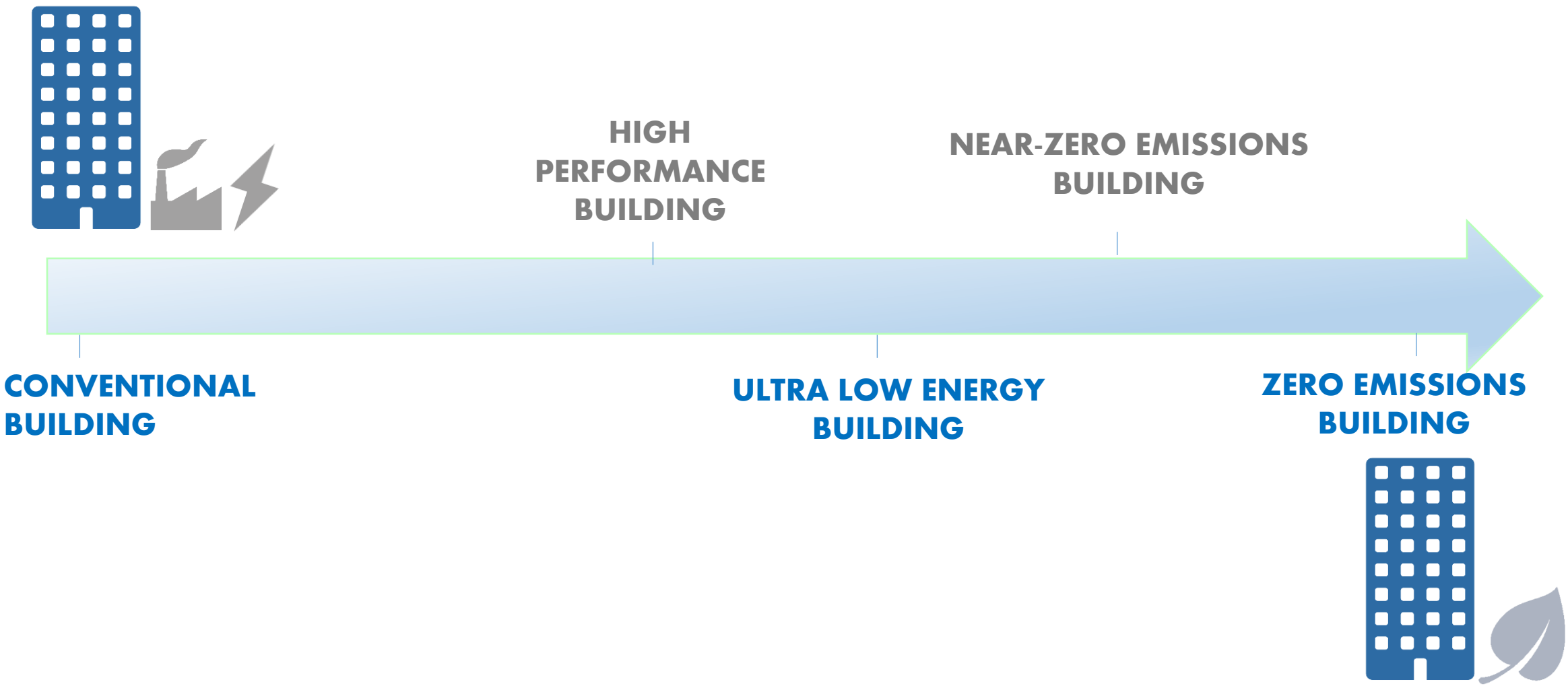


A NEW FRAMEWORK

- An increase in building **energy efficiency** to reduce overall energy demand from the built environment
- A decrease in **GHG emissions** via a shift towards the use of renewable and/or district energy as a primary source of energy for the buildings sector
- An increase in the **resilience** of the buildings sector to changing conditions and extreme events



PATHWAYS TO ZERO



UPDATE PROCESS

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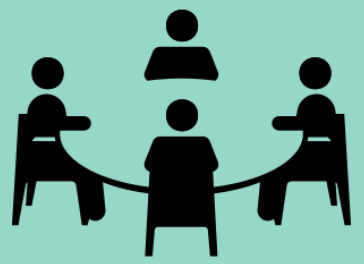
GLOBAL BEST PRACTICES IN ENERGY EFFICIENCY

Work Program



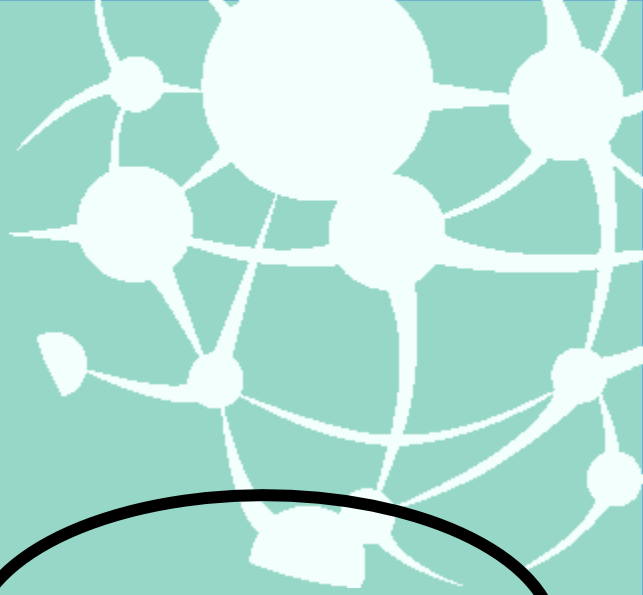
Develop Consensus on Objectives

Objectives used to evaluate frameworks

Standards

Frameworks

Identify the best performers based on Objectives



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BESTPRACTICECOMPARISON

STANDARD	COMMERCIAL	MULTI-UNIT RESIDENTIAL
Denmark Building Regulation 10 (BR10)	Non-Residential, Offices, School, Institutions, other 71.3 kWh/yr/m2	Residential, Student Accommodation, Hotels 52.5 kWh/yr/m^2
Norway Tek10	Office building 150 kWh/yr/m^2 heated floor area	Blocks of Flats 115 kWh/yr/m^2
France Regulation Thermique RT2012	40-65 kWh/m^2/yr (as per climate zone/altitude)	57.5 kWh/yr/m^2
England/Wales The Building Regulations 2010 Conservation of fuel and power	Meet or exceed reference building kgCO_2/m2/yr with pre-defined envelope and building systems standards.	Meet or exceed reference building kgCO_2/m2/yr with pre-defined envelope and building systems standards. Multi Family Housing 39 kWh/m2/yr (2016)
Germany Energy Savings Ordinance (EnEV)	Meet or exceed reference building kWh/m2/yr with pre-defined standards.	Meet or exceed reference building kWh/m2/yr with pre-defined standards.
California Title 24, Part 6	97.7 kWh/m2/yr (Example Office Building)	88.2 kWh/m2/yr (Example Residential Tower)
Seattle SEC2012 Target Performance Path	40 kBTU/sf/yr (aprox: 125 kWh/yr/m^2)	40 kBTU/sf/yr (aprox: 125 kWh/yr/m^2)
Passivhaus	Maximum cooling demand Maximum space heating demand Maximum total primary energy demand	15 kWh/m^2/yr 15 kWh/m^2/yr 120 kWh/m^2/yr
Minergie	Public/Office Buildings 40 kWh/m^2/yr	Multi Family Housing 60 kWh/m^2/yr

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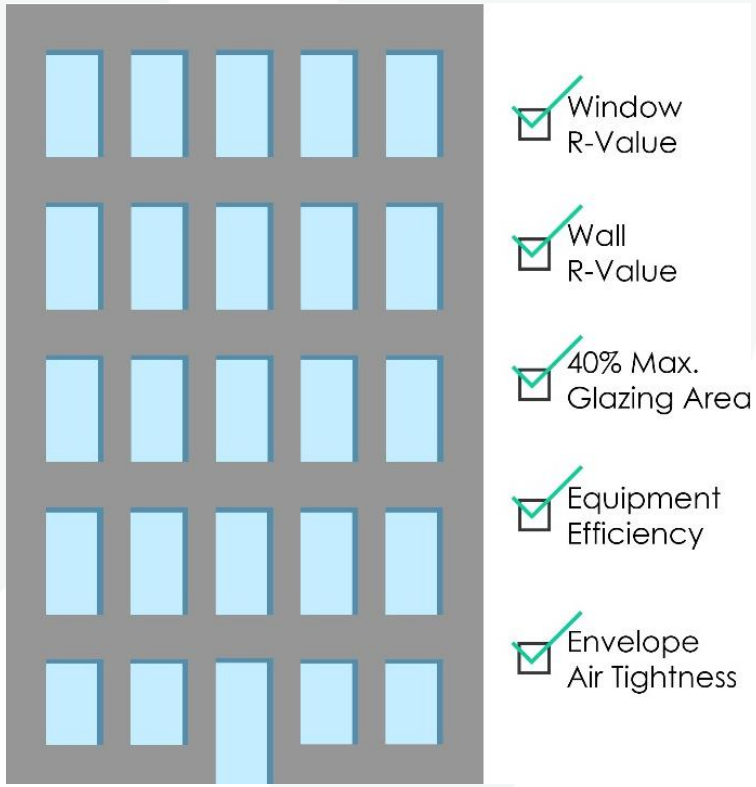
BUILDING ENERGY PERFORMANCE

Prescriptive: lists design requirements for mechanical, electrical, and envelope systems

Performance-based: focuses on overall building performance

1) Reference Building approach
2) Performance Targets approach



PERFORMANCE APPROACHES

Reference Building

x Limited success in reducing building energy performance over time

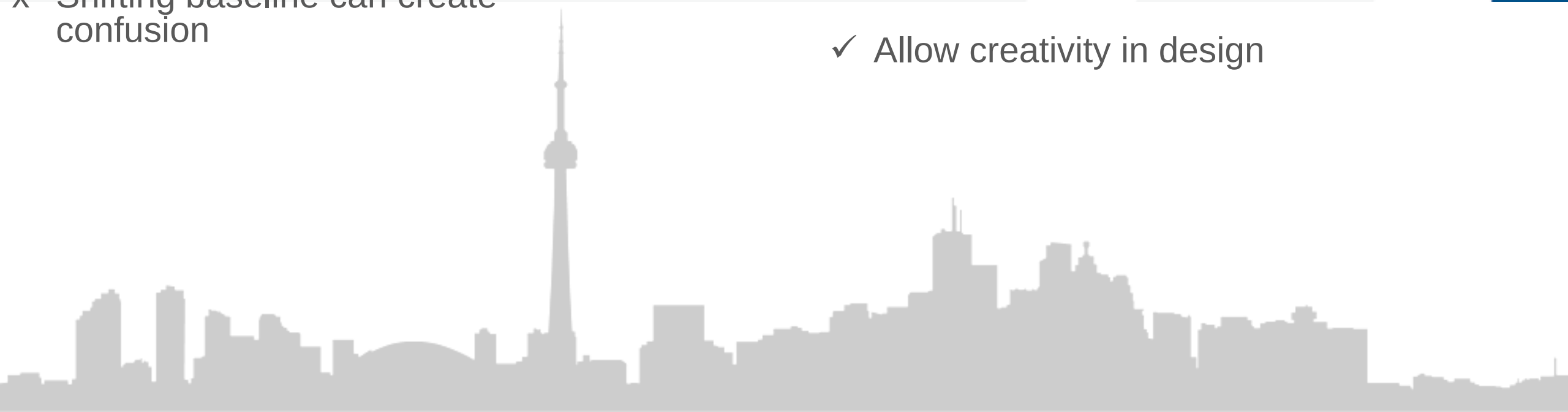
x Shifting baseline can create confusion

"Absolute" Performance Targets

✓ Correlate with better building performance

✓ Support straightforward comparison and review

✓ Allow creativity in design



SELECTING PERFORMANCE METRICS

- **Greenhouse Gas Intensity (GHGI)** to incentivize low-carbon buildings and help meet Toronto's GHG targets
- **Thermal Energy Demand Intensity (TEDI)** to encourage higher quality building envelopes and improve building resilience to climate change impacts
- **Total Energy Use Intensity (TEUI)** to reduce overall building consumption and alleviate pressure on the grid

OTHER RECOMMENDATIONS

- ✓ Adopt a performance-based approach (GHGI, TEUI, and TEDI)
- ✓ Commit to long-term targets: 2030 Zero Emissions
- ✓ Set a predictable pathway of increasing performance over time
- ✓ Add mandatory requirements alongside targets, e.g.
  - Sub-metering protocols
  - Higher building commissioning requirements
  - Administrative requirements to verify air tightness

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TORONTO'S ZERO EMISSIONS BUILDING FRAMEWORK

CONSULTATION PROCESS

Energy Target Modelling

Shortlist

Stakeholder Workshops

Costing + Sensitivity Analysis

Revision based on Feedback

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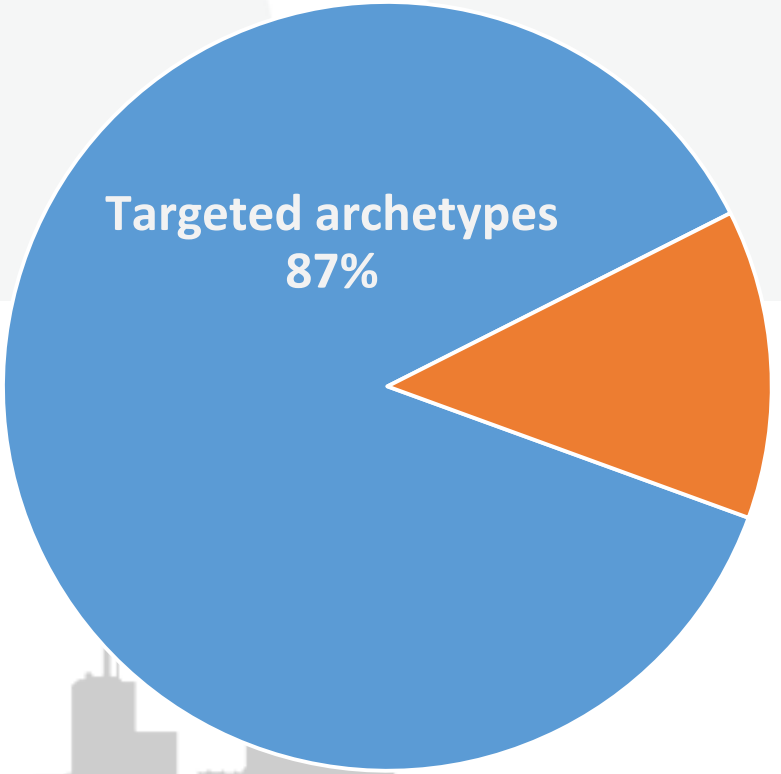
TARGETS FOR TORONTO

5 building archetypes

- High Rise MURB (i.e. concrete tower)
- Low Rise MURB (i.e. 4-6 storey wood frame)
- Commercial Office
- Commercial Retail
- Residential Mixed Use

Toronto Projected New Construction Market



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REVISED TARGETS

BUILDING TYPE	TIER	EUI (kWh/m^2)	TEDI (kWh/m^2)	GHG (kg/m^2)
HIGH RISE MURB	T1	170	70	20
	T2	135	50	15
	T3	100	30	10
	T4	75	15	5
4-6 STOREY WOOD FRAME MURB	T1	165	65	20
	T2	130	40	15
	T3	100	25	10
	T4	70	15	5
OFFICE BUILDING	T1	175	70	20
	T2	130	30	15
	T3	100	22	8
	T4	65	15	4
RETAIL	T1	170	60	20
	T2	120	40	10
	T3	90	25	5
	T4	70	15	3

MEETING THE TARGETS

TIER 2

- > R-10 walls
- Triple glazing
- 40% WWR
- 75% efficient heat recovery

TIER 3

- > R-10 walls
- Triple glazing
- 40% WWR
- 80% efficient heat recovery
- Improved air tightness
- Shift to heat pumps for portion of loads

TIER 4

- > R-20 walls
- Passive House level windows
- 40% WWR
- 85% efficient heat recovery
- Significant reductions in electrical loads
- Removal or thermal breaking of balconies

RESILIENT BUILDINGS

- Improving resilience of building stock to

  - ✓ Future climate scenarios
  - ✓ Rebound from extreme events

Passive survivability refers to a building's ability to maintain critical life-support functions and conditions for its occupants during extended periods of absence of power, heating fuel, and/or water.

Thermal resilience is one dimension of passive survivability, and refers to a building's ability to maintain liveable temperatures in the event of a power outage or disruption in fuel supply for prolonged periods of time.

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BUILDING RESILIENCE

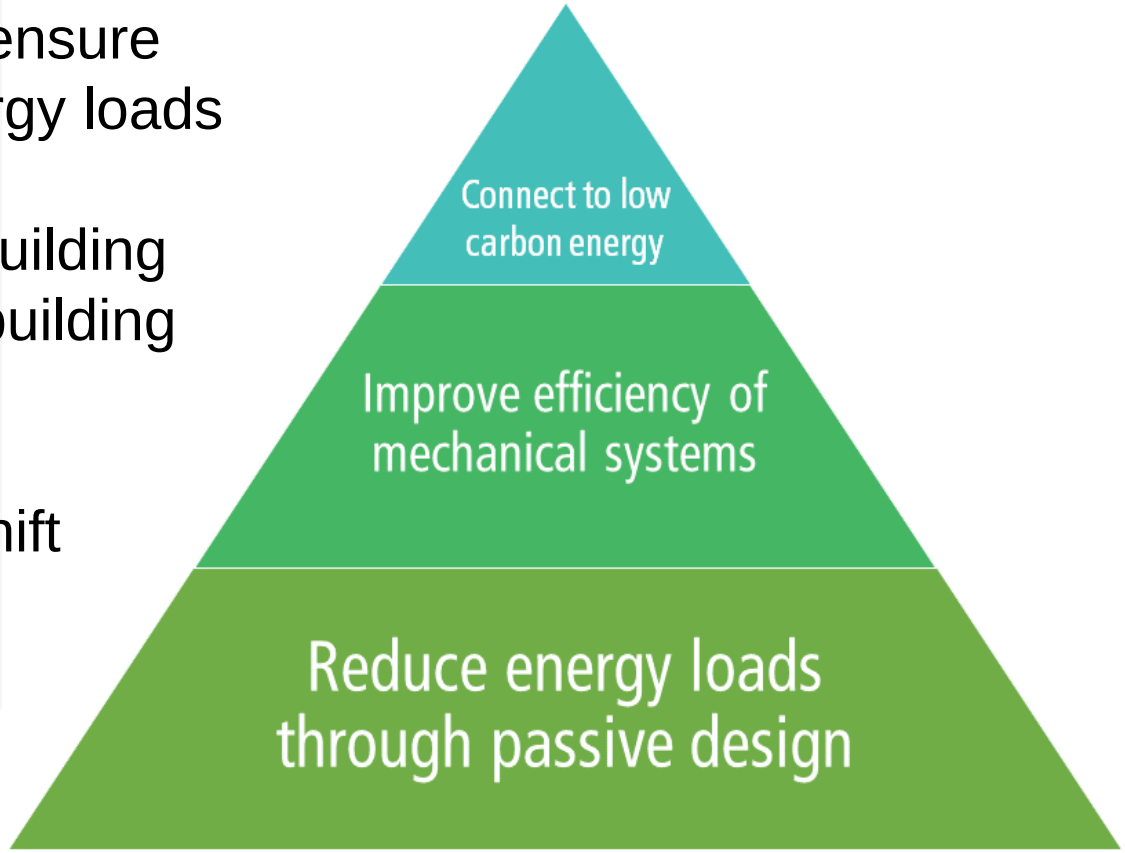
Tier	% Energy Savings over SB-10	Peak Power (W/m2)	72h Power Off Temperature Low (°C)	2 wk Power Off Temperature Low (°C)	Emergency Fuel Factor (x baseline)
TGS v2 T1 (SB-10 2017)	-	11.1	9.9	0.9	1.0
TGS v2 T2	8%	9.7	13.5	5.8	1.2
T1	8%	9.6	13.5	5.8	1.3
T2	30%	9.6	14.6	7.6	1.4
T3	35%	11.0	17.0	14.0	1.5
T4	49%	11.5	19.7	18.3	1.8

IMPLICATIONS: BUILDING DESIGN

Thermal Energy Demand Intensity targets ensure prioritization is given to reducing thermal energy loads

Total Energy Use Intensity targets require building designers to achieve higher levels of overall building energy efficiency

Greenhouse Gas Intensity targets drive a shift towards low-carbon sources of on- or off-site renewable energy

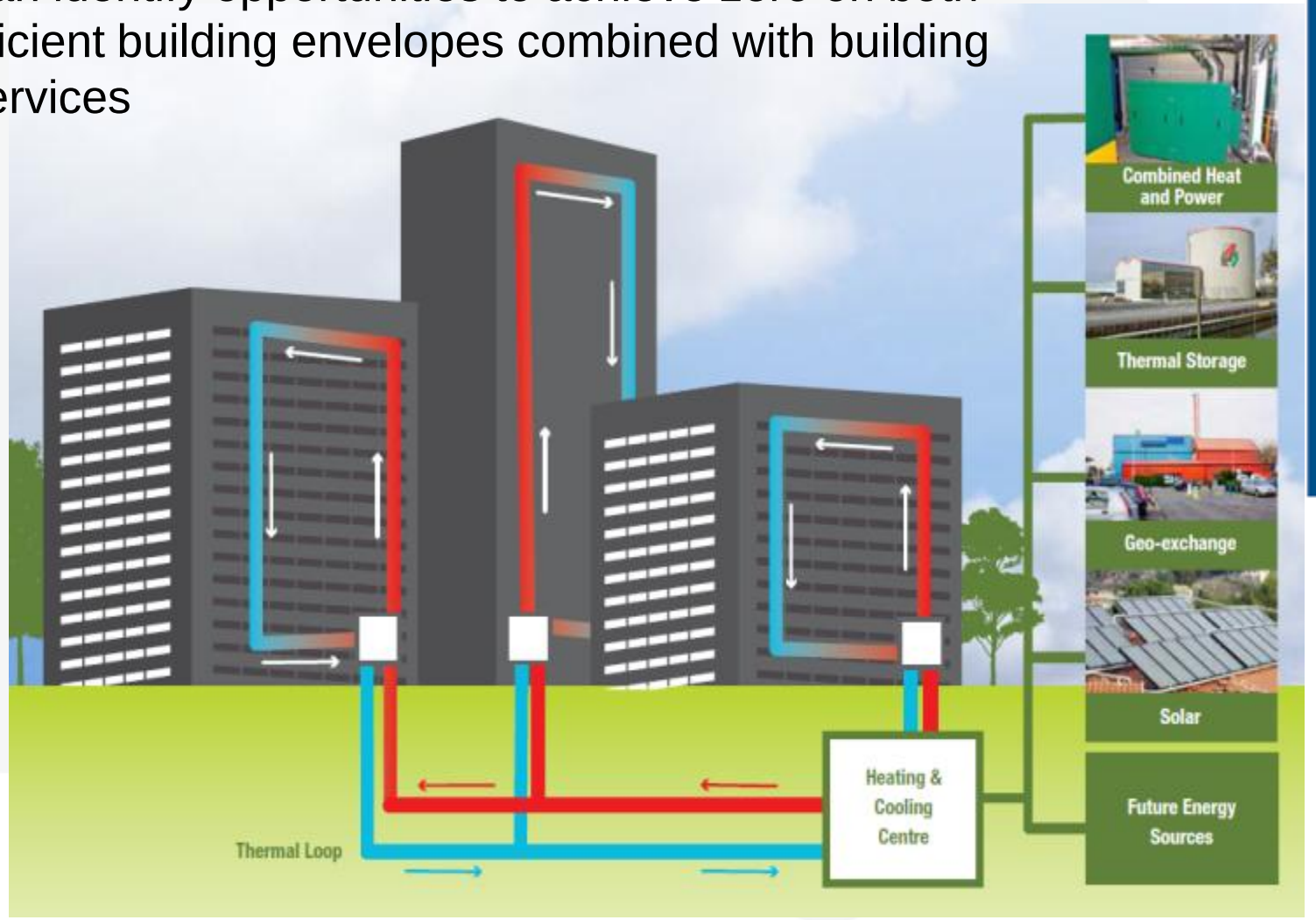


IMPLICATIONS: COMMUNITY ENERGY PLANNING

Community Energy Planning (CEP) can identify opportunities to achieve zero on both energy and emissions using super-efficient building envelopes combined with building scale renewables or shared energy services

Secondary Plans for Centres

- Energy conservation including peak demand reduction
- Resilience to power disruptions
- Small integrated energy solutions
  e.g. renewables, district energy & CHP
- Complete an Energy Strategy



www.toronto.ca/greendevelopment
www.toronto.ca/communityenergyplanning

Questions?