

An Innovative Approach to Retrofitting Multi-Unit Residential Buildings Using A Nested Thermal Envelope Design™ (NTED™)

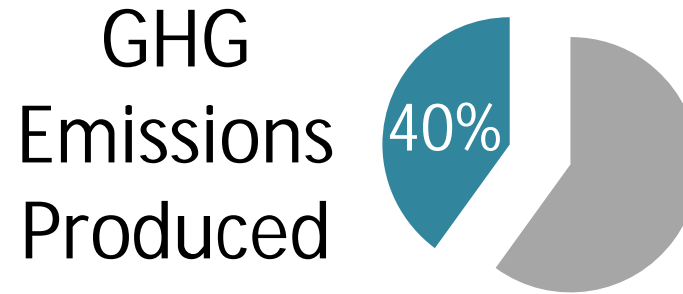
Marianne Touchie, Kim Pressnail,
Russell Richman & Erin Dixon

May 31st, 2011

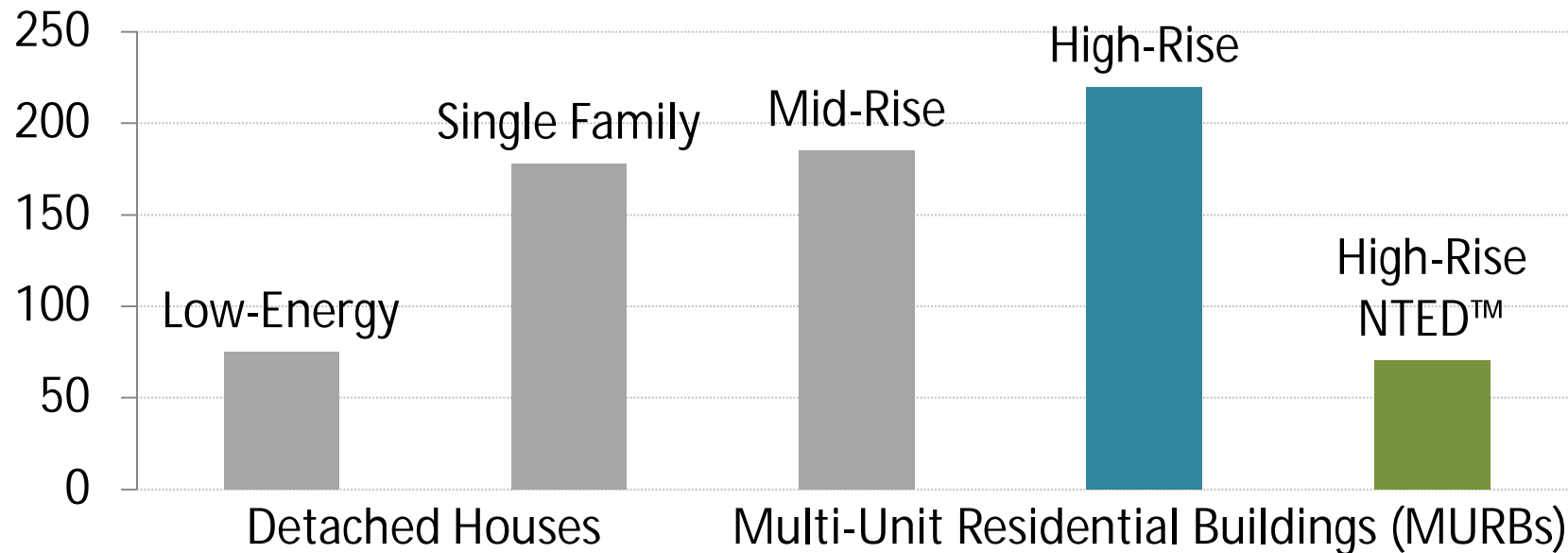
9th Nordic Symposium on Building Physics



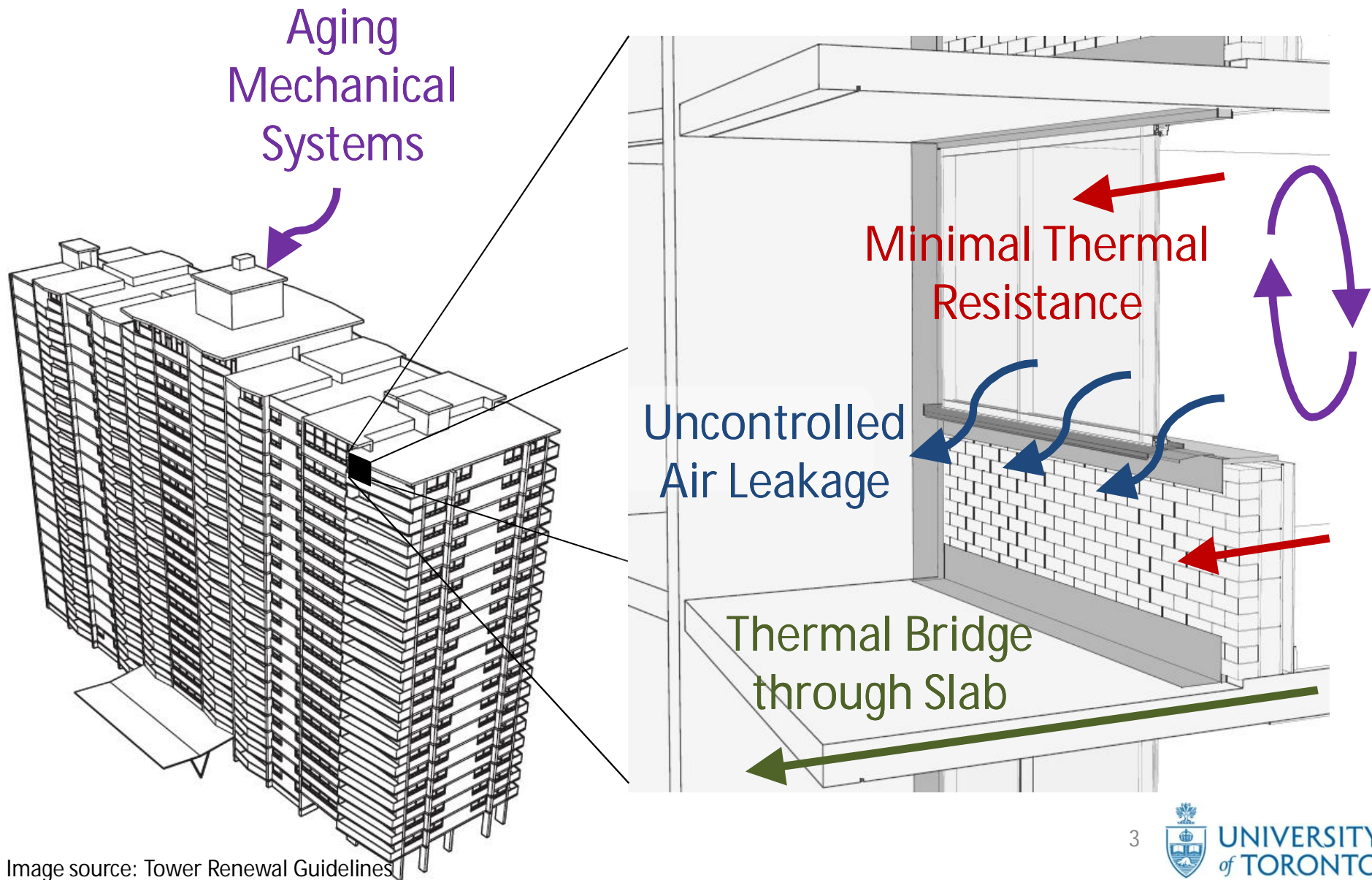
Post-War MURBs in Toronto, Canada



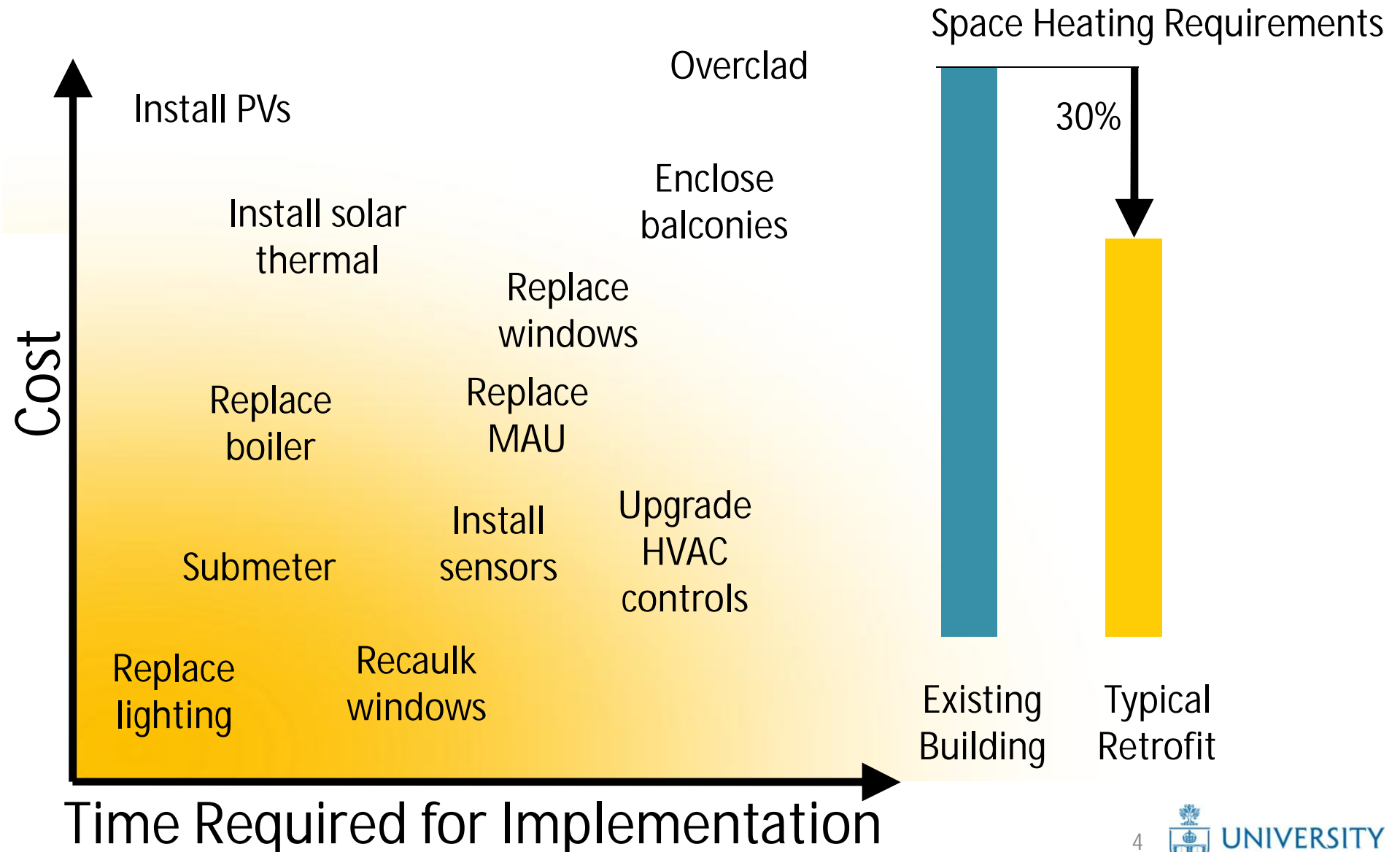
Annual Energy Consumption (kWh/m²)



Causes of Excessive Energy Use in MURBs

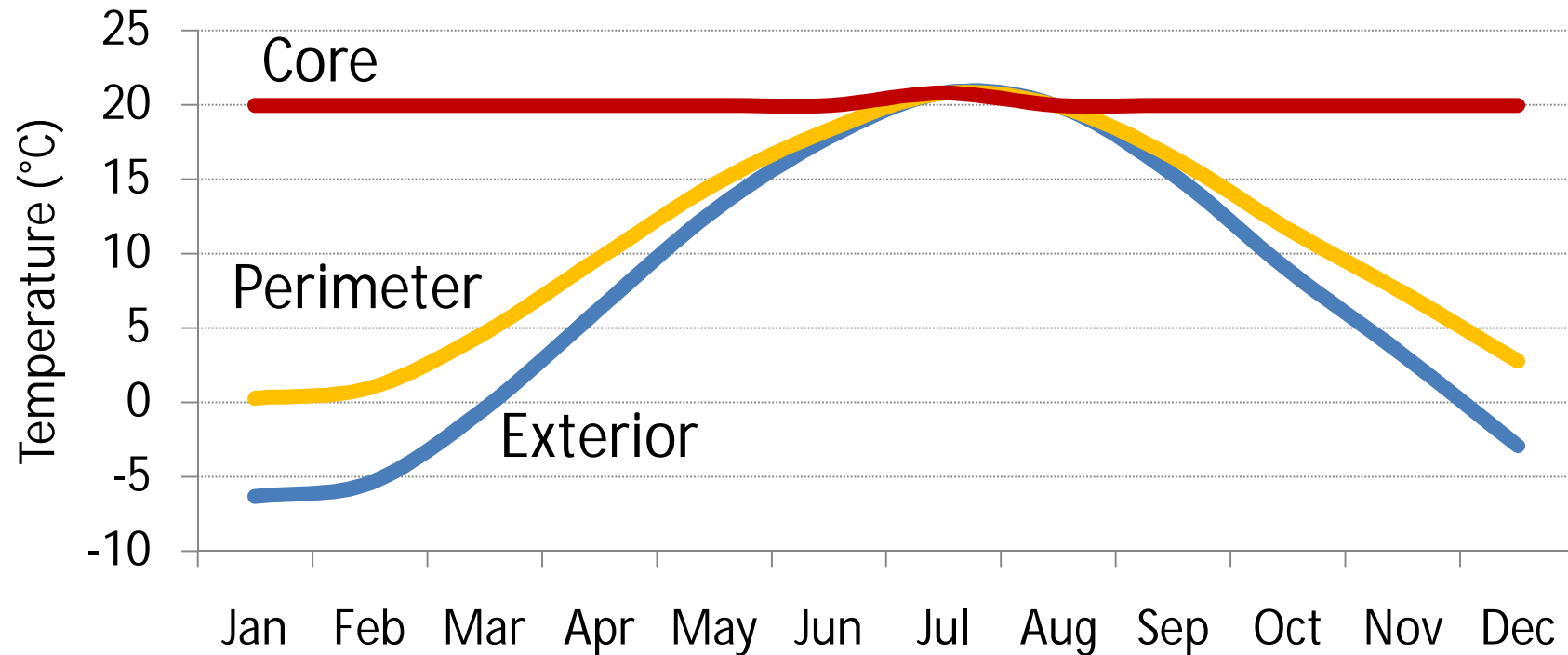


Current MURB Retrofit Solutions



Sources: Natural Resources Canada; Toronto Atmospheric Fund; Pressnail et al.

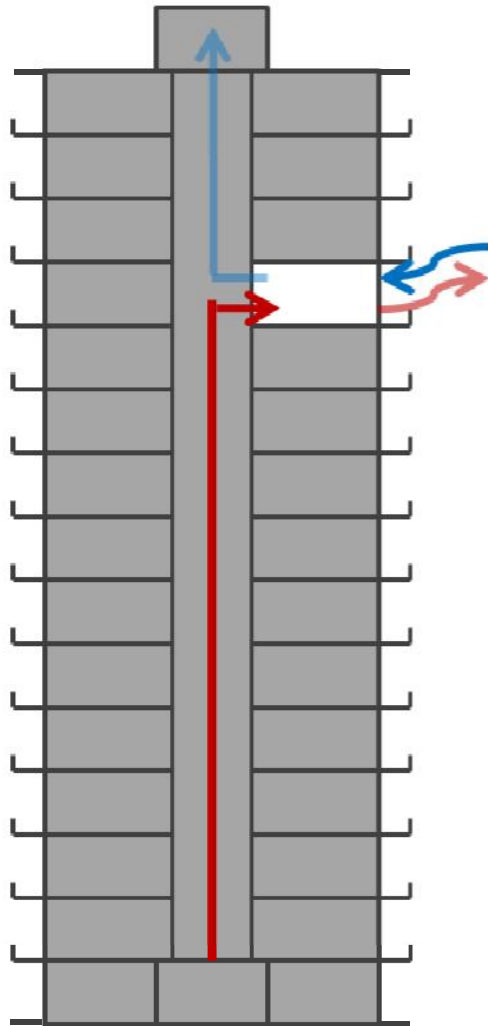
Nested Thermal Envelope Design™ (NTED™) Operation



Improves thermal comfort due to increased interior wall temperatures and improves the coefficient of performance of the heat pump

NTED™ in MURBs

Existing Building



Step 1:

Create the perimeter space by enclosing the balcony

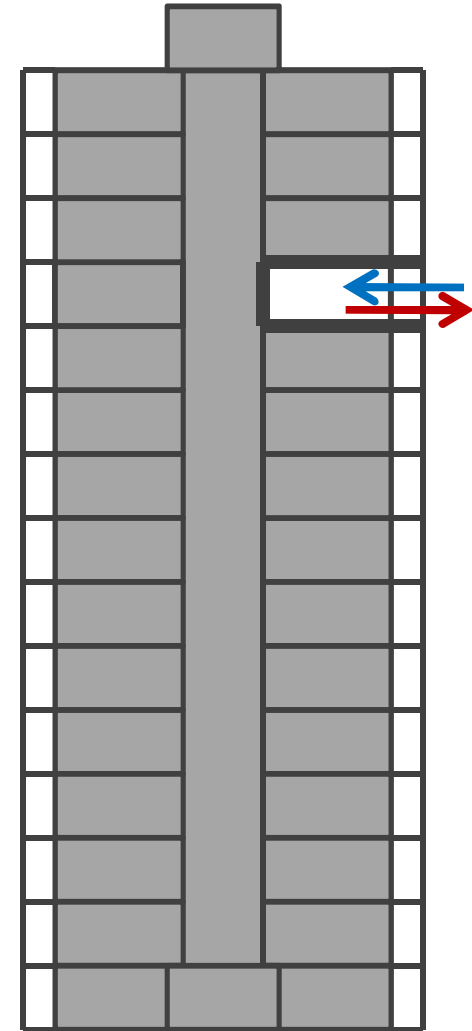
Step 2:

Air seal the suite to create the core space

Step 3:

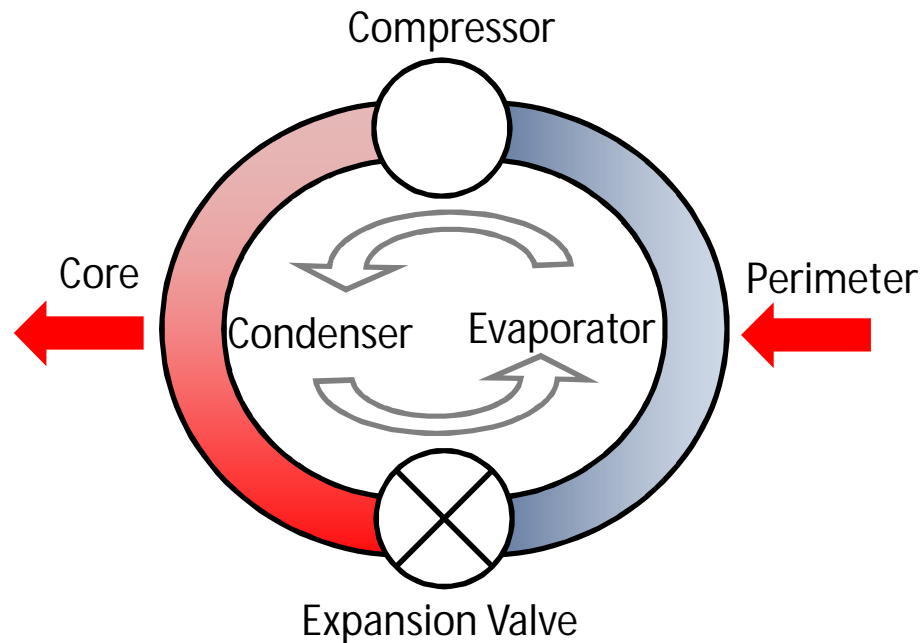
Install an interior heat pump between the core and perimeter

NTED™ Retrofit



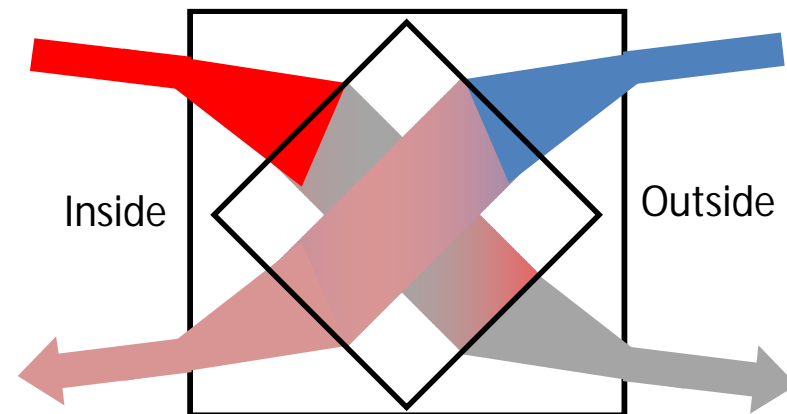
NTED™ Equipment

Heat Pump (HP)



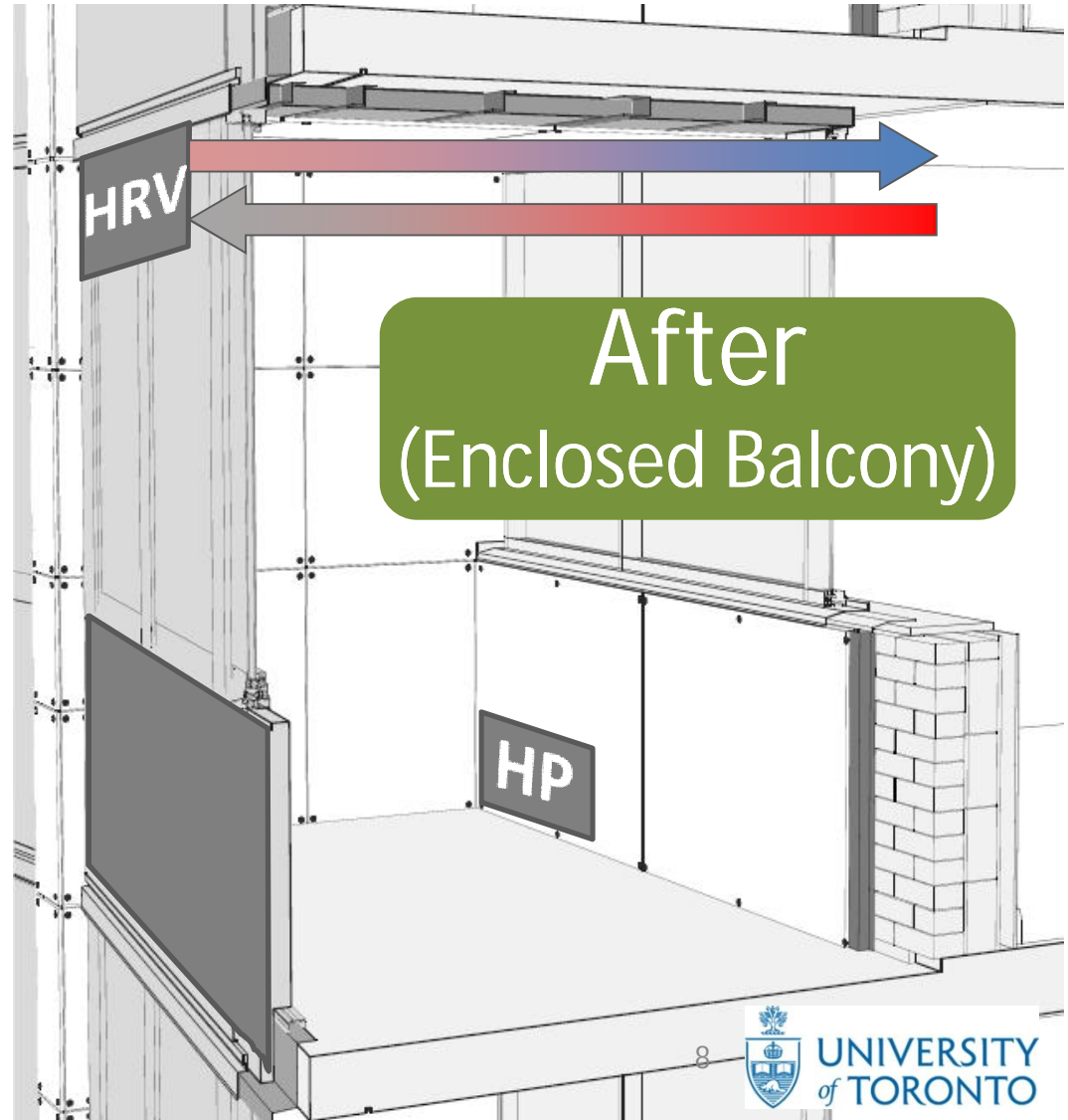
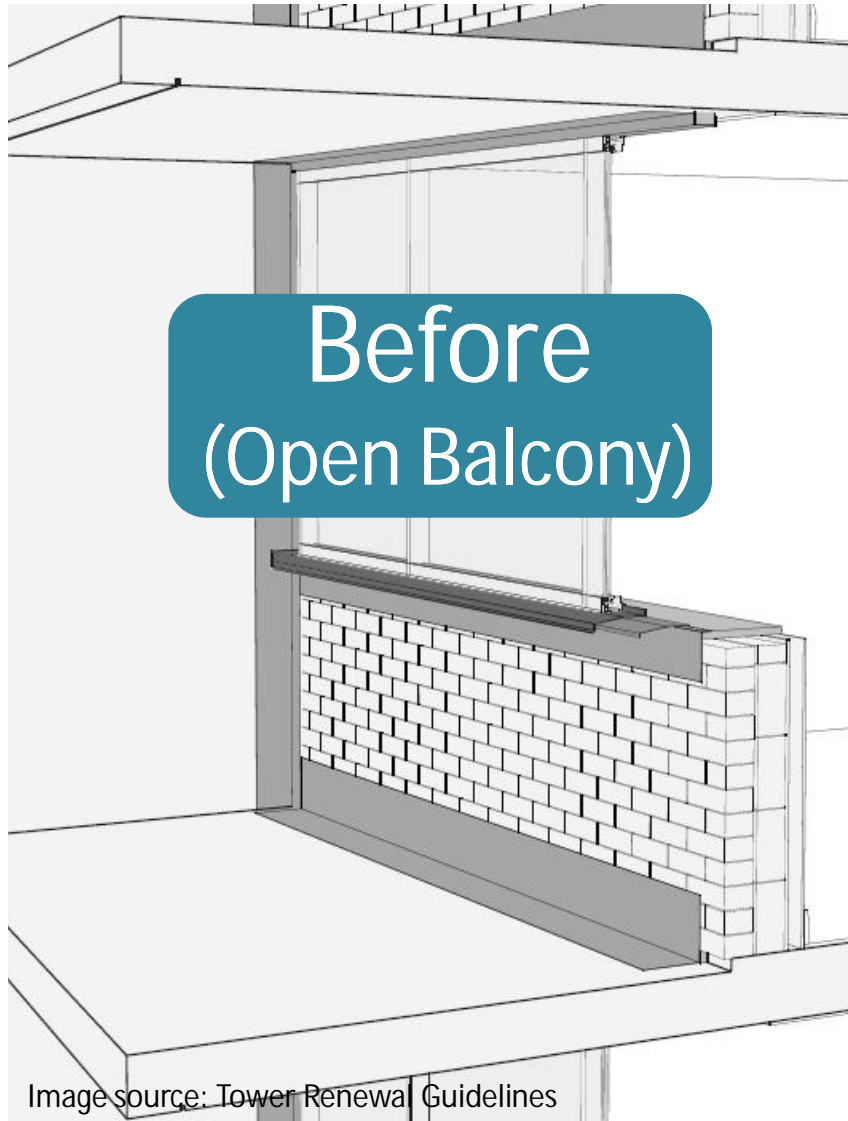
HP (COP \geq 3) to transfer core heat losses and perimeter solar gains back to the core

Heat Recovery Ventilator (HRV)

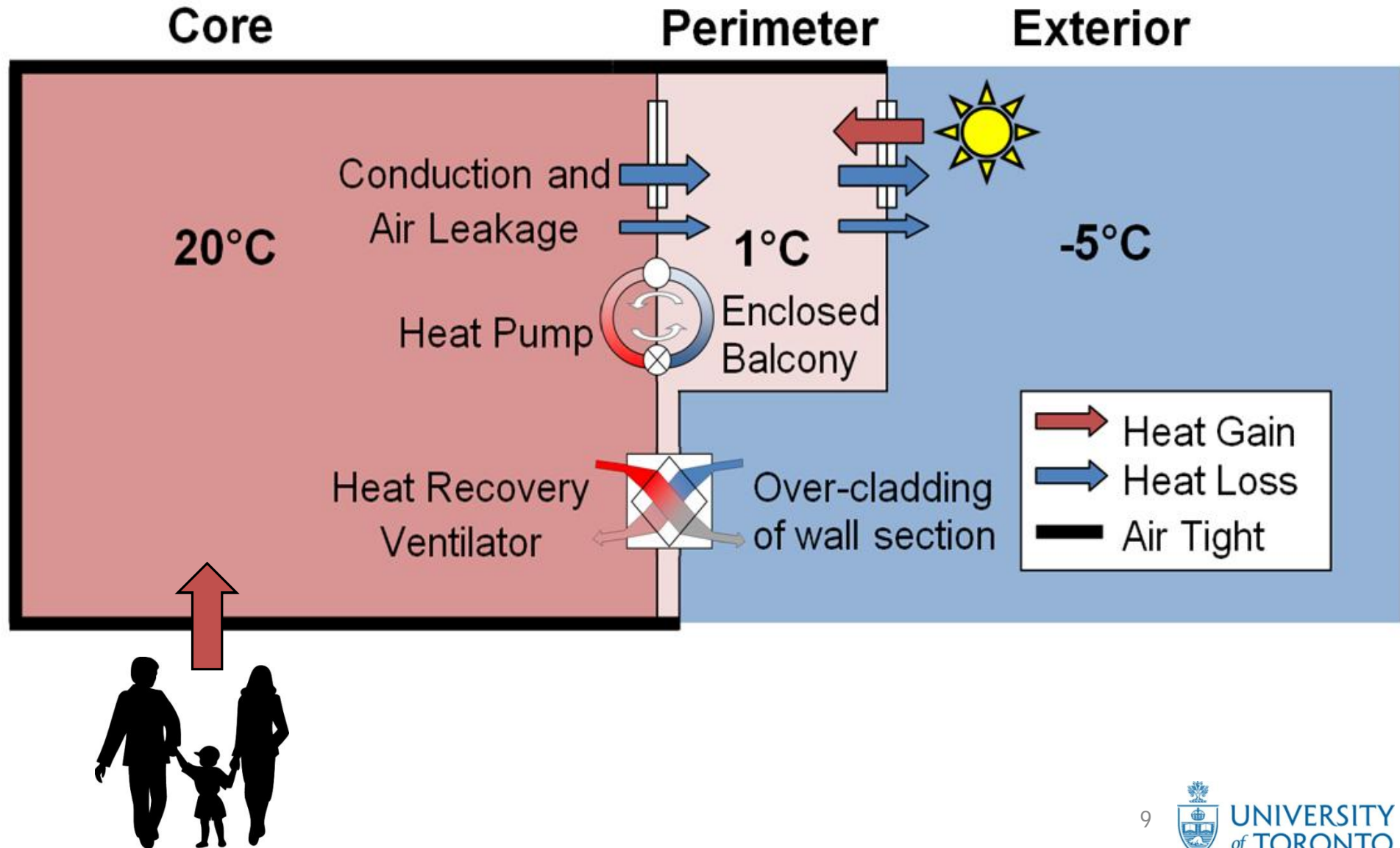


Demand-controlled ventilation provided by HRV and occupancy sensor

NTED™ Suite Retrofit

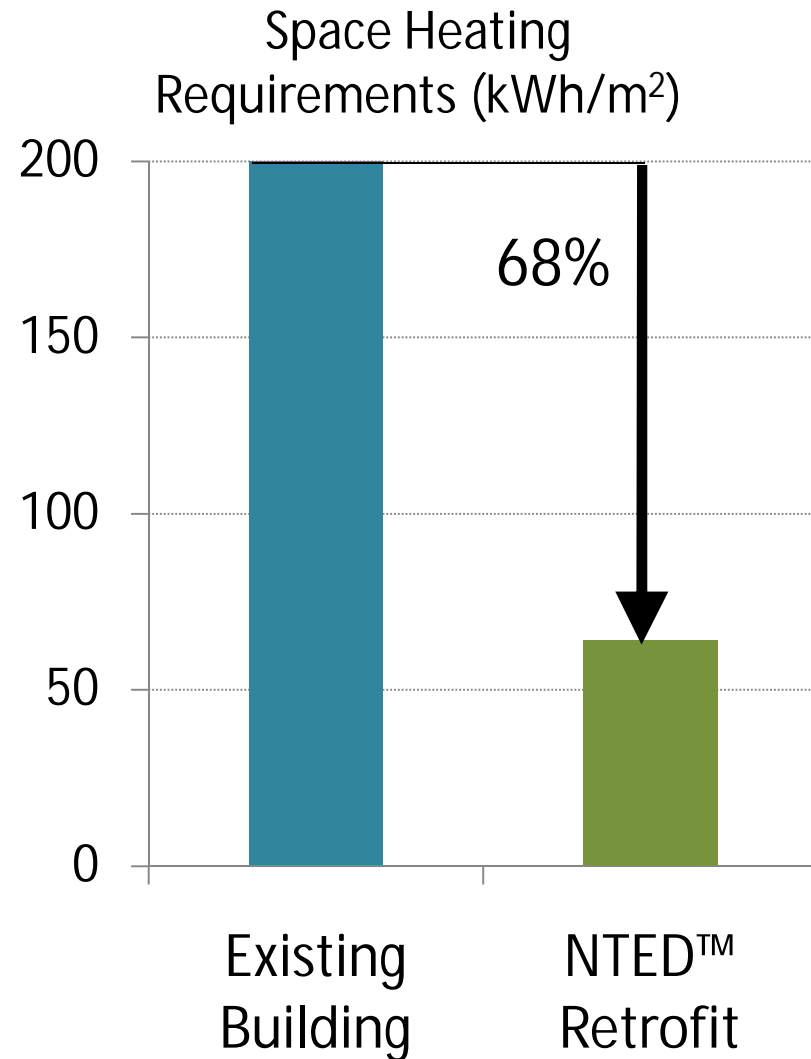


NTED™ Energy Transfer Summary



Preliminary Results

- EnergyPlus v4.0 model and 1D spreadsheet calculations
- Significant improvement in energy performance with application of NTED™
- Limitations: unit-level energy model without central HVAC system



Future Work

- Refine unit-level model to test variables including:
 - Fenestration-to-wall ratio of both envelopes
 - Suite orientation
 - Perimeter zone dimensions
 - Air-tightness and thermal resistance of each envelope
 - Cooling season effectiveness
- Develop a whole-building model to determine the effect of transitioning from central equipment to unit-level equipment.
- Lab Testing: Test a scale mock-up of the optimal arrangement in the lab to verify the energy and moisture modelling
- Prototype Testing: Develop a prototype for application in an occupied building and set up a monitoring program to verify energy savings

References

CMHC. *Healthy High-Rise: A Guide to Innovation in the Design and Construction of High-Rise Residential Buildings*. Canada Mortgage and Housing Corporation. (2001)

Kesik, T. and Saleff, I., 2009. *Tower renewal guidelines*. Toronto: University of Toronto.

Natural Resources Canada. 2008. *Comprehensive Energy Use Database Tables*. [Online]. Available: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends_res_on.cfm

Pressnail, K.D., Richman, R. and Kirsh, A.M., 2009. An innovative approach to low-energy building performance using nested thermal envelopes. In: National Building Envelope Council, *12th Canadian conference on building science and technology*. Montreal, Canada. 6-8 May 2009.

Thank you for your attention!