

Opportunities for Energy Technologies in Buildings

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AEE GTA Coffee & Conservation Series

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Intro

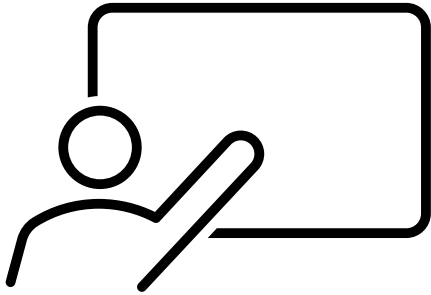
Asset owners, now more than ever, are looking for ways to reduce operating cost, mitigate ESG risk, and demonstrate performance to investors.

Over the past 10 years, the proptech industry has exploded with the widespread introduction of the cloud, IoT sensors, and analytics platforms that optimize buildings.



How do energy engineers position themselves for success in this new landscape?

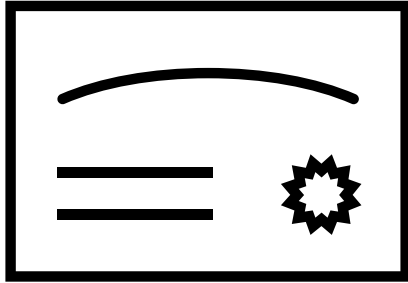
Topics



1. Evolution of building energy technology
2. Current challenges
3. Looking forward - opportunities

1- Evolution of building energy tech

About me



- Mechanical Engineer UofT (Energy)
 - B.A.Sc - 2008
 - M.Eng - 2009
- Professional Engineer & Certified Energy Manager
- 13 years - Oxford Properties
 - Energy Analyst/Sr. Energy Analyst, 2010-2016
 - Project Manager, Technology, 2017-2019
 - Manager/Sr. Manager, Digital Buildings, 2019-2023
- 3 years – Instructor, BCIT
 - Building Controls and Energy Management Program
 - CESA 5920 Controls Capstone Course

Experience in Commercial Real Estate

- Oxford: \$100B, 300 buildings
- Existing buildings & new developments
- Primary focus – office, retail, life sciences
- 2010-2016: National Scope, Energy Focused
- 2017-2023: Global Scope, Digital Buildings

Drivers:

- >\$100M/year utility spend
- Successive ESG Targets
- Leadership/Brand
- Revenue generation



Yorkdale Mall, Toronto



The Stack, Vancouver
(new office development)

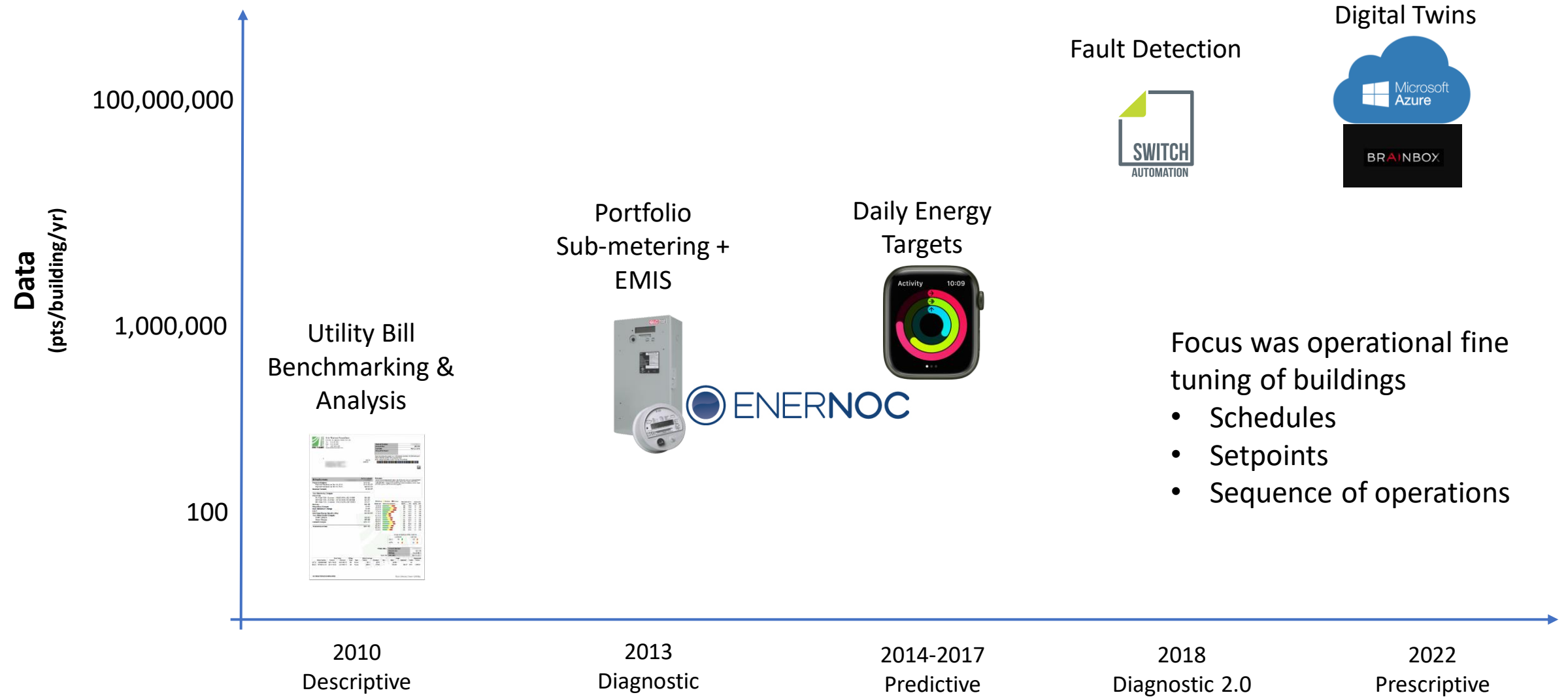


Sony Center, Berlin
(mixed use redevelopment)



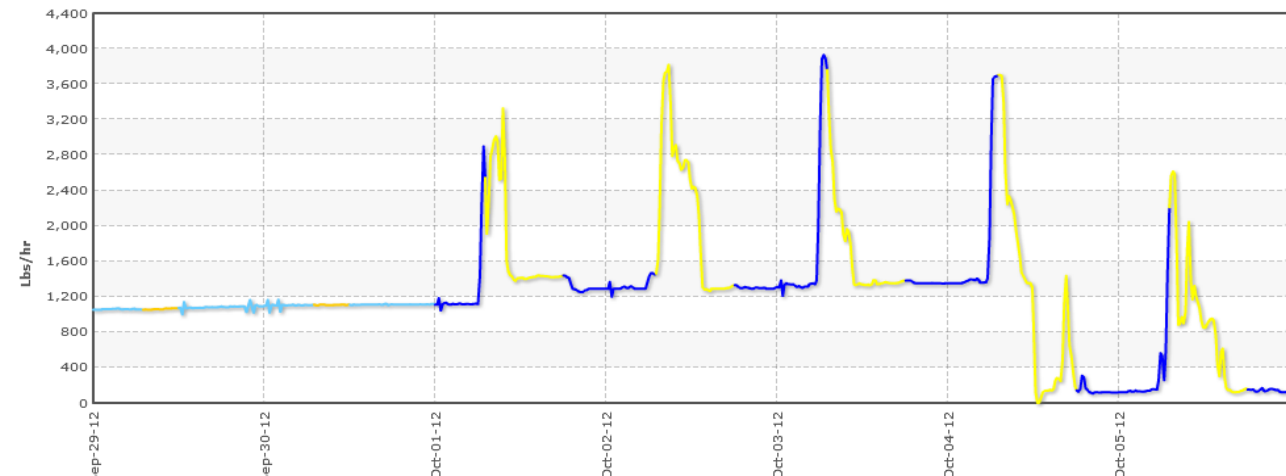
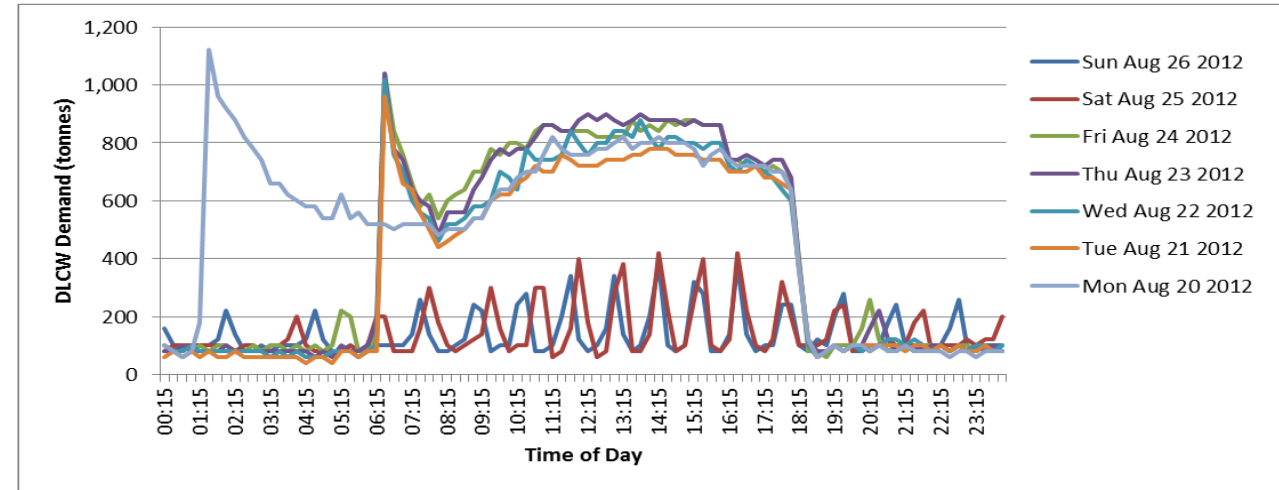
Victoria House, London
(life sciences redevelopment)

(My) Energy tech evolution



Portfolio Sub-metering

- Commenced in 2011
- 40M sf, office & retail
- ~30 meters/building
- ~100M data points/year
- Connected to software (EFT/EnerNOC)
 - 15 minute interval data
 - Visualization + basic analytics
- Typical Setup:
 - Main Utility meters
 - Electrical switchboards
 - Risers, Motor Control Centres
 - Dispro loads



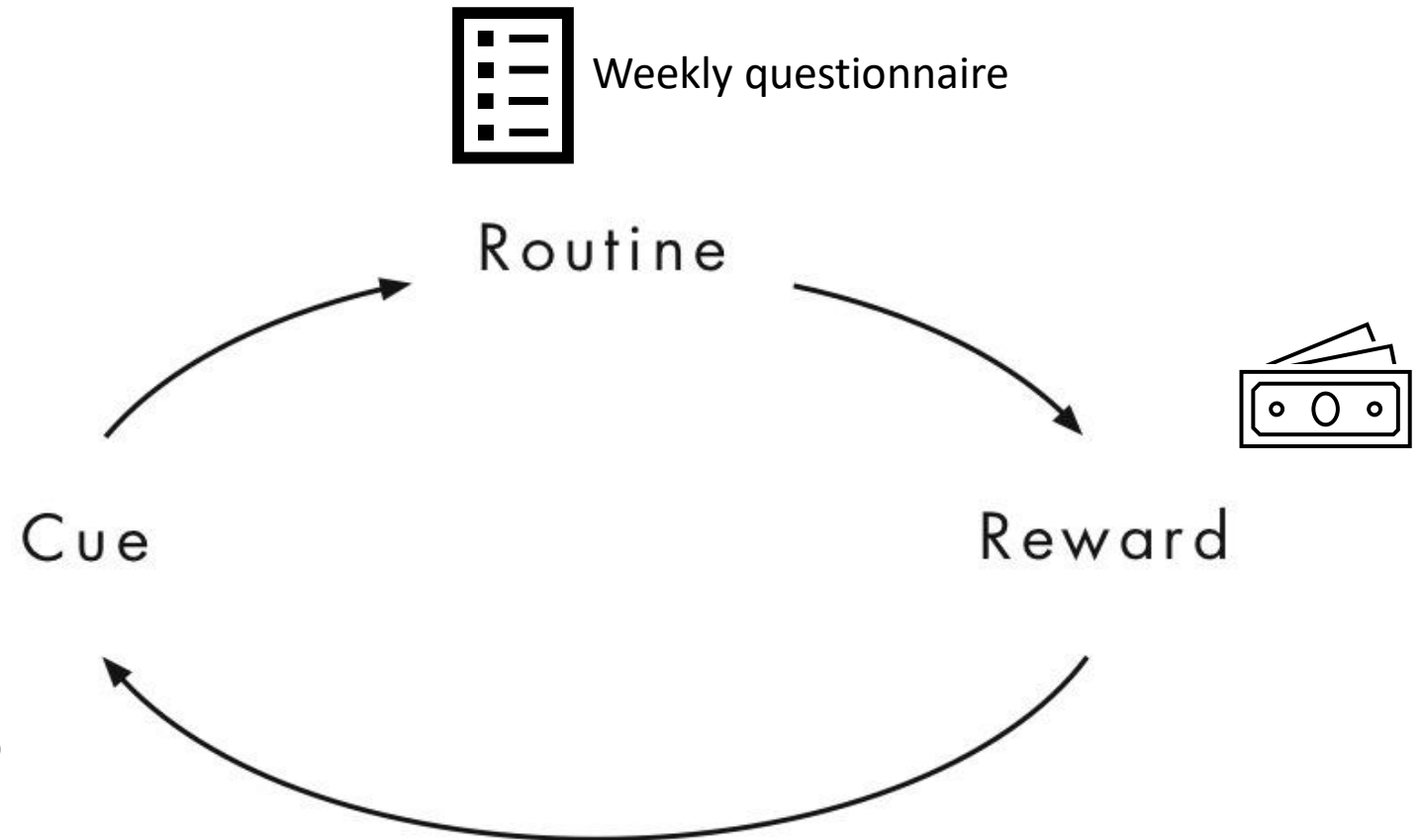
Early learnings

- Less than 5% of people log into software
- Lesson learned:
 1. Make it a habit
 2. Incentivize – performance tied to bonuses



Every Monday morning - auto emailed reports showing Actual consumption vs. Target consumption

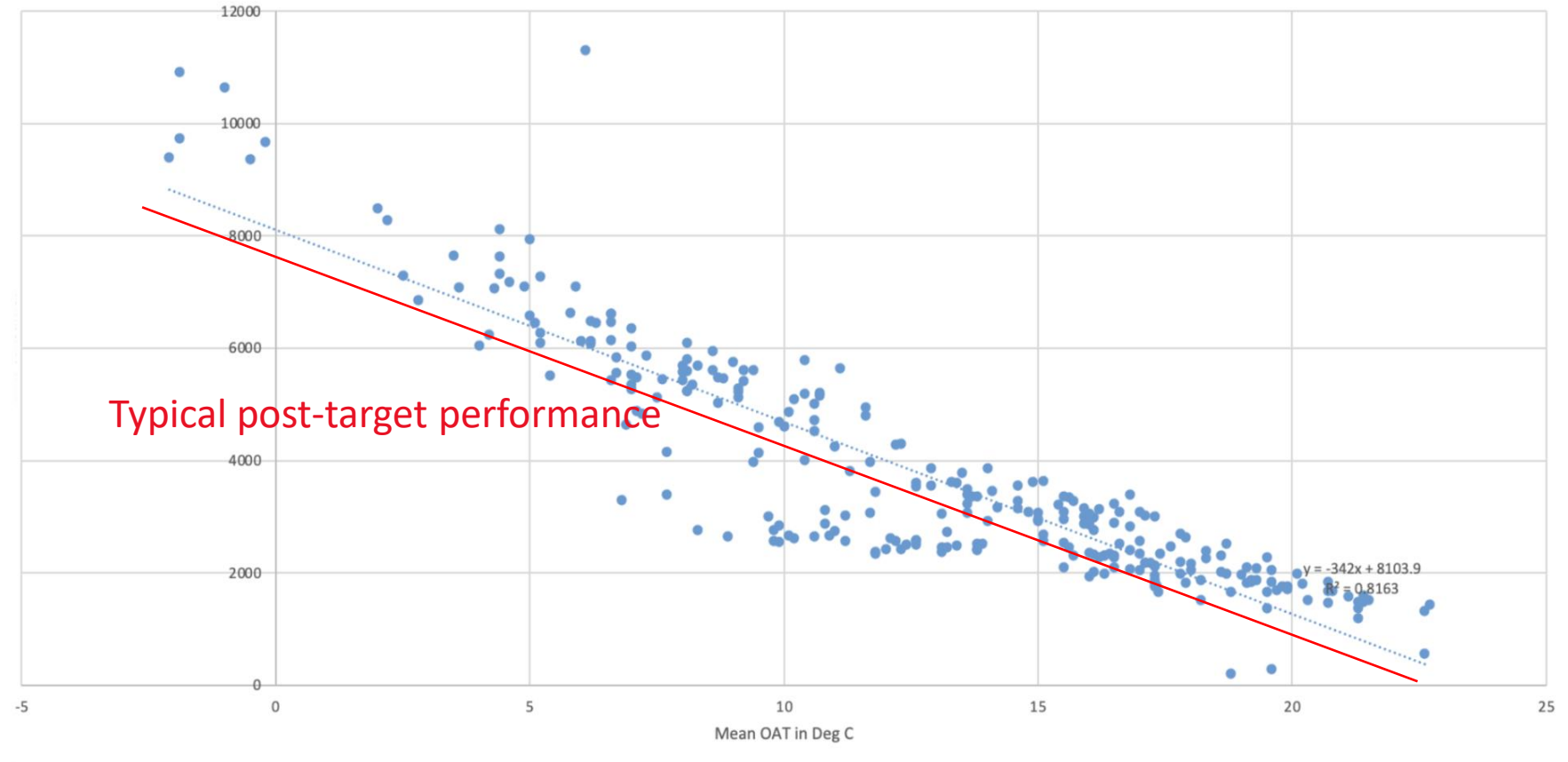
The Habit Loop



~2014 - Daily Energy Targets

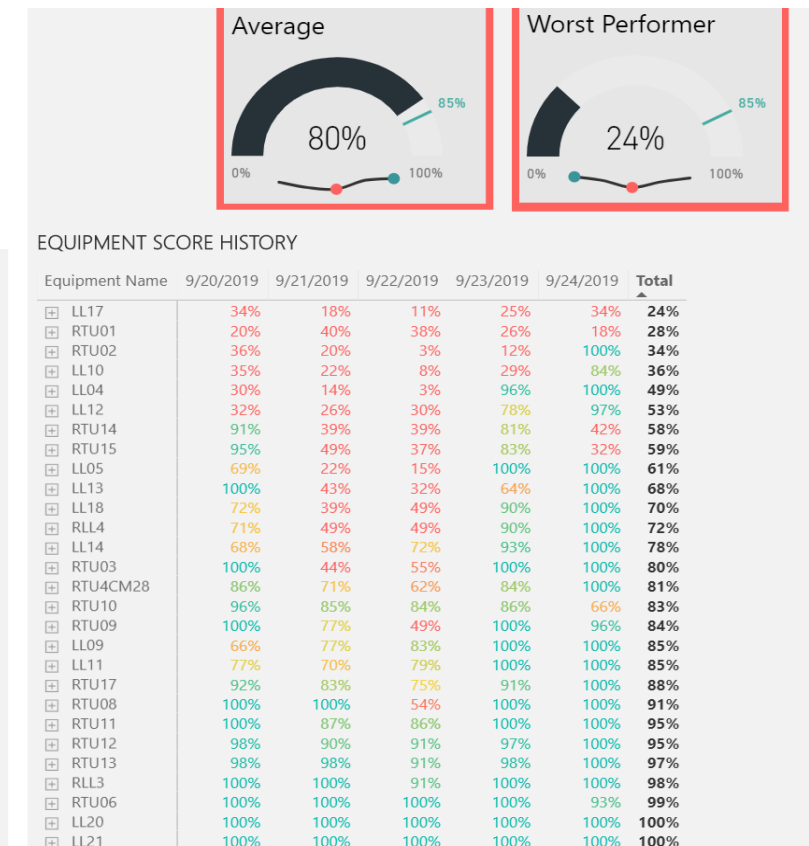
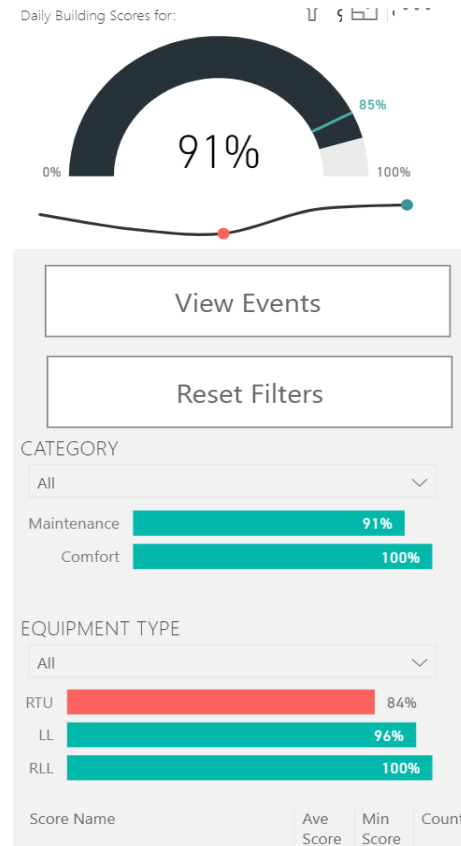
Daily Gas consumption vs. Daily average temp

- Data Science before it was cool
- Building's "energy signature"
- **Based on basic regression model:**
 $Y=m(x) + b$
- Hypothesis – daily consumption variability can be reduced by giving operators a daily target

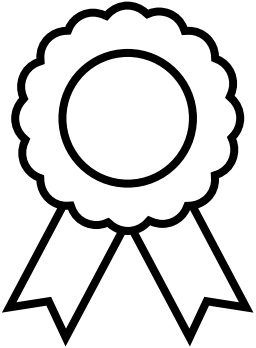


~2017 Fault Detection and Diagnostics (FDD)

- Switch Automation software
 - 21 buildings, connected to BAS
 - ~5B data points/year
- 3-5 rules per equipment, running every 5 minutes
- In-house analyst
 - Used software to filter/refine findings
 - Bi-weekly meetings with sites and controls vendors

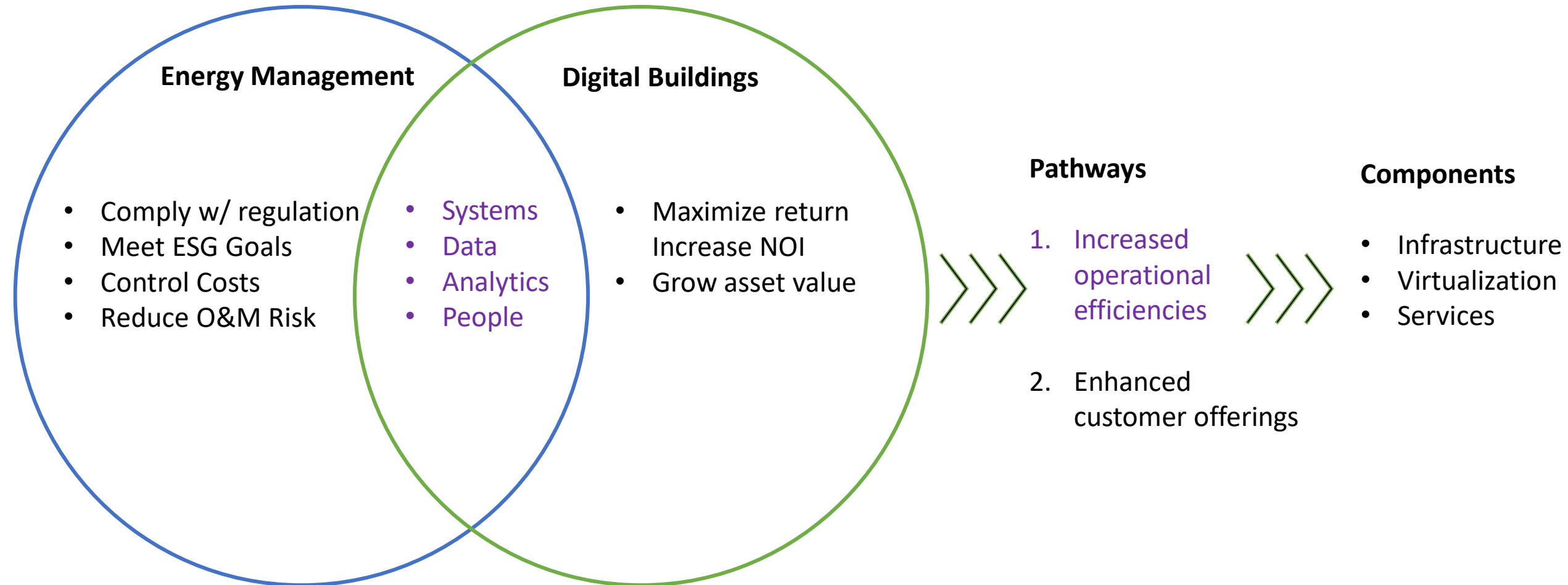


Results



- ~\$65M avoided utility costs 2010-2016 (opex + capex)
- 2-3% y/y consumption reduction, just from operational fine tuning
- 2017 – 2023: FDD ~\$4M identified across 20 buildings
- 1200+ staff trained on energy management targets, reports


The shift to digital buildings



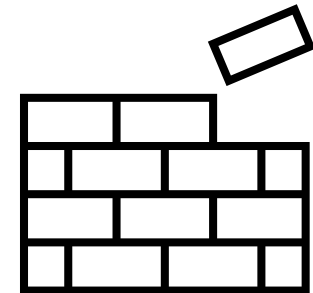
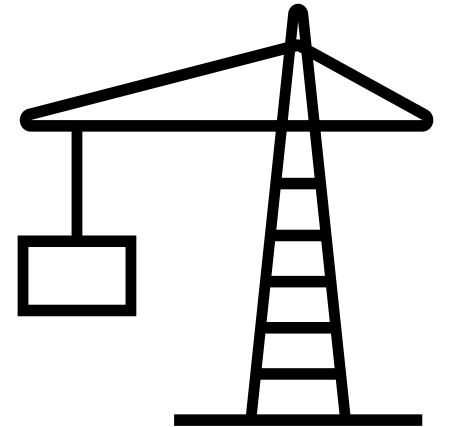
2 – Current Industry Challenges

Observations & barriers

New Construction

- Buildings designed to obtain certification, not to maintain it
- Not uncommon to see 100s of deficiencies on day one
- Obsolete systems are common
- < 100% Cx & unremedied Cx findings
- Post construction vendor finger pointing 

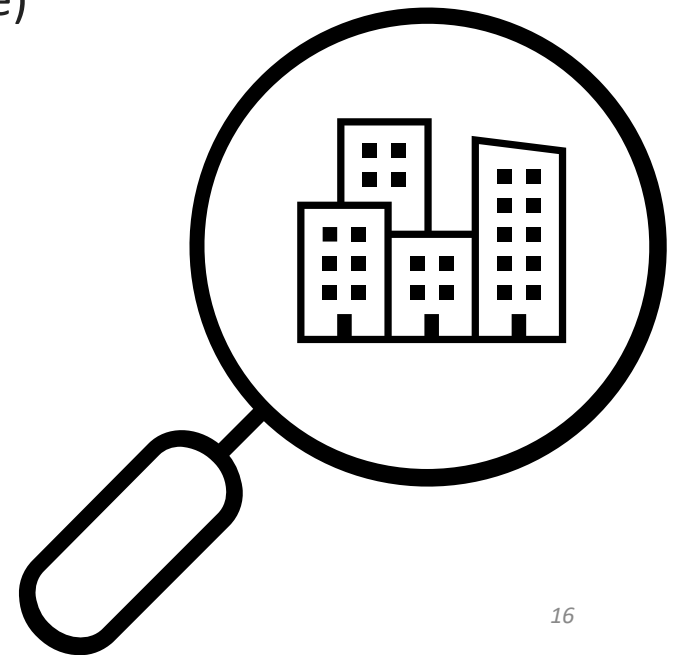
→ Issues exist because of financial motivation during design & construction.



Existing Buildings

- External Benchmarks don't always reflect reality
- Utility overbilling very common
- Lack of documentation (understanding/inventory of systems)
- Looking under the hood yields unresponsive devices, duplicate device IDs, broadcast storms
- Insufficient maintenance (and sometimes complete lack of maintenance)
- 3rd party integration of tech is difficult

→ **We lack clear indicators of actual real-time performance of buildings.**



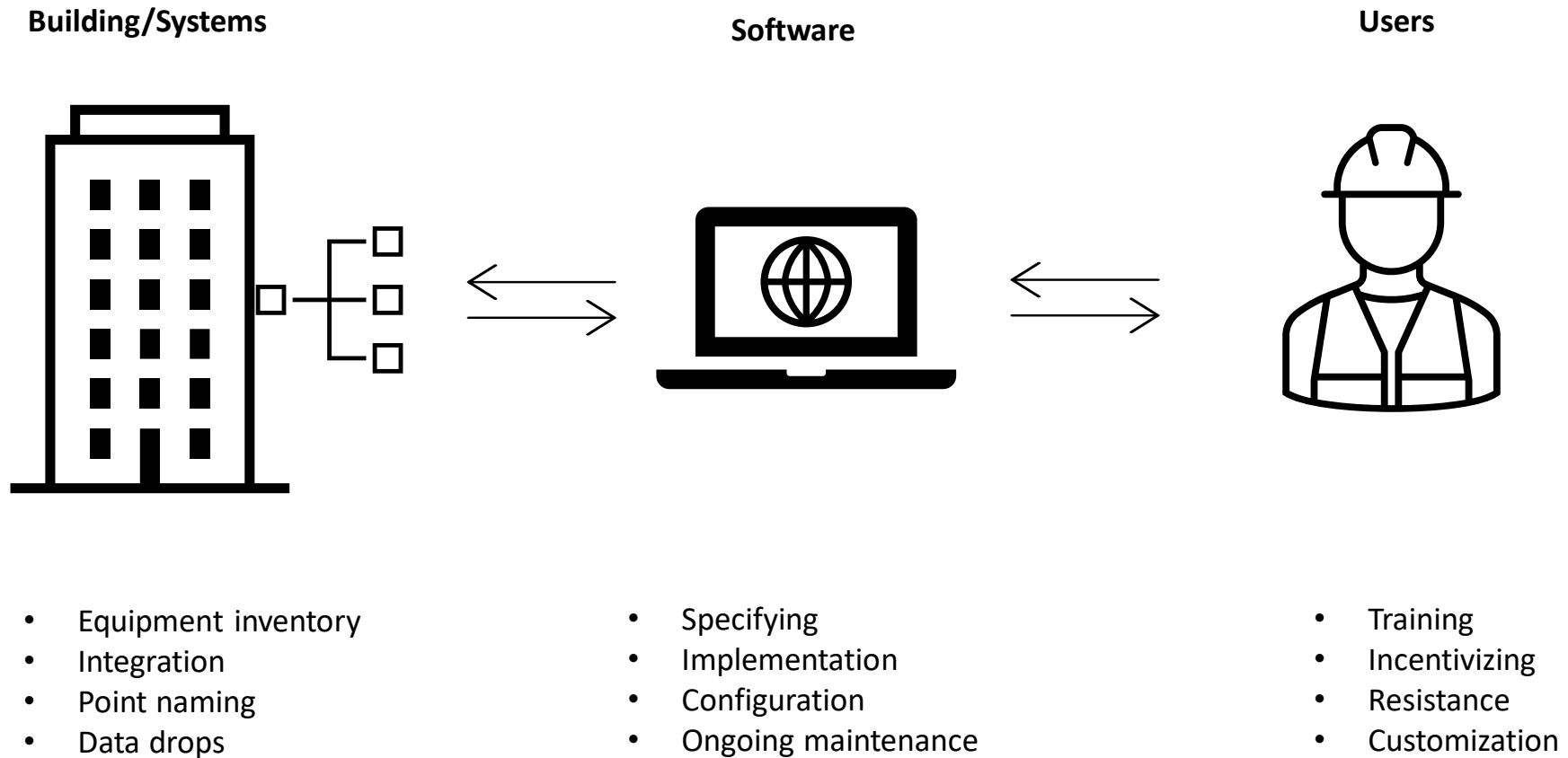
Industry & People

- Evolving (but limited) understanding of data, analytics, technology
- Limited use of software (staff don't log in)
- EMIS/FDD Platforms - too many alerts, not enough action
- Owners - resistance to spend
- Vendors – resistance to change methods

→ **Change management is at the root of tech adoption. Incentivizing leads to greater adoption.**



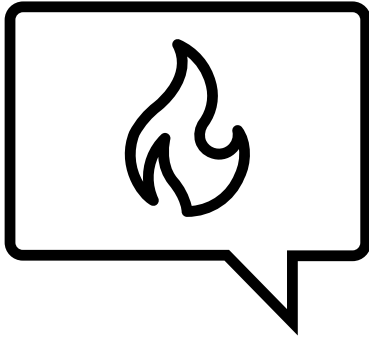
Platform Challenges



3 – Looking forward

Opportunities to advance the industry

4 Industry Movements in the Next 5 Years



- 1. IT & OT will converge**
 - Existing IT standards will be applied to Operational technology, simplifying integration, and unlocking data.
- 2. Asset valuation will consider operational risk**
 - O&M of assets held to a higher standard
 - Will influence design, construction and Cx practices
- 3. Shift towards proving real-time, transparent asset performance**
 - Digital Twin Technology will be common in buildings
 - AI will be used to optimize asset performance
- 4. The scope of the energy engineer will evolve**
 - Systems/controls/data science/engineering

Convergence of IT/OT

Large commercial owners are consistently specifying 'digital' in new developments

- Convergence of systems onto a single network
- Single server, or complete virtualization
- No more 'copy and paste' system specs
- Unified User Interface/Single Pane of Glass (basic Digital Twin) requirement is common
- Emergence of Technology Contractor
- Shift towards IT governance policies

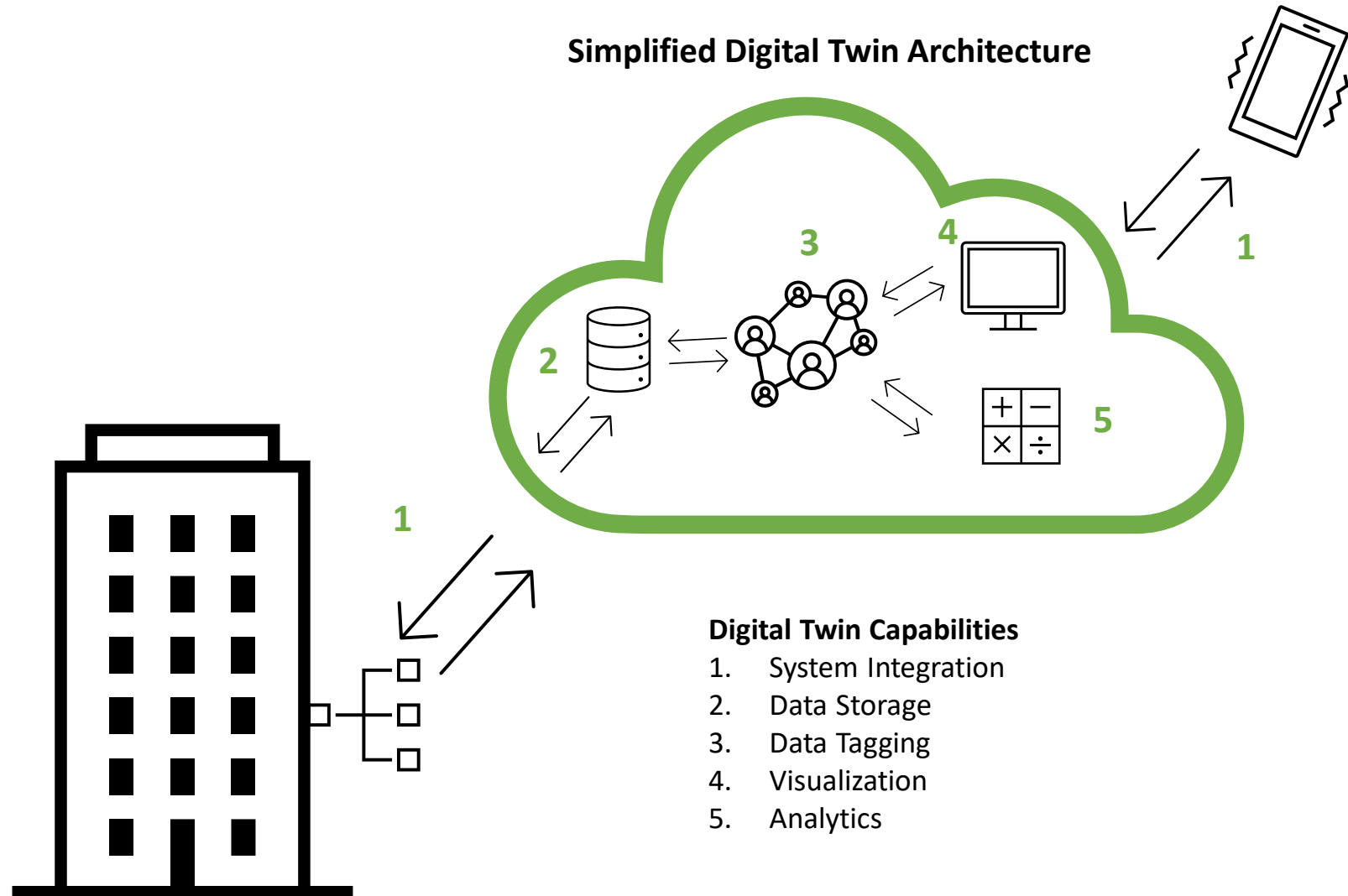


Digital Twin

A virtual replica of a physical asset.

Twins enable you to run simulations of asset under different scenarios.

1. Model that maps, describes, and relates each element of the asset
2. Real-time and historical information on each element of the asset.
3. Tools that allow you to explore the twin – visualization, analytics, and query.
4. Feedback mechanism that allows you to make adjustments to the the asset



Basic Digital Twin Maturity Model

Basic

- Data extraction & Storage
- Data model
- Visualization

Intermediate

- Basic analytics
- API
- Basic spatial model

Predictive

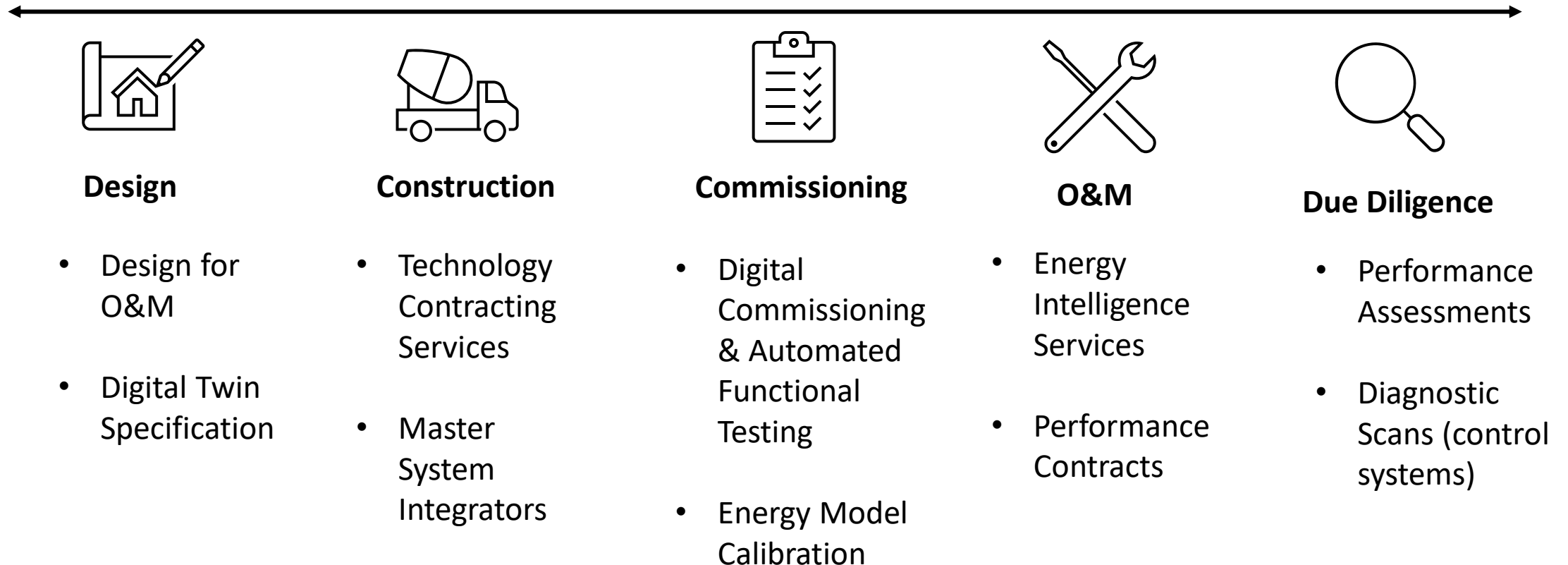
- ML models employed
- Fault detection
- Manual control

Autonomous

- AI models applied
- High fidelity 3D spatial model
- 3rd party app integration

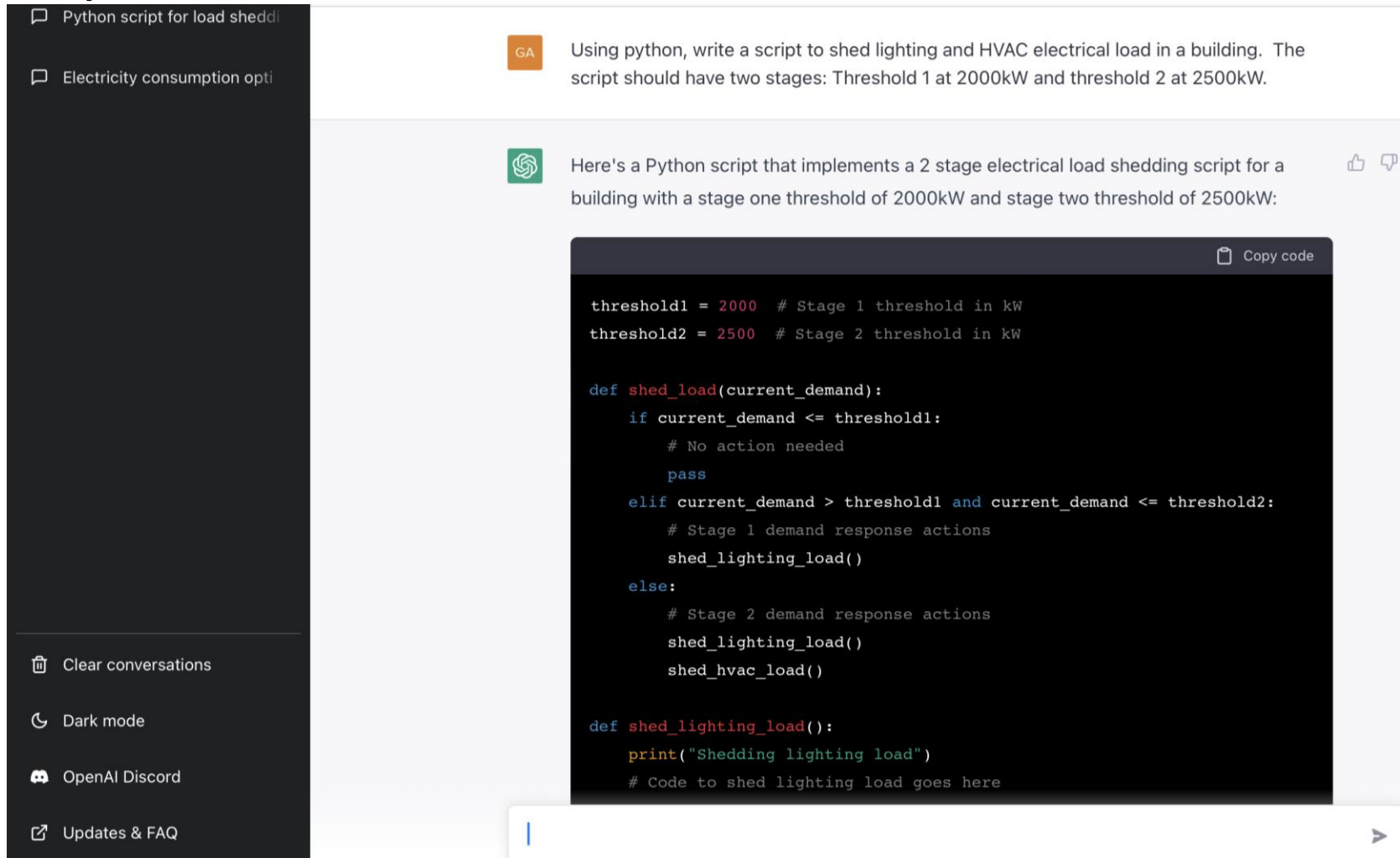
Sophistication 

Owner requirements for digital buildings and guarantees of performance will spur the creation of new services across the asset lifecycle.



Application of AI Example (ChatGPT)

<https://chat.openai.com/chat>



The screenshot shows a chat window with a dark sidebar on the left containing navigation options: 'Clear conversations', 'Dark mode', 'OpenAI Discord', and 'Updates & FAQ'. The main chat area has a white background. A user message (GA icon) asks for a Python script to shed lighting and HVAC electrical load in a building with two stages: 2000kW and 2500kW. The AI response (GPT icon) provides a Python script with a 'Copy code' button. The script defines a 'shed_load' function that checks current demand against two thresholds and performs actions like 'shed_lighting_load' and 'shed_hvac_load'. A 'shed_lighting_load' function is also defined with a print statement and a comment.

```
threshold1 = 2000 # Stage 1 threshold in kW
threshold2 = 2500 # Stage 2 threshold in kW

def shed_load(current_demand):
    if current_demand <= threshold1:
        # No action needed
        pass
    elif current_demand > threshold1 and current_demand <= threshold2:
        # Stage 1 demand response actions
        shed_lighting_load()
    else:
        # Stage 2 demand response actions
        shed_lighting_load()
        shed_hvac_load()

def shed_lighting_load():
    print("Shedding lighting load")
    # Code to shed lighting load goes here
```

Tips for success

- Develop an owners perspective: increase NOI, grow asset value, maximize return, minimize risk.
- Data will be key to demonstrating value; endless opportunities for new services.
- Be willing to augment your skills with tech.
- Every building is unique, so consider individualized plans. One size does not fit all!
- Topics apply to all built environment, not just buildings.
- Don't forget the human element. Technology is a tool, but still need people to use the technology (today). Have a solid plan for how people will use technology!

Questions?

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