



Passive Survivability in Buildings

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2003 Black-Out



2012 Hurricane Sandy





2013 Ice Storm



2013 Rain Storm

BREAKING NEWS

**CP
24**

**COMMUTERS HAVE BEEN ON
THE TRAIN FOR 4 HOURS**

2016 Ice Storm





THE TOWERING INFERNO



DIGITALLY **THX** MASTERED
FOR SUPERIOR SOUND AND PICTURE QUALITY

DVD
VIDEO



Key Questions:

- What is our expectation of our homes, and how has multi-family living changed this?
- Is it really shelter if it fails when we need it most?
- Can resilience build value?

Toronto Green Standard Update

Regulatory and Incentive Framework for Green Buildings

- Update to become a world class standard
- Update to provide a road map to Zero Carbon Buildings. Directly address carbon.
- Add resilience as a new lens by which to view the building 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

HIGH RISE MULTI-FAMILY

Floor Area: 308,000 ft₂ (28,600 m₂)

Parking Floor Area: 35,500 ft₂ (3,300 m₂), ~80 spaces

Floors: 30 x 9ft (2.74m)

Schedules:

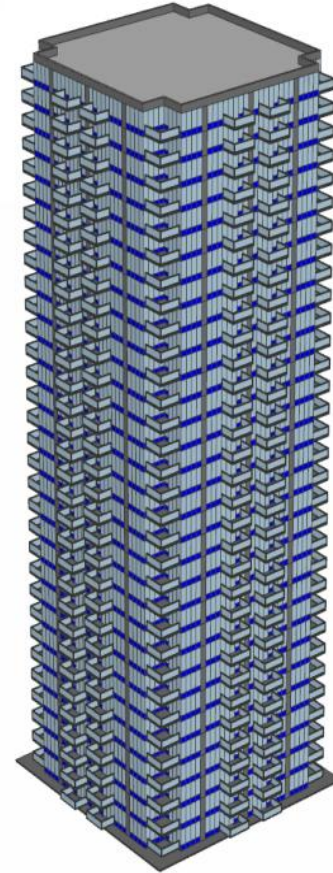
- NECB G Schedules for occupancy, lighting and plug loads
- Parking Ventilation 4h/day, heated to 5°C, 0.5W/cfm fans

Occupants: 755 people, 275 suites

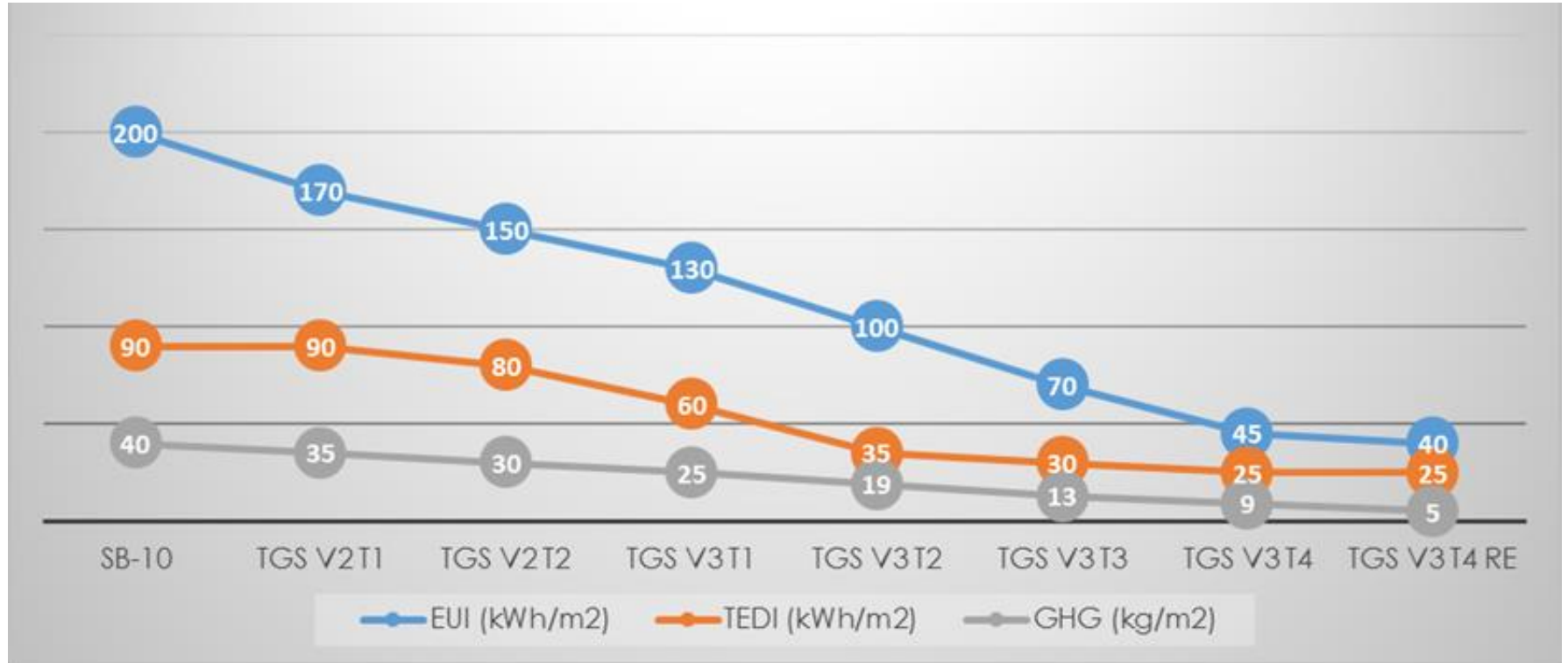
DHW Load: 0.0013 L/s/person peak flow (300 W/person)

Baseline:

- ASHRAE 90.1-2010 ECB Baseline Envelope, Lighting, and Fan and Pump performance per ASHRAE 90.1-2010 Appendix G



HIGH RISE MURB – TARGETS



MEETING THE TARGETS

TIER 2

- > R-10 walls
- Triple glazing
- In-suite HRV/ERV
- 40% WWR

TIER 3

- Triple glazing
- 40% WWR
- Improved air tightness
- Shift to heat pumps for portion of loads

TIER 4

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

BUILDING RESILIENCE

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

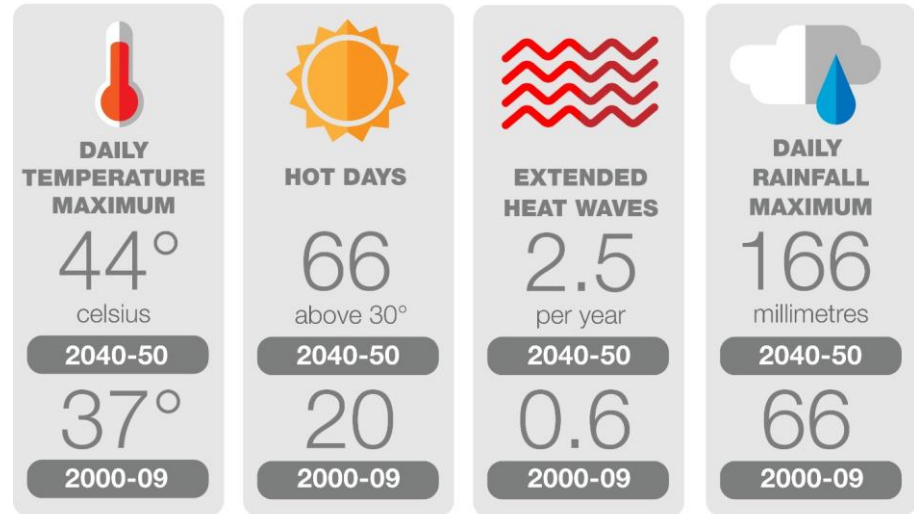


Flooding events

Extreme heat events

Power outages

Toronto's **Future Weather***



*Source: Toronto's Future Weather and Climate Driver Study, 2011

IMPROVING RESILIENCE

- **72 hour temperature low w/o power**

- Tier 1 – 13.5° C
- Tier 2 – 14.6° C
- Tier 3 – 17° C
- Tier 4 – 20° C

- **2 week temperature low w/o power**

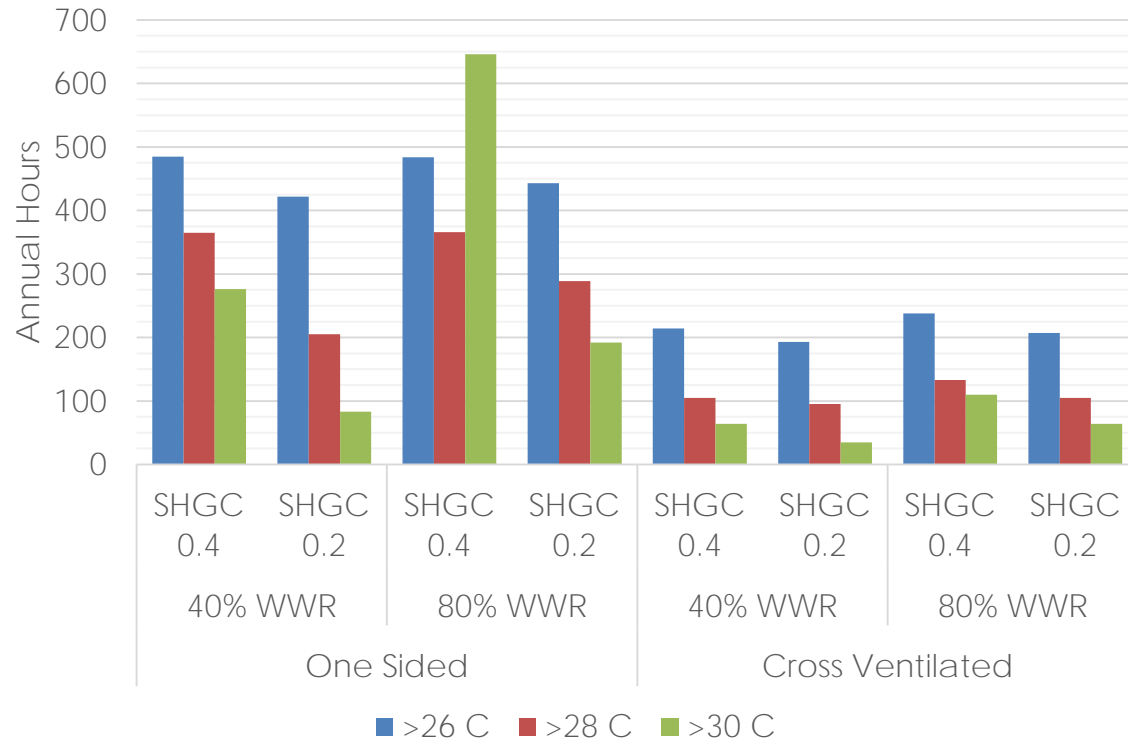
- Tier 1 – 5.8° C
- Tier 2 – 7.6° C
- Tier 3 – 14° C
- Tier 4 – 18.3° C

- **Emergency Fuel longevity (over baseline)**

- Tier 1 – 1.6x
- Tier 2 – 1.8x
- Tier 3 – 1.9x
- Tier 4 – 2.3x



SUMMER BLACKOUT COMFORT



Improved Back Up Power Requirements

- 72 hours of fuel storage
- Power to pumps, fans, Emergency lighting, Security systems
- Power to a common refuge area

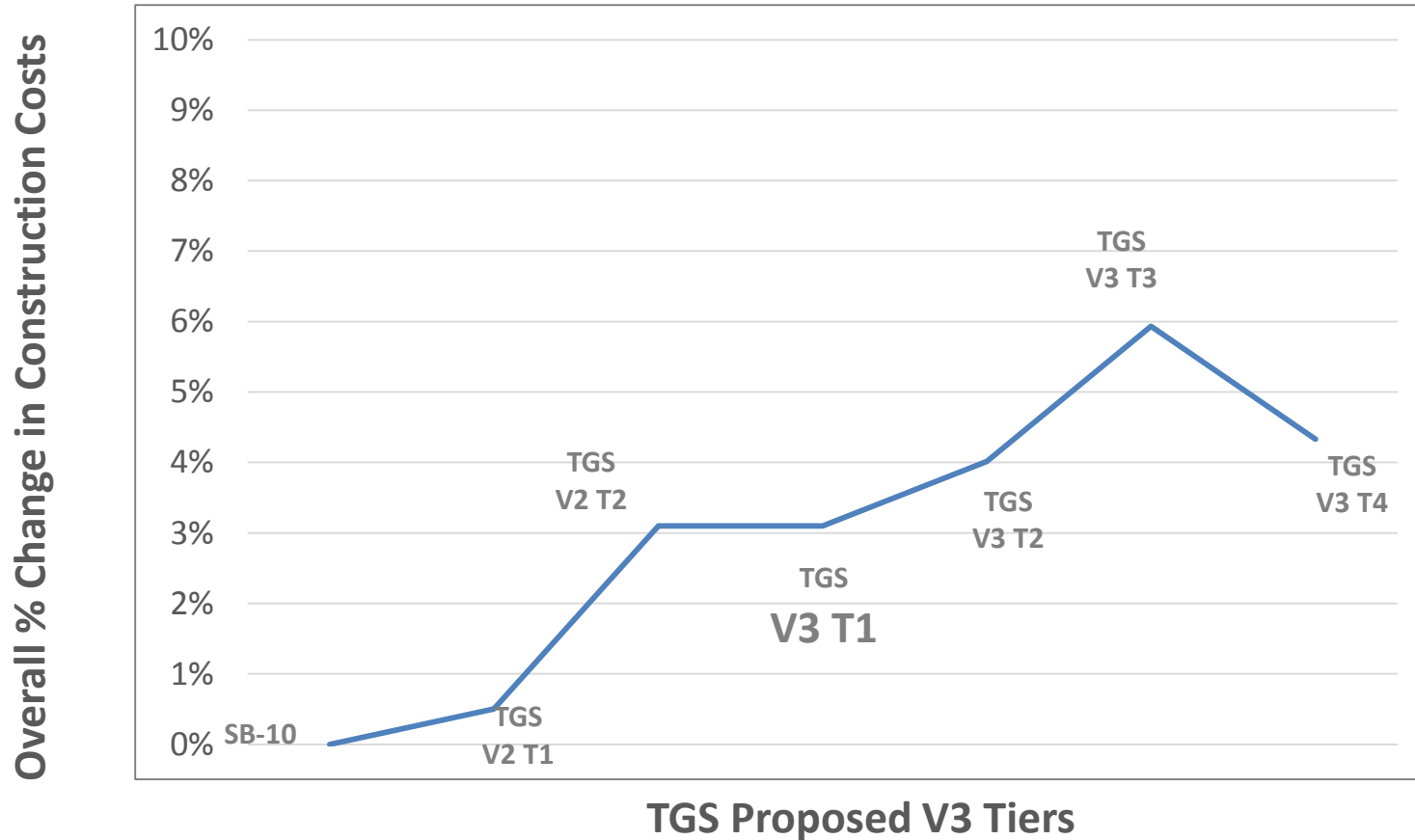


Resilience Check list

- Have you provided a refuge area?
- Deployable barriers for flooding
- Voluntary Back up power requirements
- Future Weather file testing
- Draft emergency action plan



HIGH RISE MURB – % CONSTRUCTION COSTS



The Future?

“Resilience without community development is just survivalism”

- Building “happier developments”
- Using social media to connect residents
- Setting buildings up for success





Thanks!

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