The Role of Digital Twins in Performance-Based Simulation

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What is a Physics-Based Digital Twin?

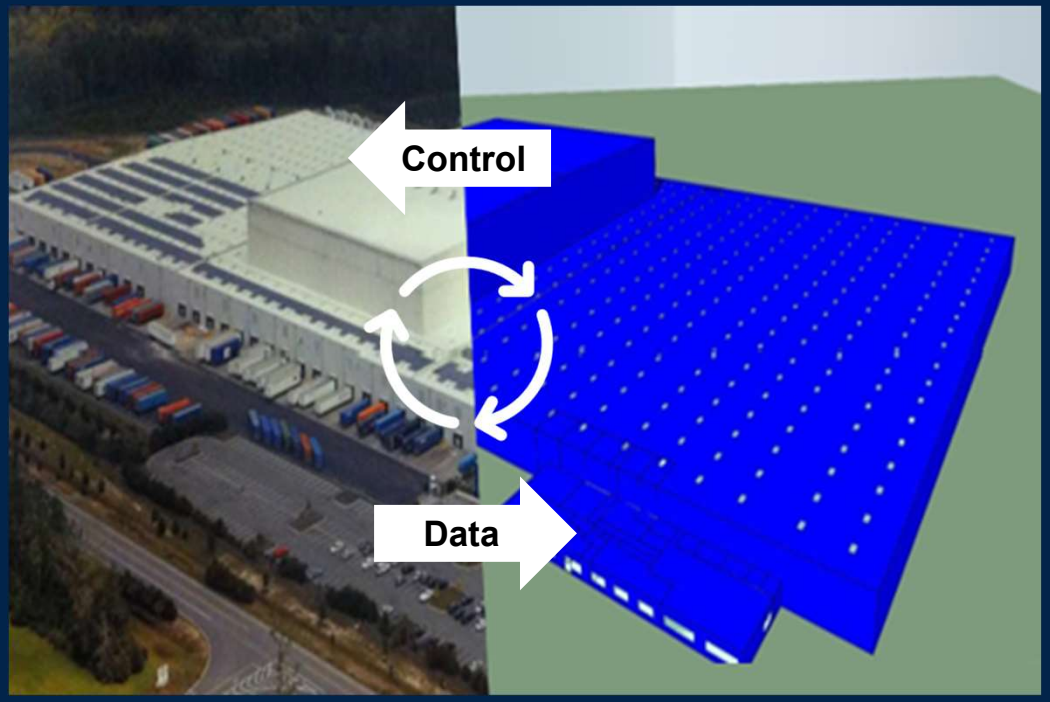
A digital twin is a virtual representation of an object or system that spans its lifecycle, is updated in real-time data, and uses physics-based simulation, Artificial Intelligence (AI), Machine Learning (ML) and reasoning for **informed** decision-making.

This presentation will cover:

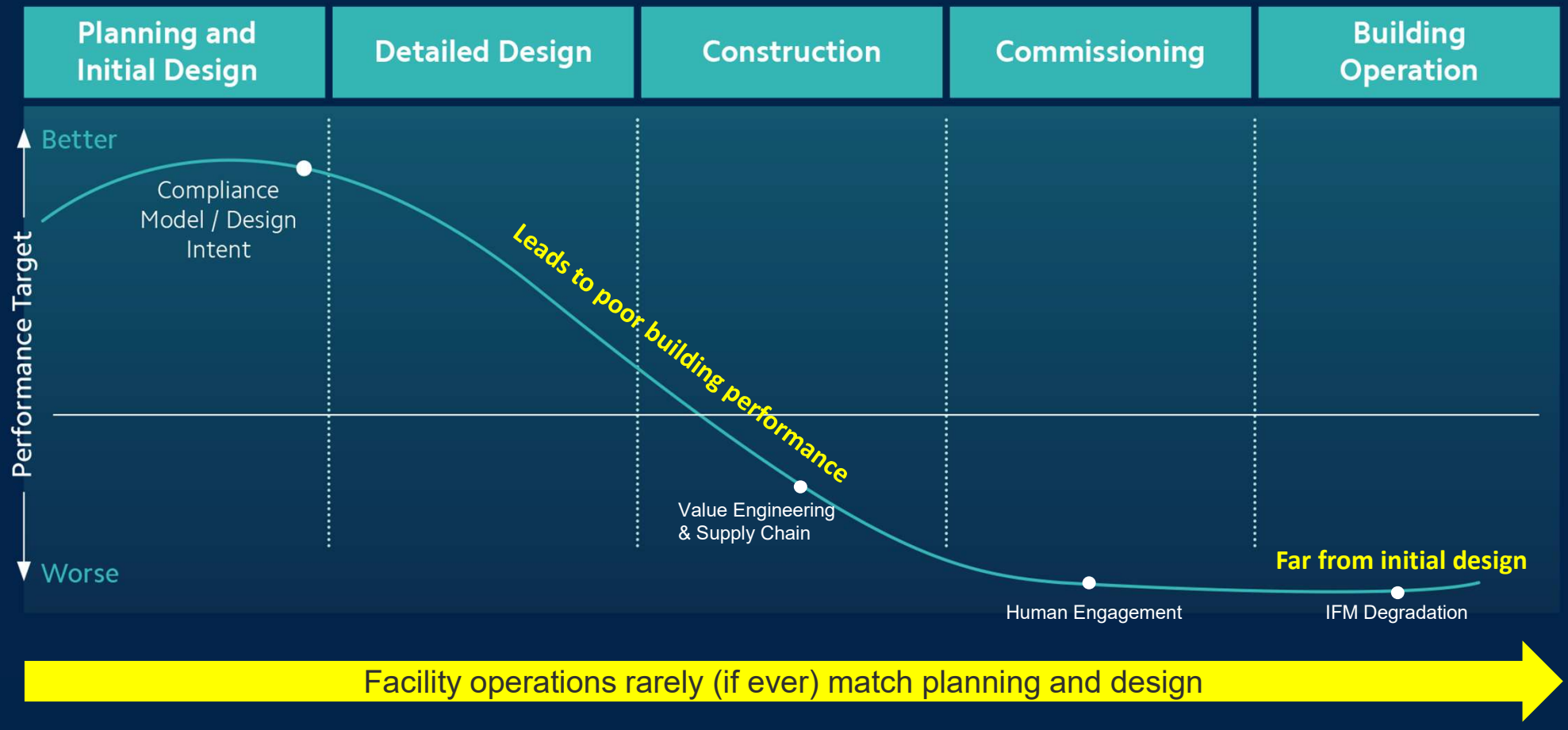
- Physics-based digital twin analysis
- Virtual sensors and physical sensors
- Lifecycle performance and data aggregation
- Integration of AI and ML for continuous improvement

The Problems with Buildings:

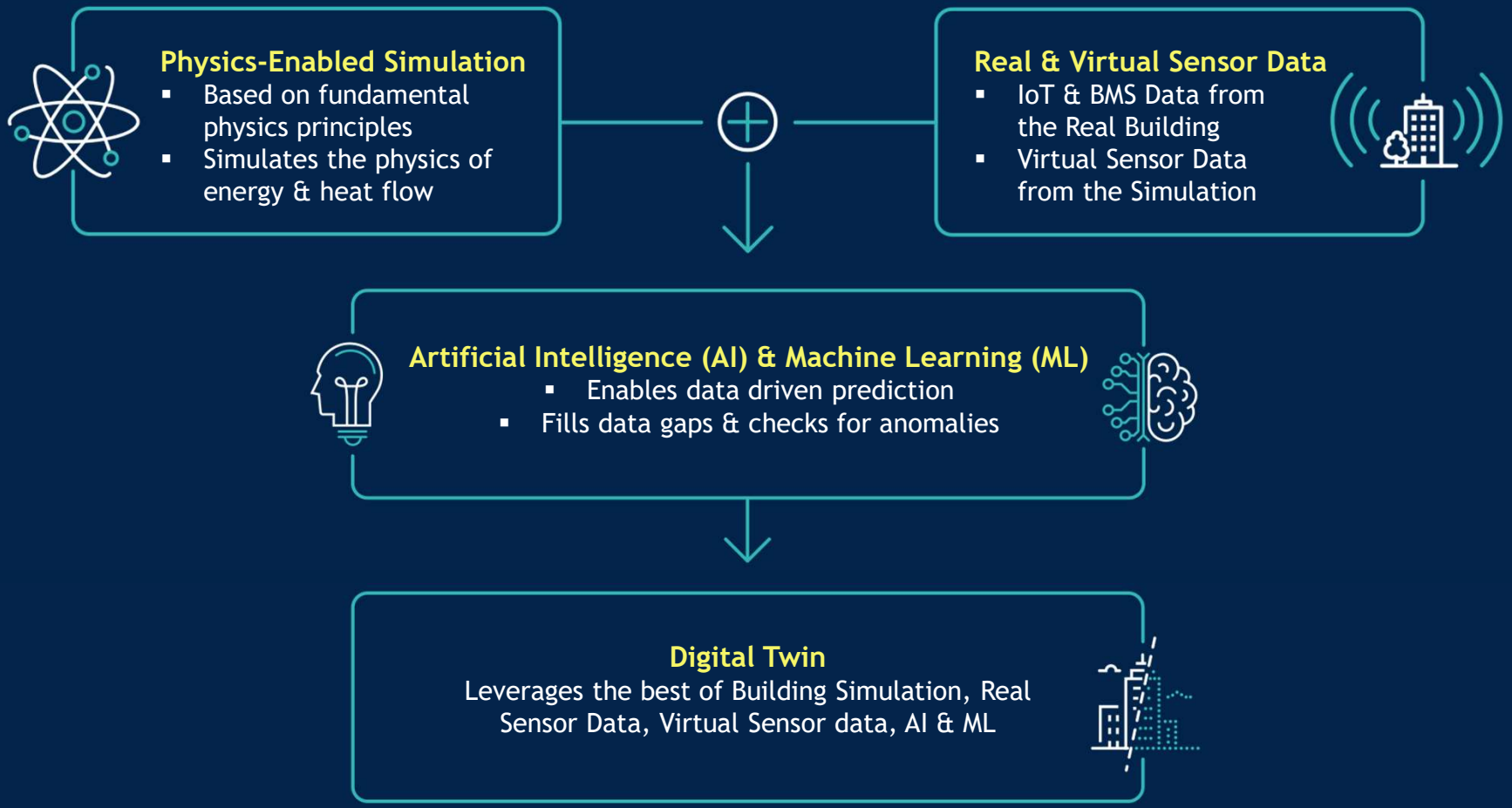
- **Operations don't match design!**
- **90%** of our time is spent indoors
- **96%** of Generation Y employees are concerned about the environment and expect their employers to take steps towards becoming more sustainable
- Buildings are **designed for energy**, (e.g. LEED, BREEAM), but controlled for comfort
- Employees in high-performance buildings showed:
  - **26%** higher cognitive function test scores
  - **30%** fewer sick building symptoms versus non-certified



The “S-Curve” – Traditional Building Lifecycle Trajectory

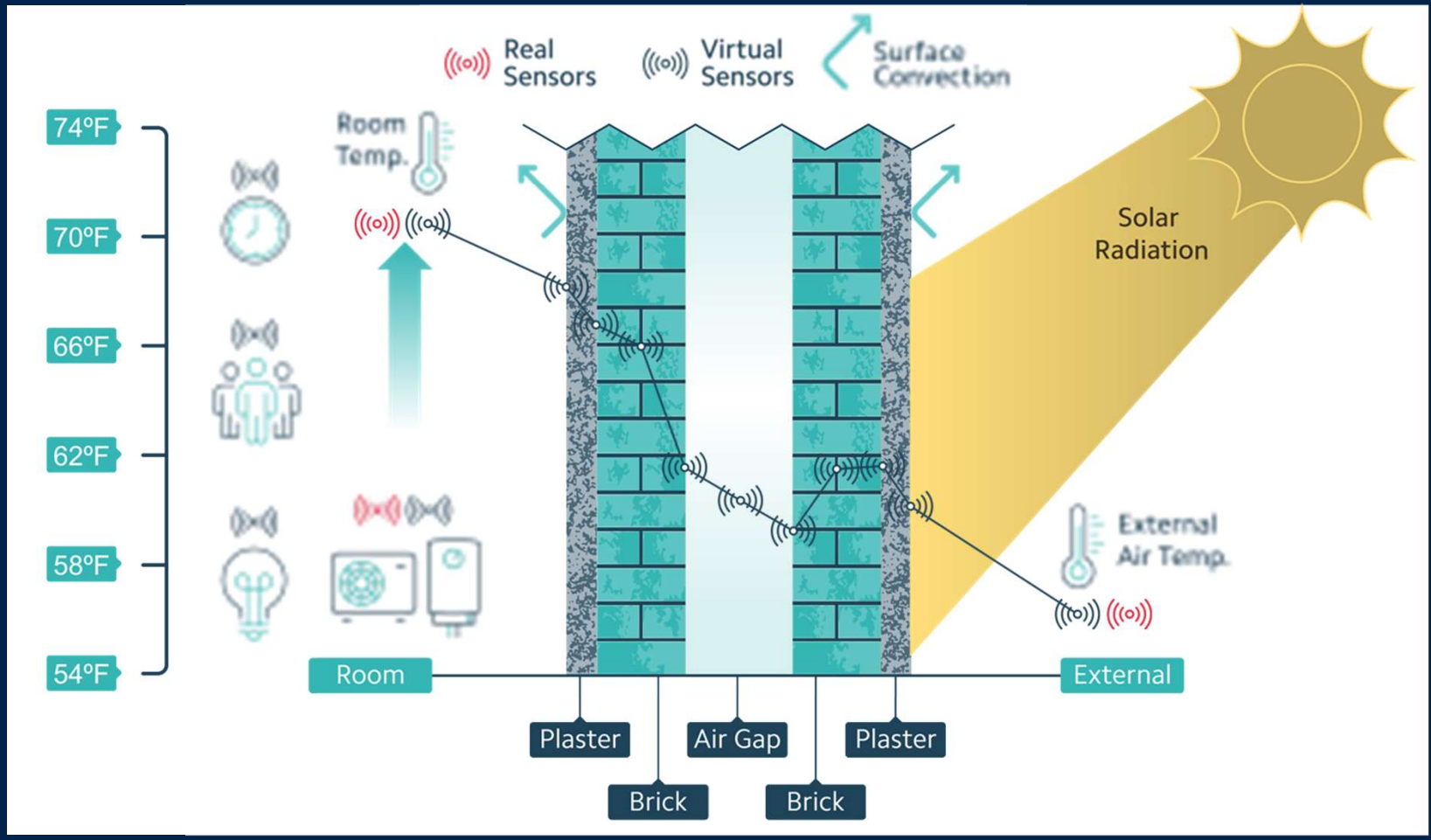


Integrated Physics, Data Aggregation, AI & ML

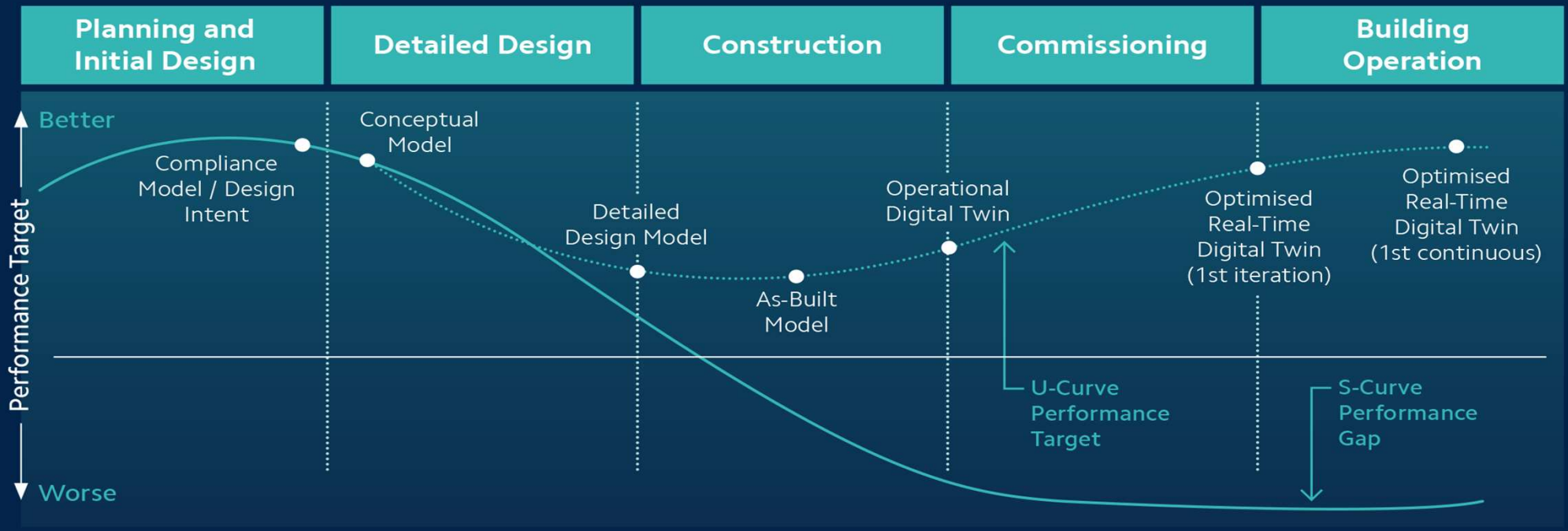


Digitizing Physics, Virtual Sensors & Virtual BMS

- Each room can have >650+ **virtual sensors**
- Data can **register and record** every 1-30 mins
- Sensitive rooms (e.g., datacenters) can record data **every few seconds**
- Virtual sensors **don't fail** unlike physical sensors with limited useful life-span
- Comparing **costs** of a physical sensor vs a virtual sensor
- Combing physical and virtual sensors provide **greater analysis** and comprehensive understanding of asset performance



The “U-Curve” – Make Operations Match Design



High-performance planning and design	Monitor construction performance	Initial commissioning	Continuous commissioning

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Calibration

=

Digital Twin!

Ensure and validate operations match planning and design

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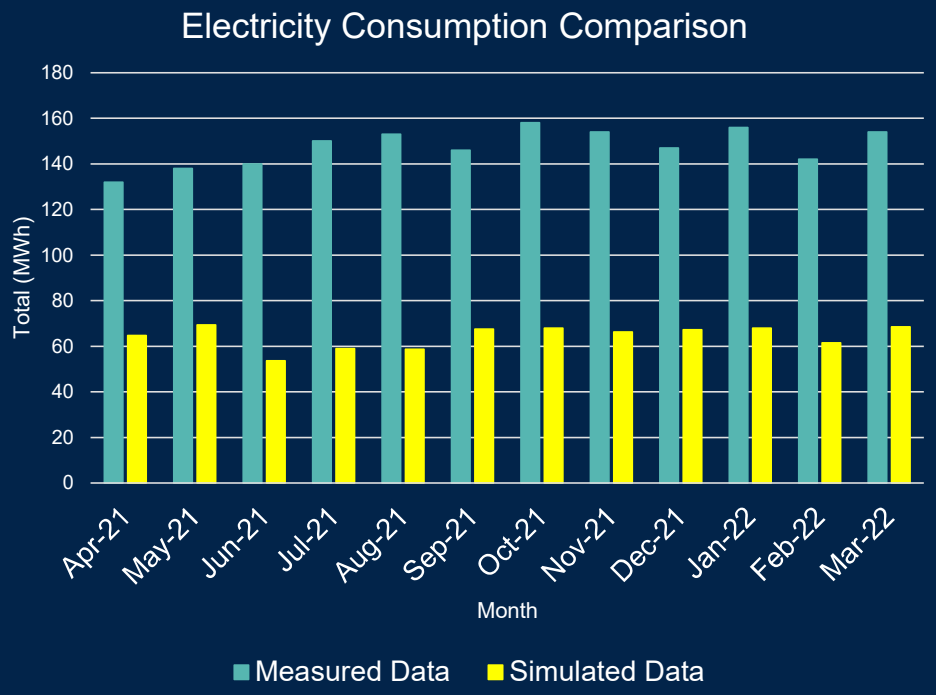
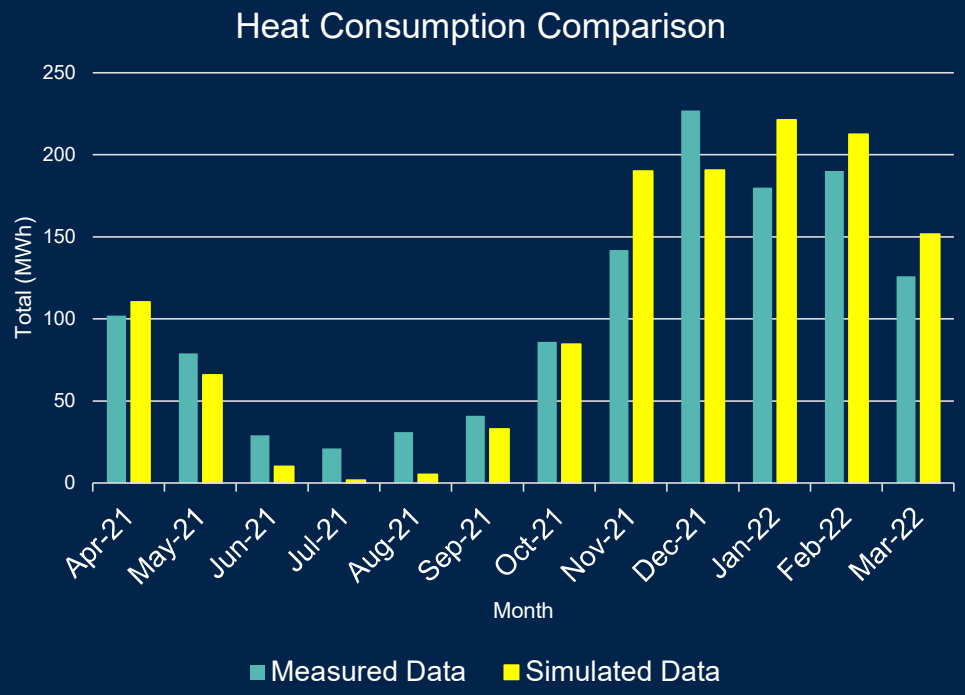
Use Case: Design Model Comparison to Operations

- 12 months of actual building **measured** energy consumption data
- 12 months of compliance model **simulated** consumption data

These discrepancies become obvious, quickly





Questions?

Thank you!

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