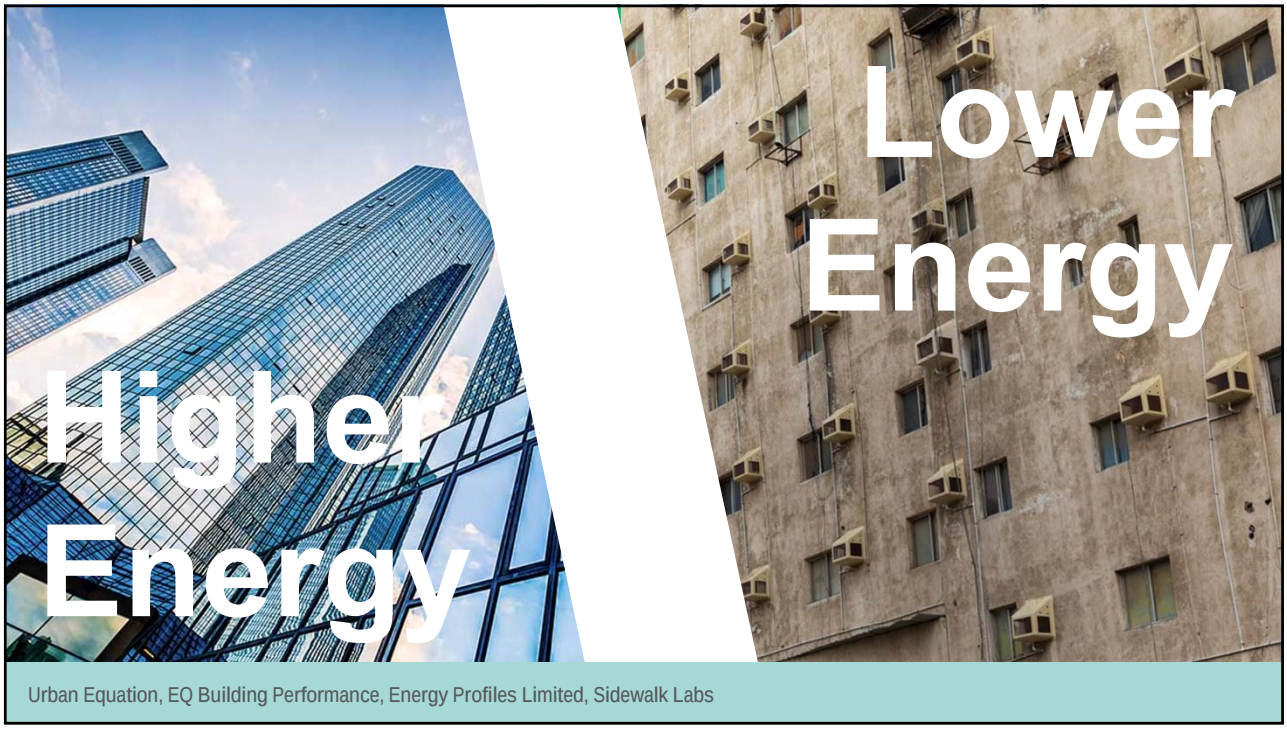
Diagnosing the Performance Gap
Between Design and Operational Energy Use

Getting to Zero Forum
October 10, 2019

Authored By:
URBAN EQUATION | EQ BUILDING PERFORMANCE

Commissioned By:
SIDEWALK LABS

Urban Equation, EQ Building Performance, Energy Profiles Limited, Sidewalk Labs



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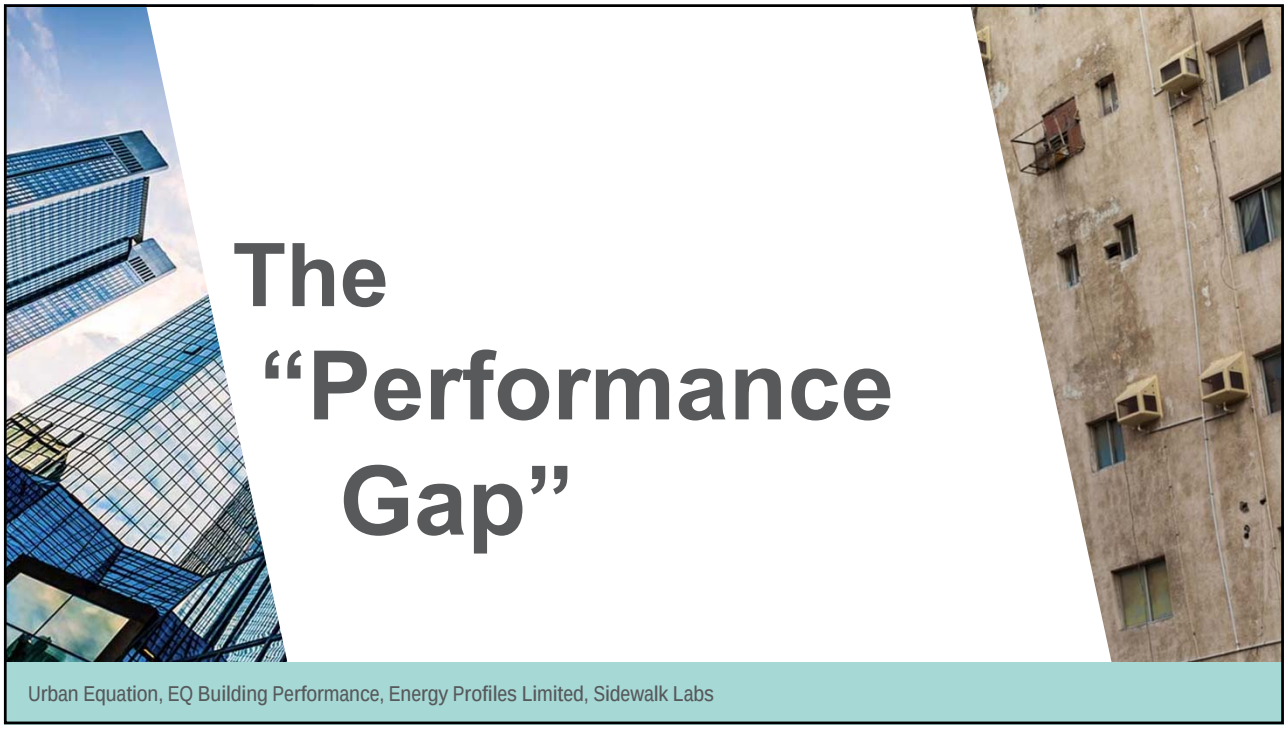

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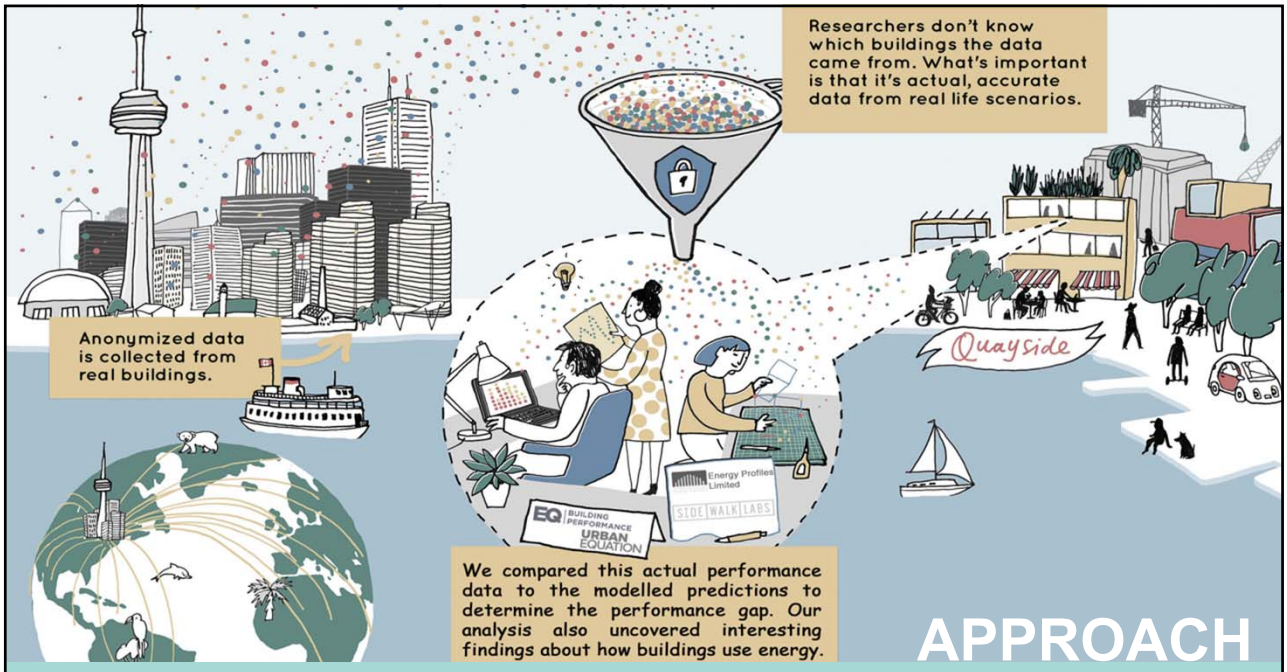

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A QUICK LOOK AT OUR DATA – Multi-Unit Residential.

Design Models
95 BUILDINGS

Utility Bills
43 BUILDINGS

Modelled & Metered Data
19 BUILDINGS

End Use Meters and Models
6 BUILDINGS

Suite Level Meters
83 BUILDINGS

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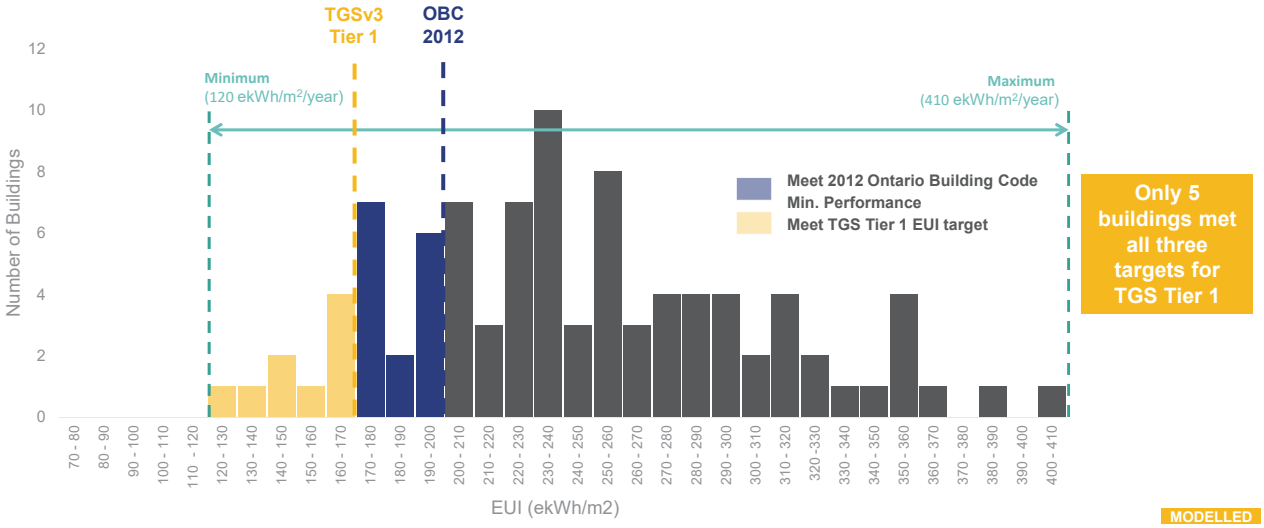
RECENT MODELLED PERFORMANCE OF DESIGN STAGE MURBS IN TORONTO



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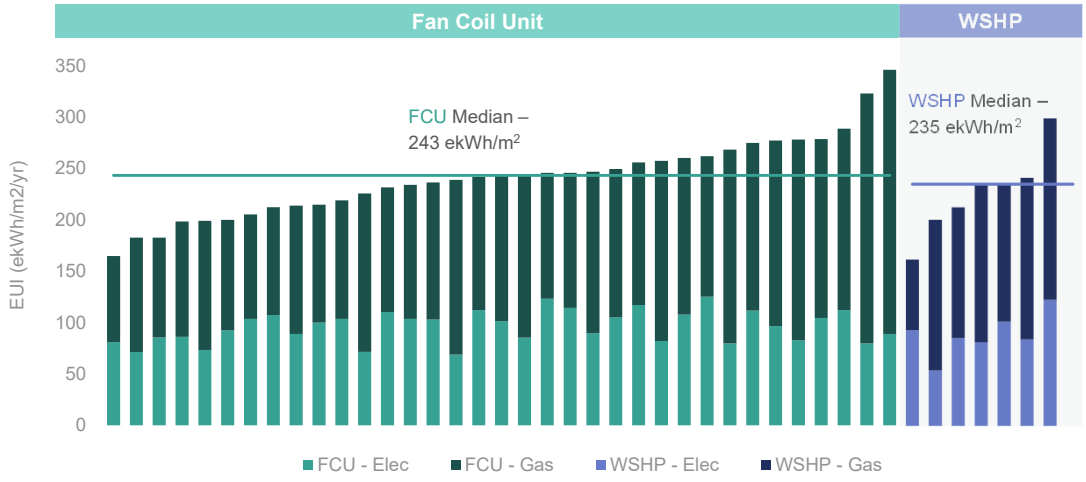
/ 8

ENERGY USE INTENSITIES PER METERED DATA FROM BUILDINGS BUILT BETWEEN 1995 AND 2015.

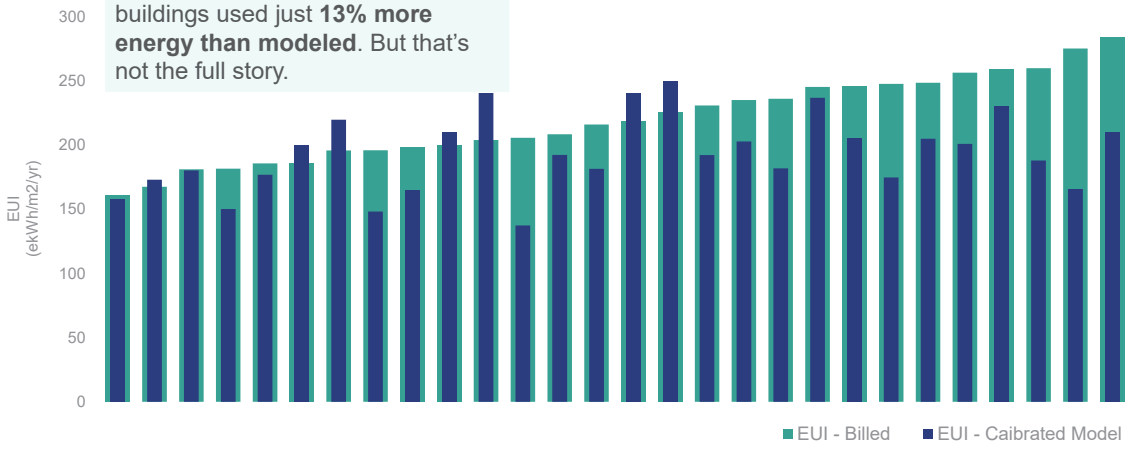


FCU – Fan Coil Unit **WSHP** – Water Source Heat Pump

METERED

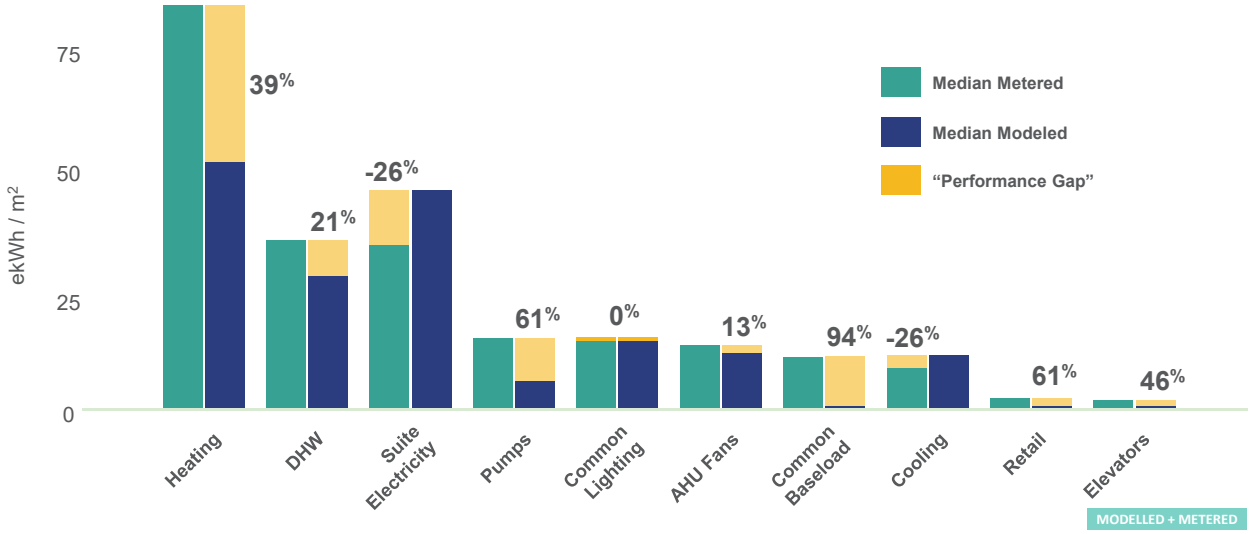
COMPARING METERED ENERGY USE INTENSITY AGAINST CALIBRATED ENERGY MODELS

On average, the studied multifamily buildings used just **13% more energy than modeled**. But that's not the full story.



MODELLED + METERED

PERFORMANCE GAP BY END USE – METERED VS. MODELLED ENERGY USAGE.



MODELLED + METERED

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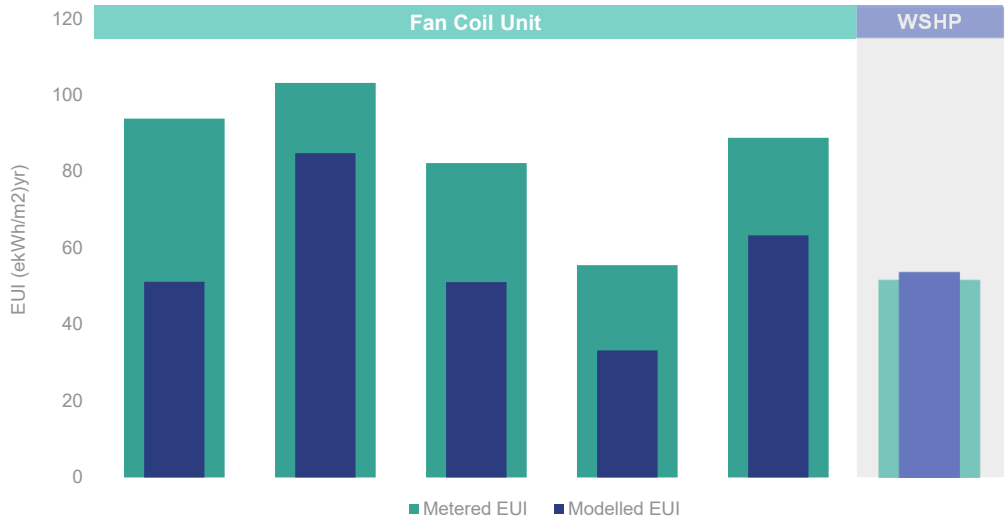
PERFORMANCE GAP - SPACE HEATING.

Modelled gas usage for space heating is 39% lower than metered performance



MODELLED + METERED

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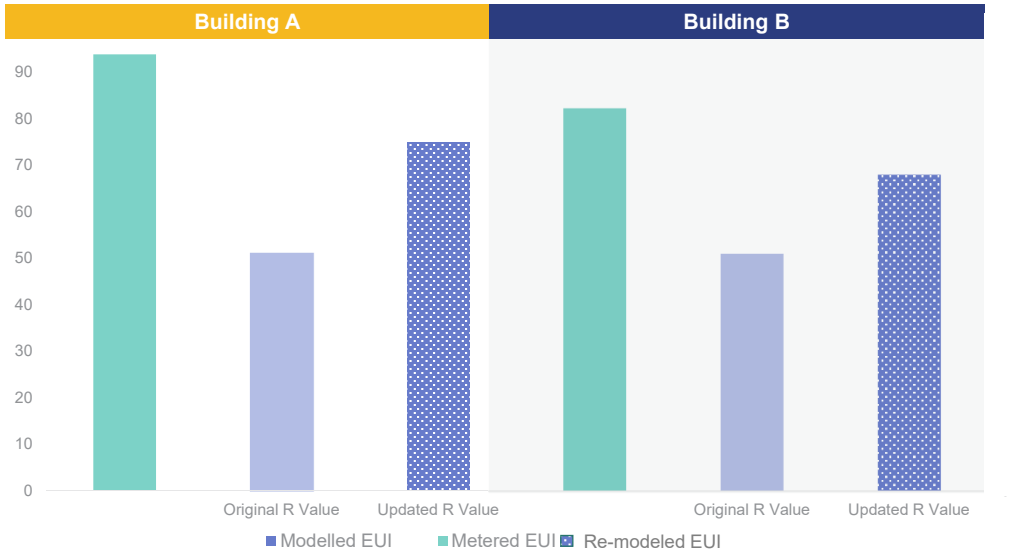
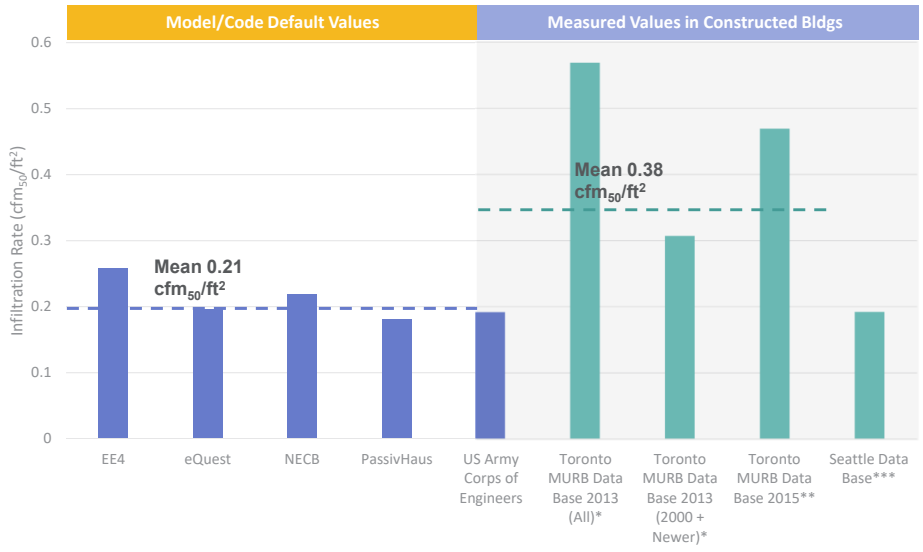
SPACE HEATING – EFFECTS OF THERMAL BRIDGING.



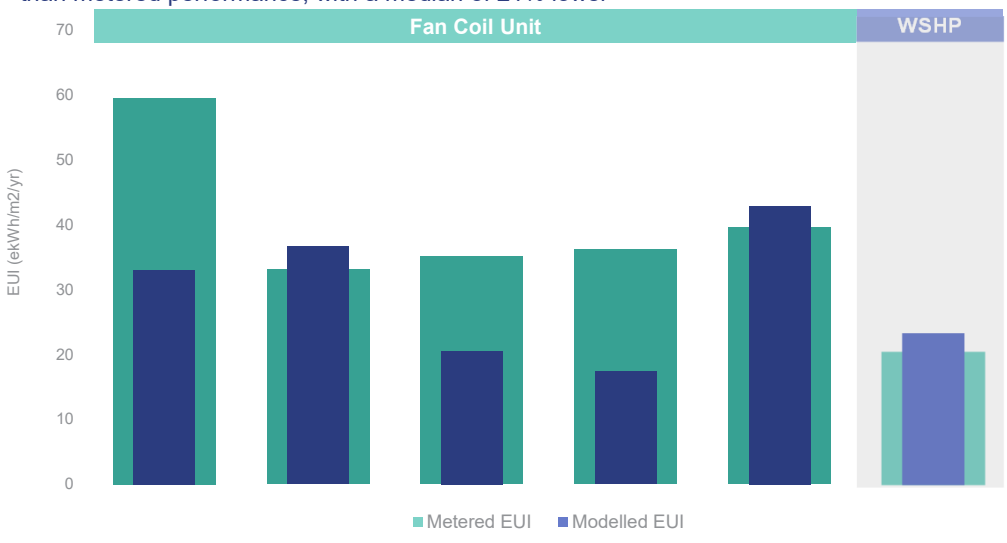
MODELLED + METERED

SPACE HEATING – INFILTRATION.



PERFORMANCE GAP – DOMESTIC HOT WATER.

Modelled gas usage for domestic hot water production varied from 44% lower to 14% higher than metered performance, with a median of 21% lower



MODELLED + METERED

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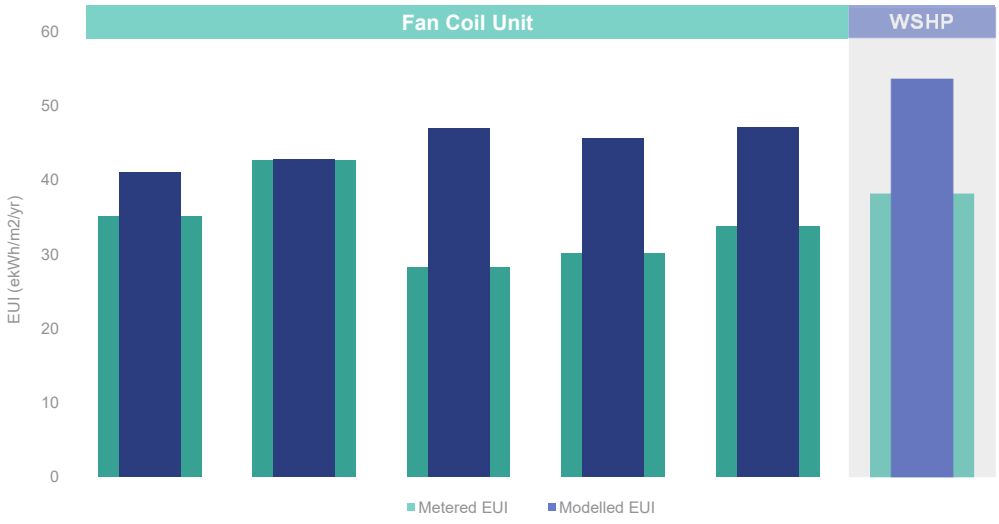
/ 15

PERFORMANCE GAP – IN-SUITE ELECTRICITY.

Modelled in-suite electricity usage is 26% higher than metered performance



MODELLED + METERED

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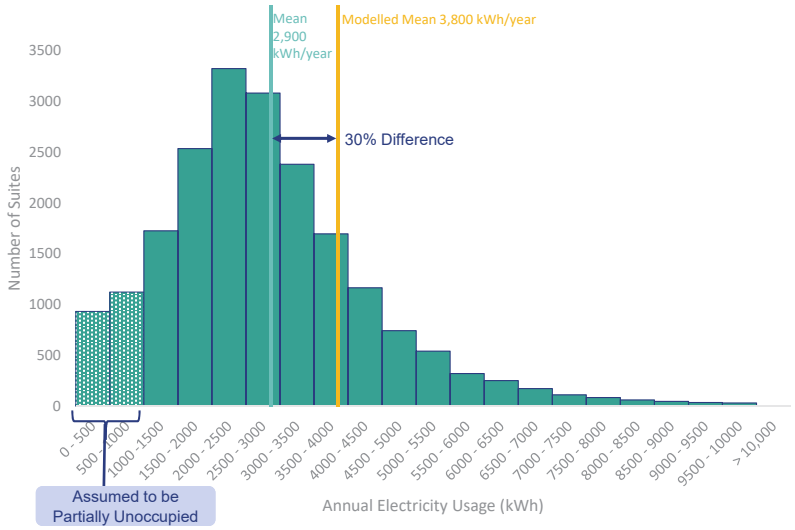
/ 16

IN-SUITE ELECTRICITY – AGGREGATE DATA.

Data pulled from 80 Toronto MURBs, constructed between 2000-2015, shows actual suite electricity is lower than modeled.



MODELLING PRACTICES

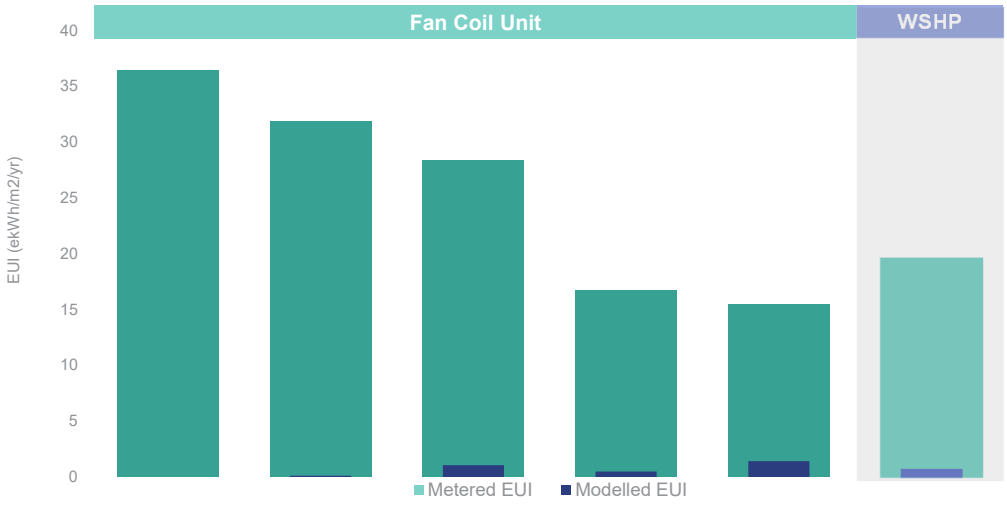
Models assume default power densities, expressed per area of floor space, and default usage schedules.

Current code requirements use default power densities from 1997.

MODELLED + METERED

PERFORMANCE GAP – MISC COMMON AREA ELECTRICITY.

Modelled common area electricity usage is 94% lower than metered performance



MODELLED + METERED

MULTI UNIT RESIDENTIAL- KEY FINDINGS

1. Only 5% of Toronto MURB projects in design and construction would meet TGSv3, Tier 1

2. Toronto MURBs use **13% more energy** and emit **28% more GHG emissions** than predicted by modelling.

3. Bigger gaps by end use:
   - Space Heating- + 39%
   - Domestic Hot Water +21%
   - Baseload Electricity +94%
   - Suite Electricity -26%

Managing the Performance Gap

Outcome-Based Code with dynamic targets normalized by **building occupancy, weather** and **tenant energy use**

Dynamic building control to reflect **actual** and **predicted occupancy, weather** and **tenant feedback**

Dynamic and responsive tenant space control that includes plug loads and thermostats

Smart home control that learns **tenant preferences** and **responds to price**

Tool to enable Outcome Based Energy Codes

A real time normalization of Toronto Green Standard or Passive House-like energy and GHG-intensity budgets based upon:

- **Building occupancy**
- **Weather**
- **Productive tenant energy use**

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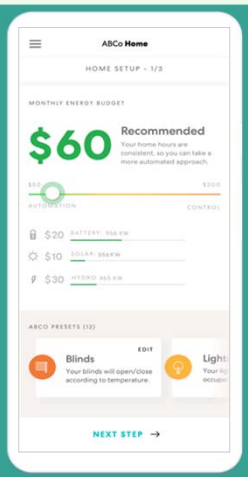
Autonomous Building tools to weed out the electricity use no one cares about or that actually degrades comfort, like overheating and air-conditioning



Home Scheduler - automation to provide a predictable utility bill

Urban Equation, EQ Building Performance, Energy Profiles Limited, Sidewalk Labs

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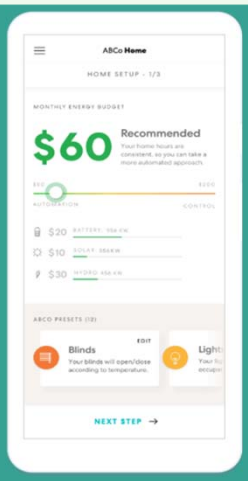

Home Scheduler - automation to provide a predictable utility bill

Office Scheduler - automation to enhance comfort and eliminate energy waste

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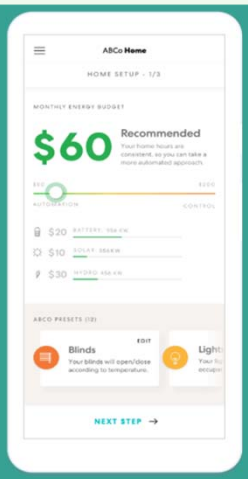

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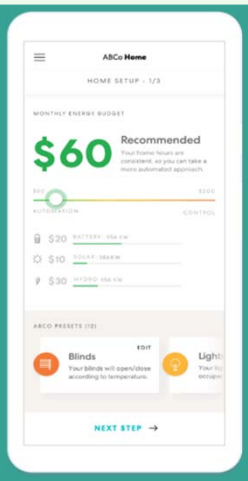

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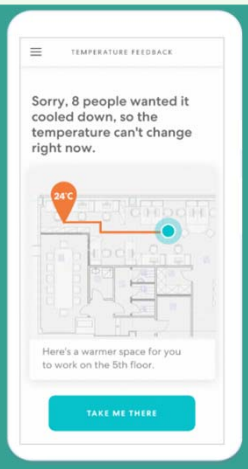

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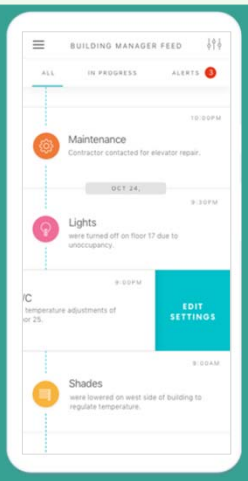

Building Operator Scheduler - dynamic building control that responds to tenants

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QUESTIONS?

Contact Information

Craig McIntyre
President
EQ Building Performance
cmcintyre@eqbuilding.com

Jenny McMinn
Managing Director
Urban Equation
jenny.mcminn@urbanequation.ca