



# Using data to make real estate decisions

Dr. Guy Newsham, Dr. Weiming Shen and colleagues  
NRC - Construction

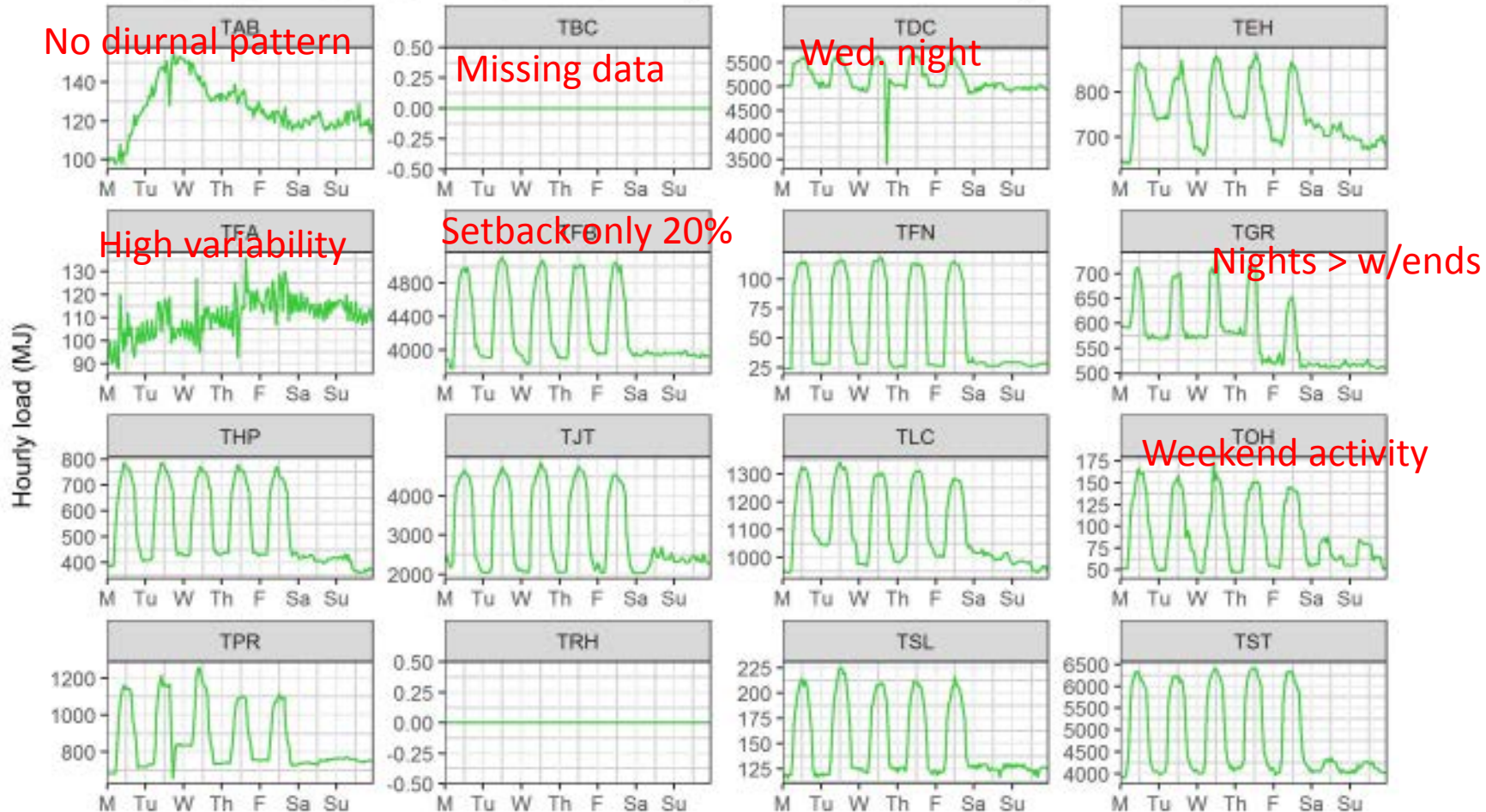
# Energy Analytics

- › Uses for portfolio-wide energy and BAS data in optimizing building operations:
  - Benchmarking
  - Fault Detection
  - Energy Anomalies
  - Forecasting
  - M&V of energy retrofits
- › Archival and (close to) real-time applications
- › Monthly, daily, hourly aggregation and applications
- › Scalability (100+ buildings, 5 CHCPs)

# Energy Anomalies

1 week of hourly data  
16 buildings on same  
campus

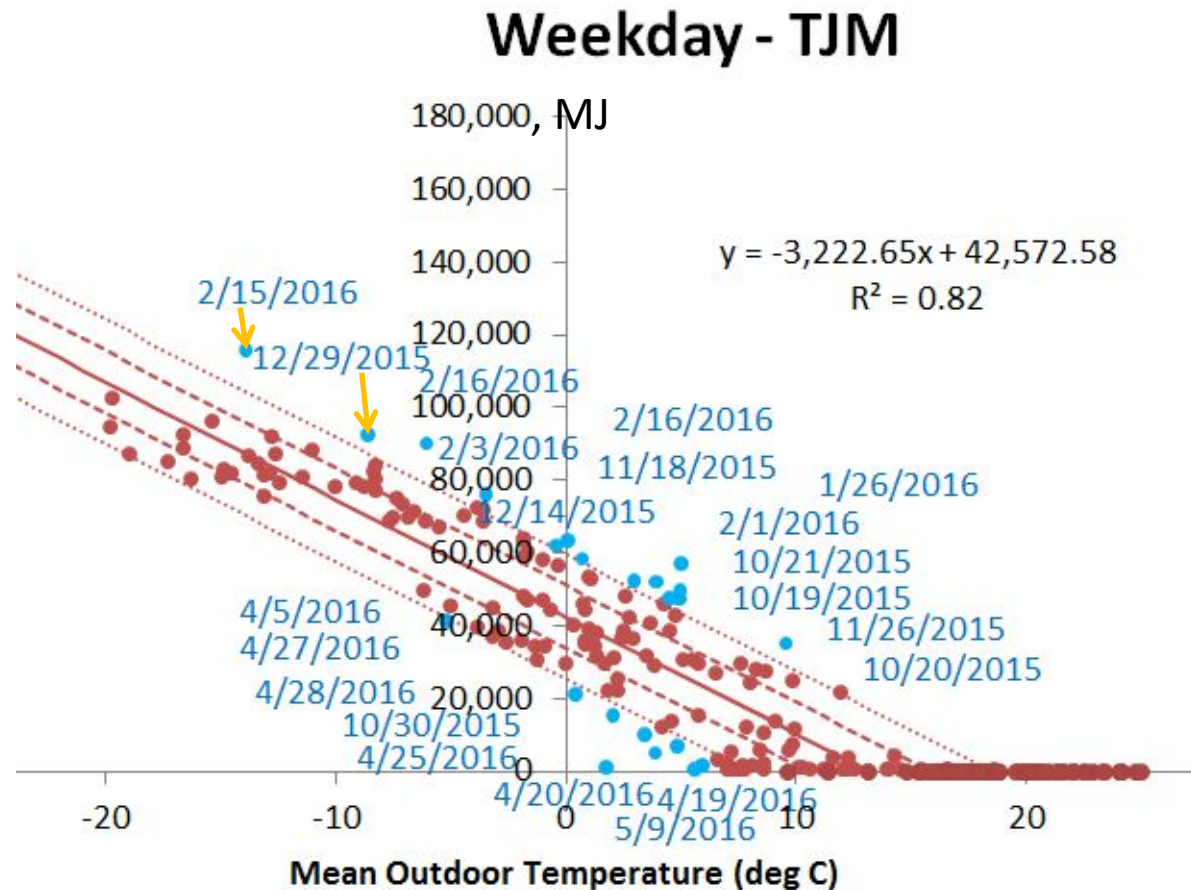
ELECTRICITY CONSUMPTION PROFILE (2016-01-18~2016-01-24)



Similar observations for steam, CHW

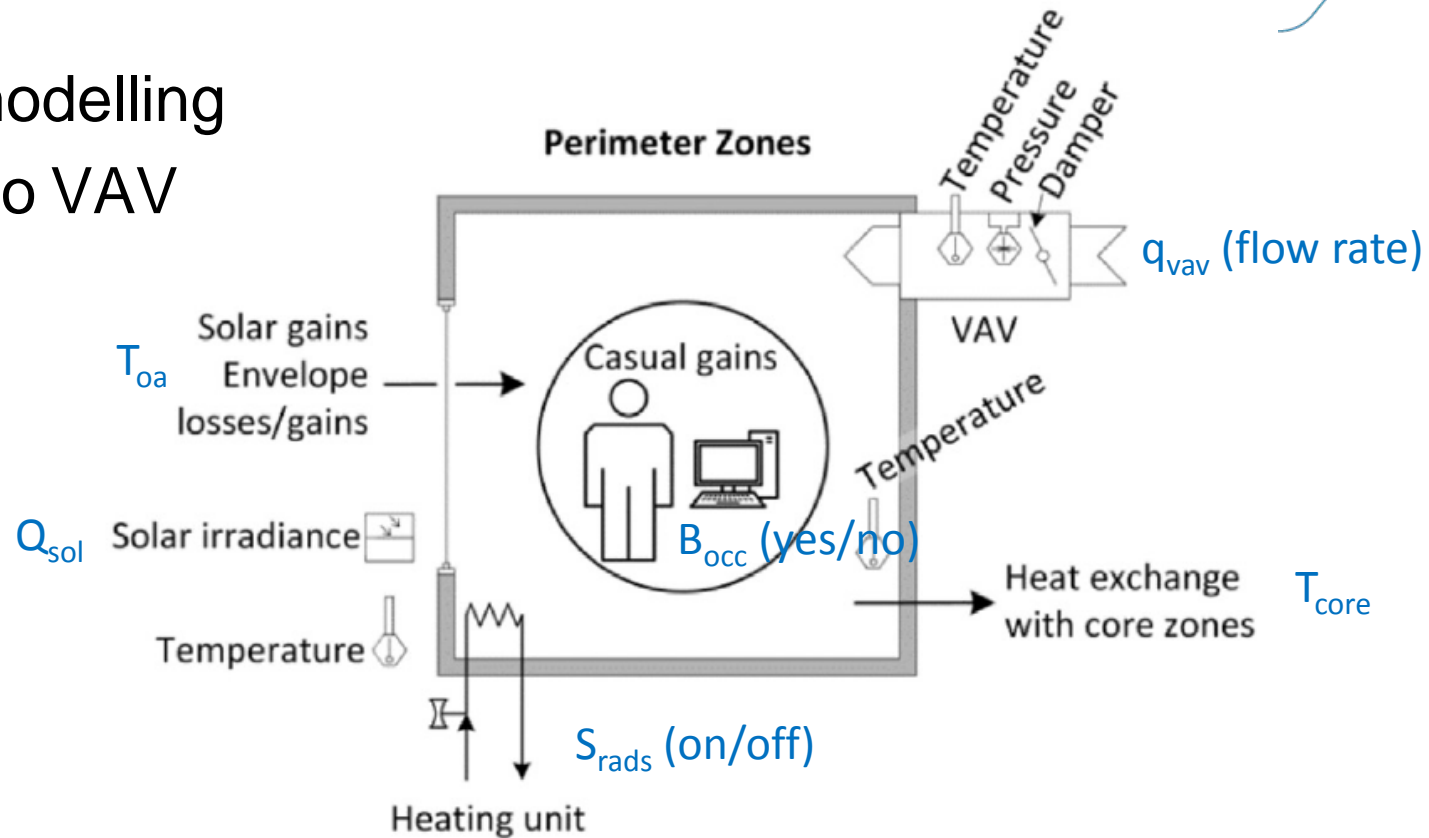
# Energy Anomalies

- Daily steam use
- 1 building, 1 year
- High slope might indicate envelope issues



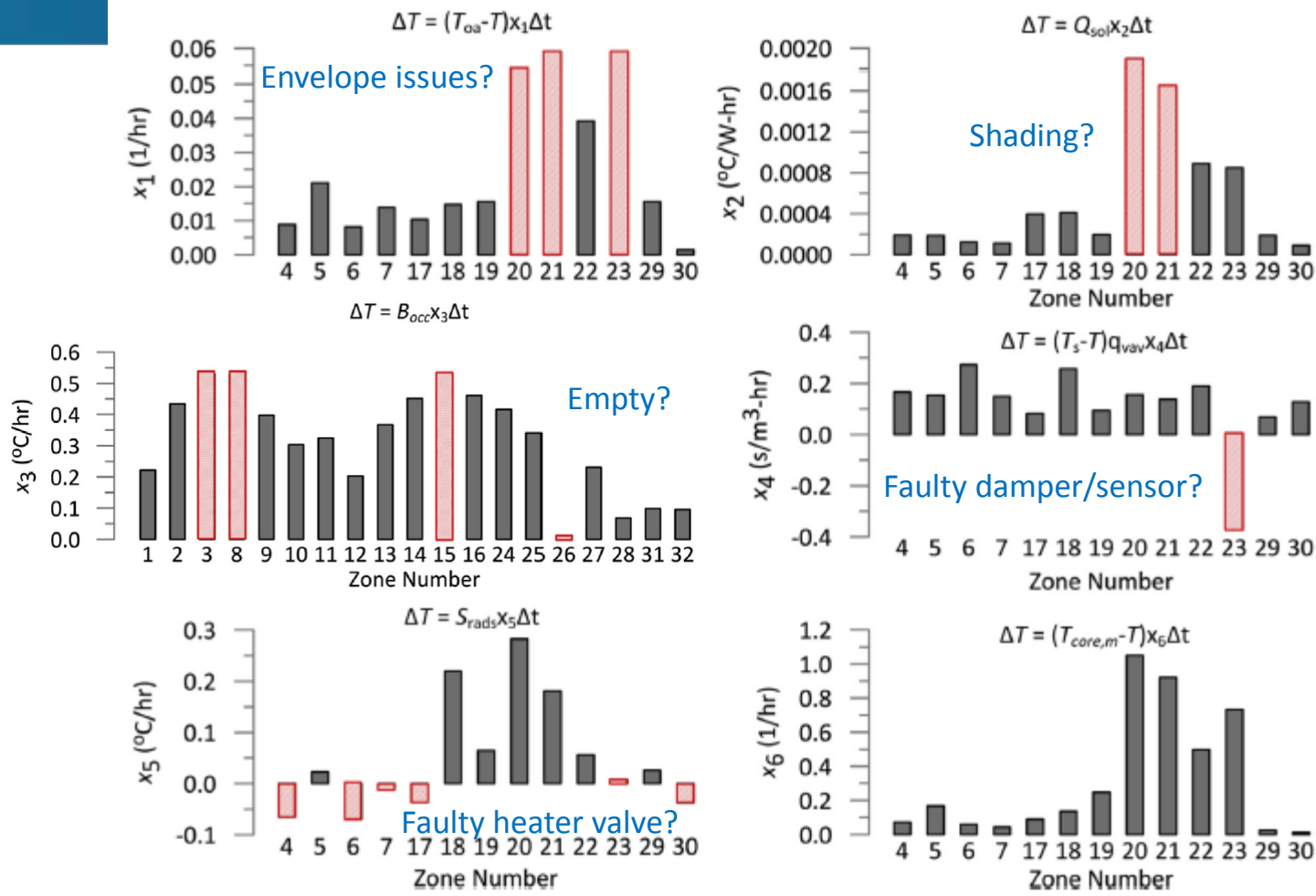
# Utilizing BAS data

- Grey-box modelling
- From AHU to VAV (zone level)



$$\dot{T} = T + (T_{oa} - T)x_1 + Q_{sol}x_2 + B_{occ}x_3 + (T_s - T)q_{vav}x_4 + S_{rads}x_5 + (T_{core,m} - T)x_6$$

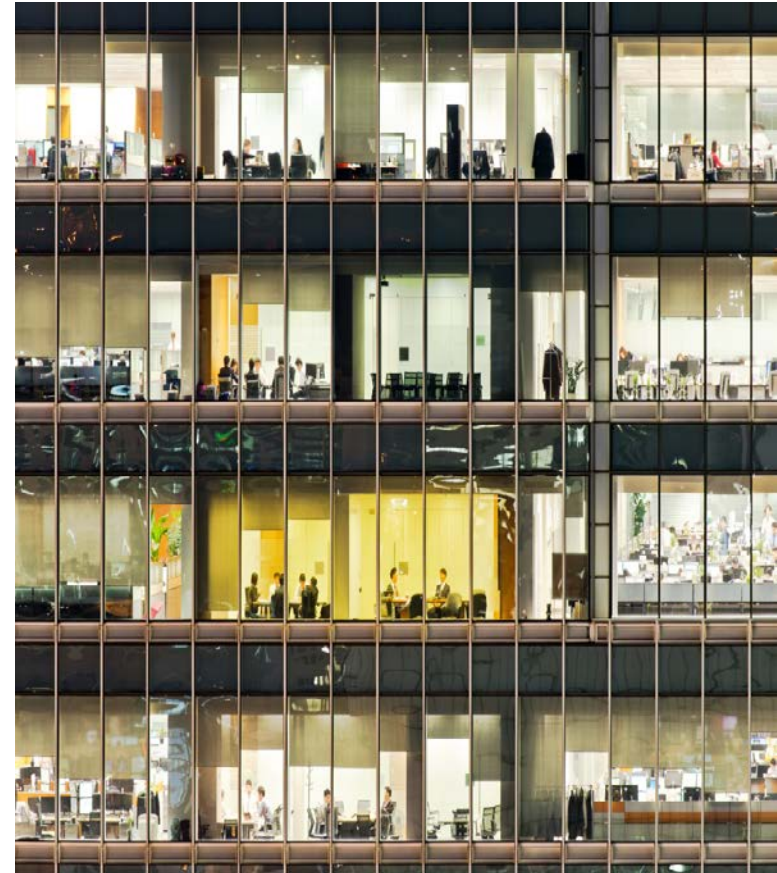
# Utilizing BAS data



➤ Similar approaches applied to AHUs, and CHCPs

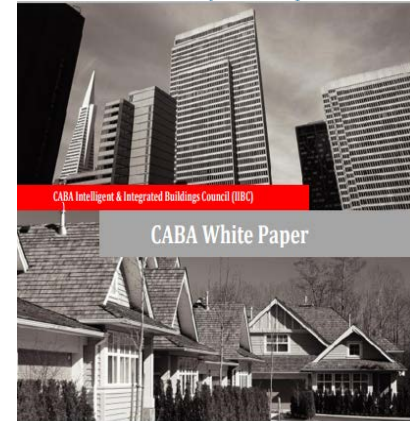
# Building-Level Occupancy Sensing

- Not who, but how many?
- Demand-controlled ventilation, space allocation
- Methods with existing data:
  - Security system
  - WiFi connections
  - PC power management
  - IT logins, traffic
  - Elevator activity/loading
  - Lighting motion sensors
- All have pros/cons, inaccuracies



# Effects of Buildings on Organizational Productivity

- Traditional productivity thinking not applicable to modern office work
- Multiple metric approach: CABA and WGBC
- Balanced scorecard concept widely accepted in other contexts
  
- “Better buildings” strategies have positive effects on organizational productivity metrics similar in size to other corporate strategies



## Improving Organizational Productivity with Building Automation Systems

Ajevantra I I Thimmann, National Research Council (Main Author)  
Jer Gu



Health, Wellbeing & Productivity in Offices

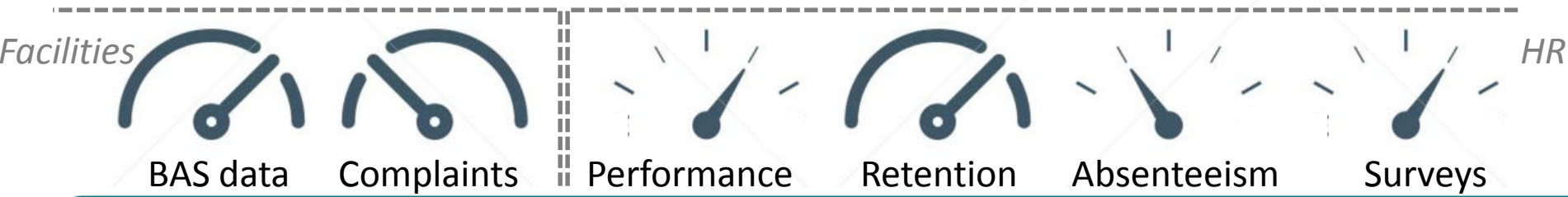
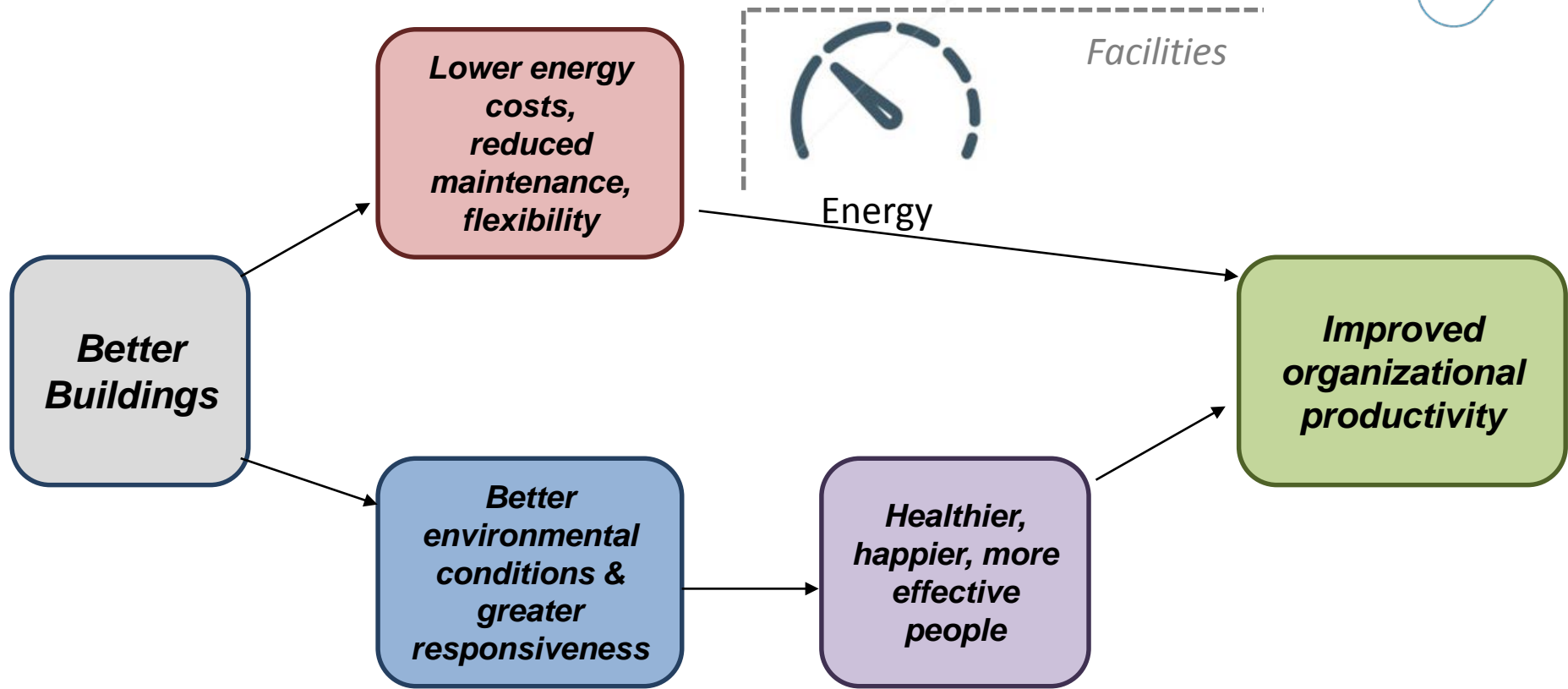
The next chapter for green building

JLL Land Lease SKANSKA





# Unlocking Existing Data Sets





# Applying this Model to RBC

## Data from RBC Facilities

- Building characteristics
- Green credentials
- Complaints to FM
- Mapping of employees to buildings

## Data from RBC HR

- Demographics
- Job class., Salary, Staffing Actions
- Manager-assessed performance
- Employee Opinion Survey (EOS)

- 70 office buildings, 1130 branches, 70,958 employees
- ~120 million data points (only a subset of the total!)
- Focus on large offices: 13 LEED **certified**, 33 **conventional**
- Control for other differences between buildings
  - 10 Matched pairs, 14,569 employees

**RBC's LEED office buildings associated with better employee job satisfaction, and manager-assessed performance**



# Thank you

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