Better Buildings Webinar Series

We'll be starting in just a few minutes….

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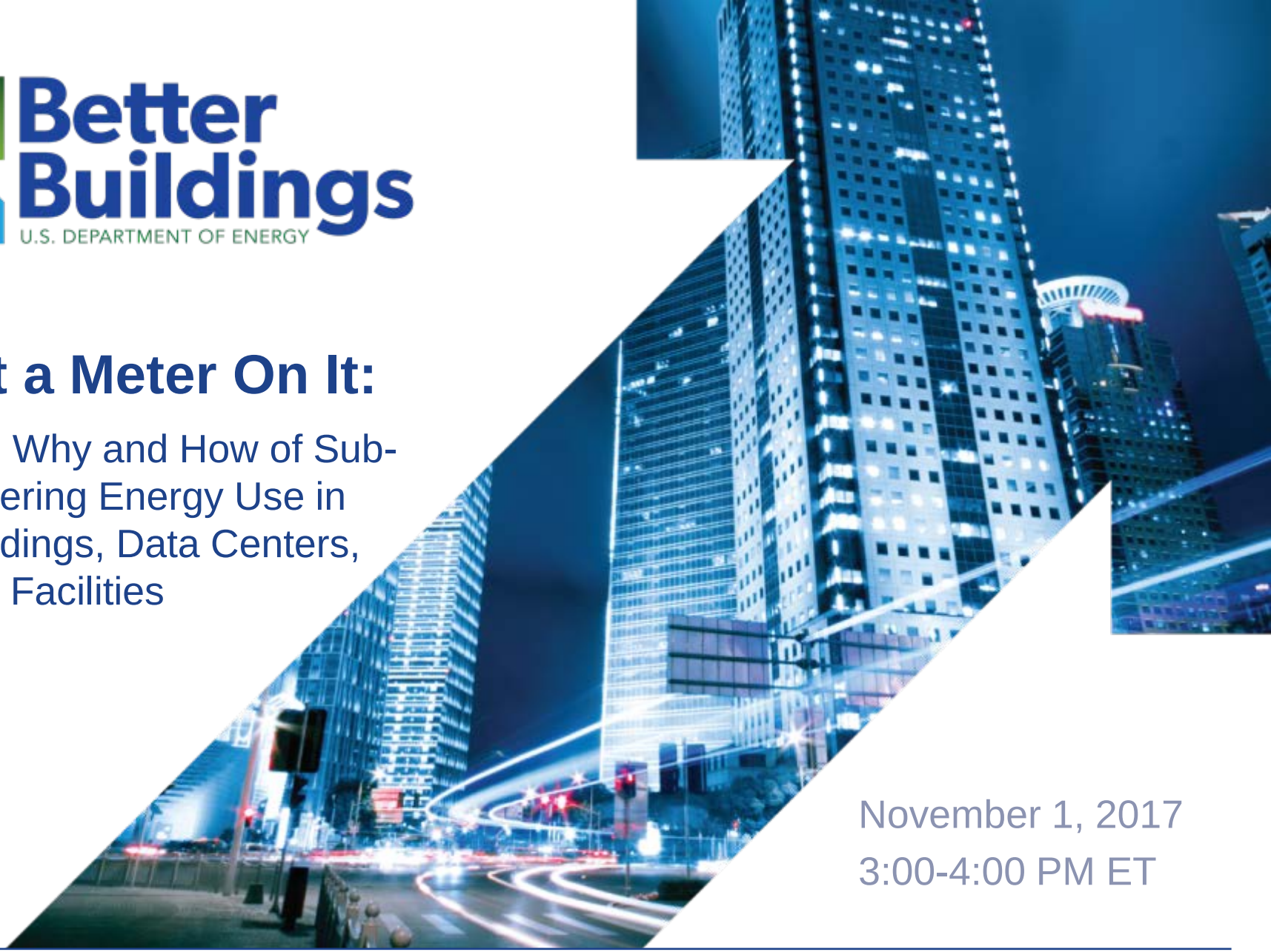
What topics are you interested in for future webinars?

Better Buildings
U.S. DEPARTMENT OF ENERGY



Put a Meter On It:

The Why and How of Sub-metering Energy Use in Buildings, Data Centers, and Facilities

November 1, 2017
3:00-4:00 PM ET

U.S. DEPARTMENT OF ENERGY

Ryan Billing

Abercrombie & Fitch

U.S. DEPARTMENT OF ENERGY

PUT A METER ON IT

Ryan Billing, PE

Director of Technical Services

Abercrombie & Fitch

Abercrombie & Fitch

- Specialty clothing retailer with brick and mortar and online sales
- Three brands: Abercrombie & Fitch, abercrombie kids and Hollister
- Approx. 900 stores globally ranging in size from 4,500 to 50,000 ft^2
- Main office is located in New Albany, OH
  - Two onsite distribution centers each 1M ft^2
  - One onsite data center

Why you shouldn’t install sub-meters?

- No payback
- Don’t save you energy
- Can’t guarantee budget savings due to weather variations

Why does your company want to be more sustainable?

- Marketing
- Financial
- Legal
- Tax Advantages
- Public Relations
- Work Environment
- Sustainability

Elec Rate	Eff Gain	New Rate	Hrs	Cost
$0.10	0%	$0.10	24/365 = 8,760	$876
$0.10	20%	$0.08	8760	$560.64
$0.10	0%	$0.10	7,008	$560.64

Energy Procurement

$0.10 kW-h

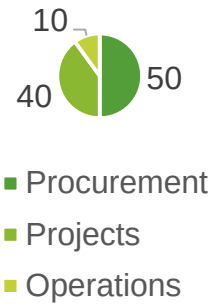
Operation Projects
- Scheduling
- EMS

J/

S

Energy Projects

% Spent on



Energy Project Lifecycle

Selling Mode
Energy Modeling

Credit Mode
EMS
Sub-meters

Implementation Mode
Energy Projects

You have an Idea

What is the problem you are trying to solve? 5Ps, Metrics

Selling Phase

Scope of Work (SOW)
Stockholders
Measurement & Verification (M&V)
Project Schedule

Request For Proposal (RFP) Project Justification (PJF)

Implementation
Project Management
Vendor Management
Logistics

Implementation Phase

Collecting Data

Analyzing

Credit Phase

Reporting

Why you should install sub-meters?

- EMS auditing
- Benchmarking
- Compliance
- Reporting
- Electrical billing auditing
- Energy project justification
- Landlord electrical disputes
- Lease negotiations
- Rebates

Sub-meter Project

1. **Analysis**
   - What is the potential savings?
   - Gap analysis: Energy modeling prediction vs LL charges
   - Are we allowed to install meters? Green lease language

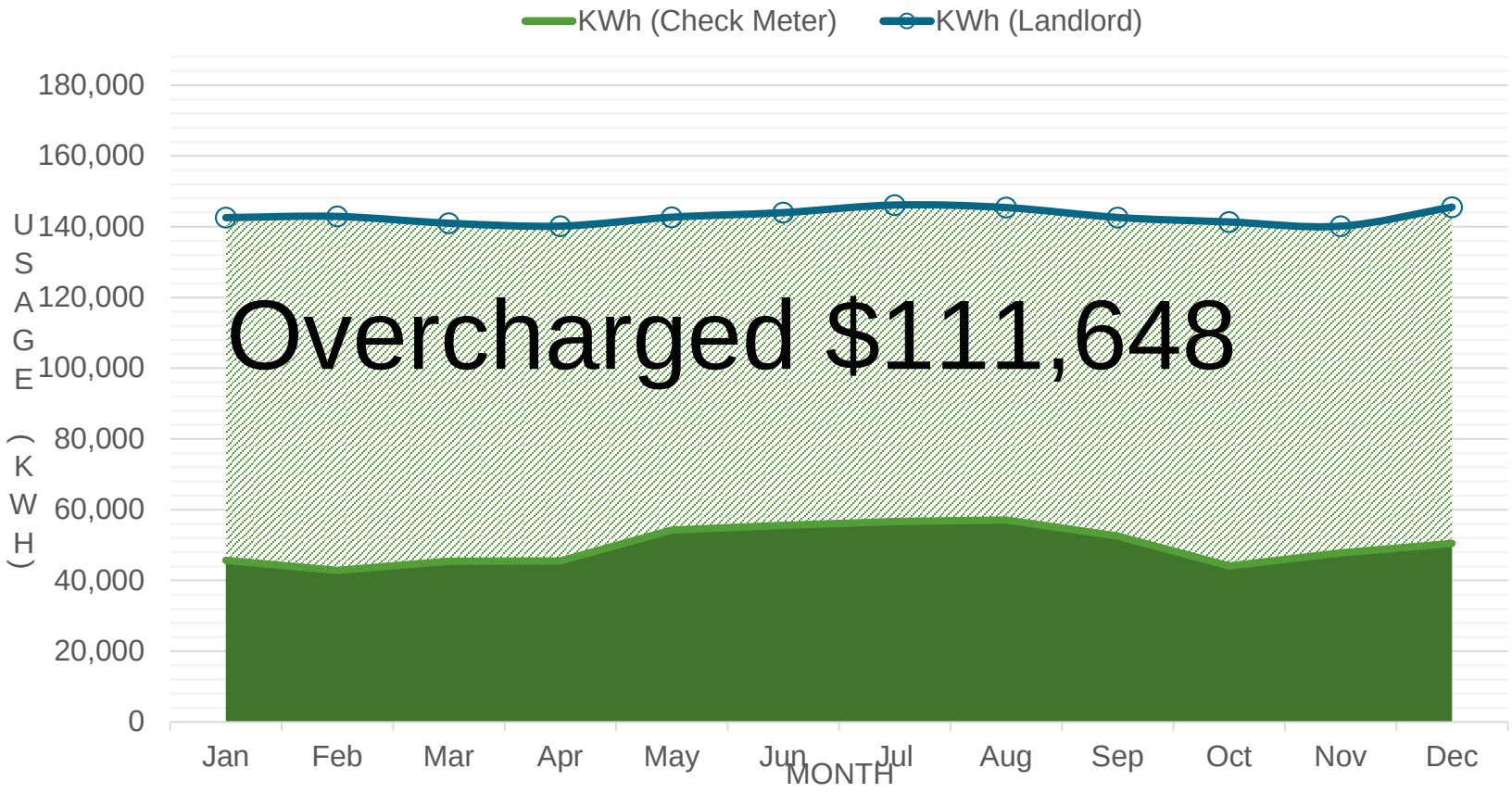
2. Metrics
   - Meter selection
   - Data collecting and reporting

Section 1. Landlord shall provide at Landlord's expense all necessary utility services stubbed to a location acceptable to Tenant within the demised premises. Tenant shall pay for all utilities (including electric, gas, water, sewer and any related charges) consumed within the demised premises during the term hereof. Tenant shall have the right to install and use direct meters for utilities provided to the demised premises. All costs for the hookups, meters and service connections shall be borne by Tenant. Notwithstanding anything to the contrary contained herein, Tenant shall have the right, at its sole cost and expense, to install its own HVAC system to serve the demised premises and the electrical service provided by Landlord shall be sized accordingly for Tenant's additional load.

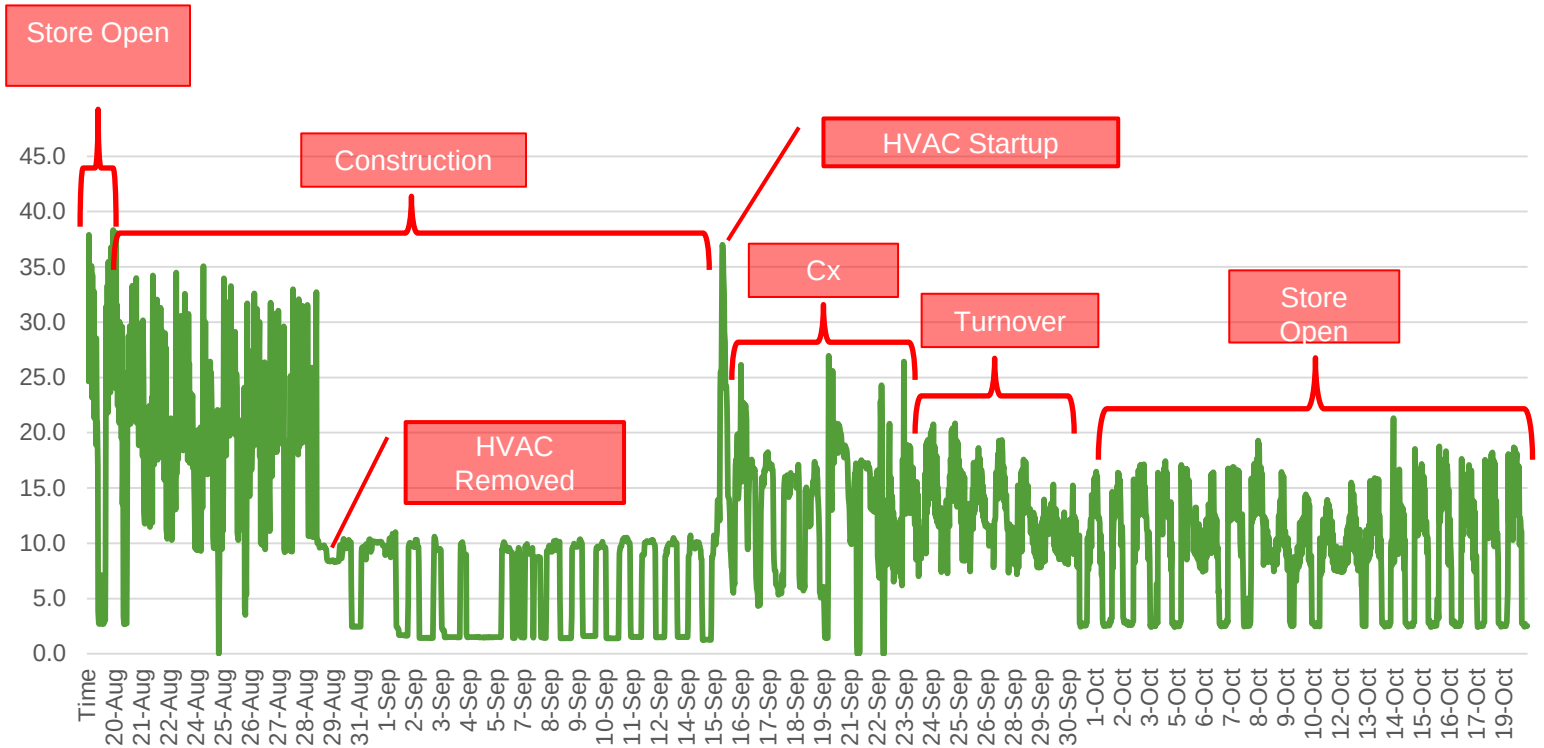
3. Pilot Program
   - Determine pilot locations…a lot of variables to consider
   - LL communication pre and post install

4. Project Implementation
   - Business case packaged with LED lights roll out and store renovations
   - Collecting data
   - Reporting

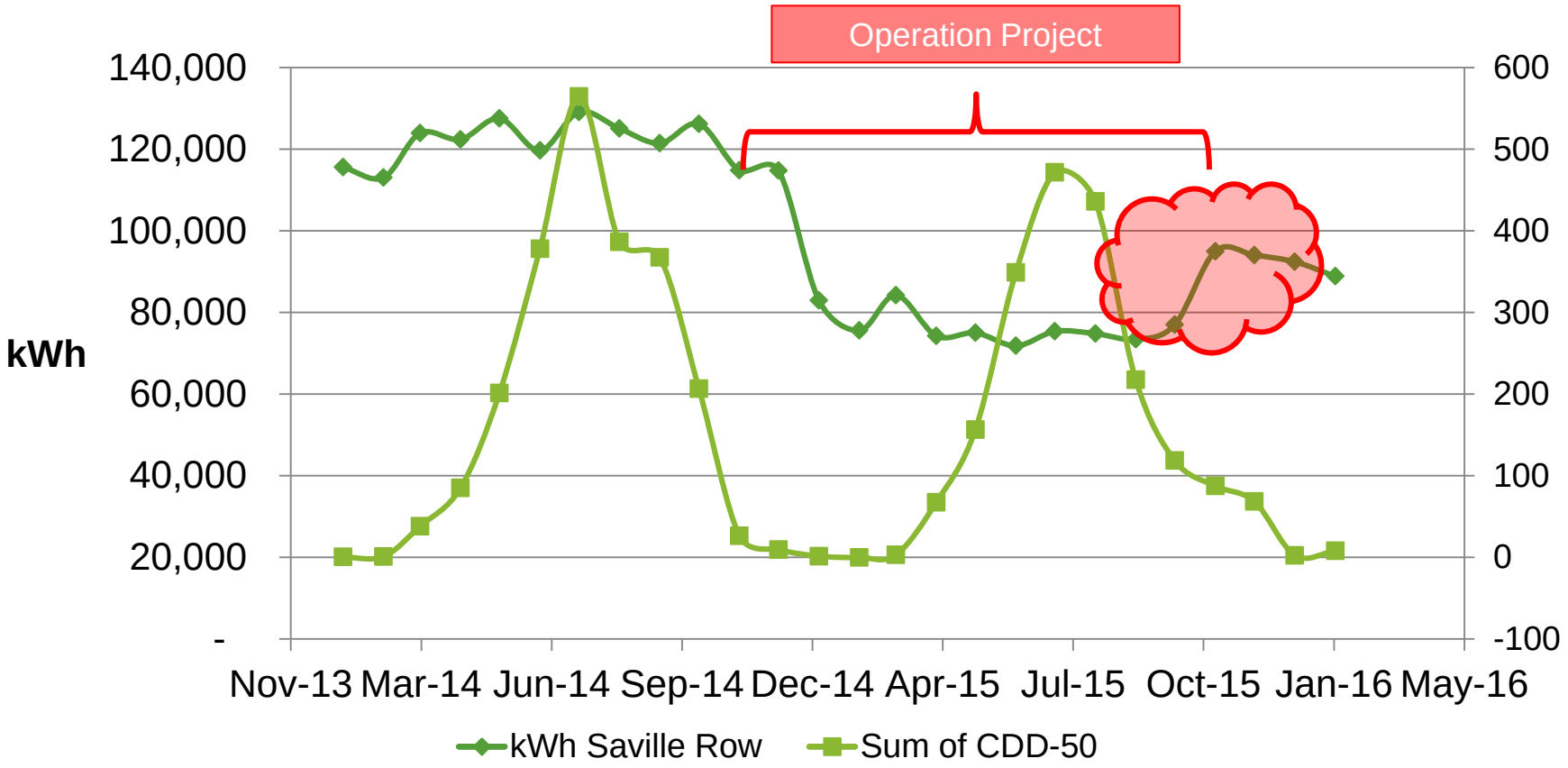
Sub-meter Pilot Project Results



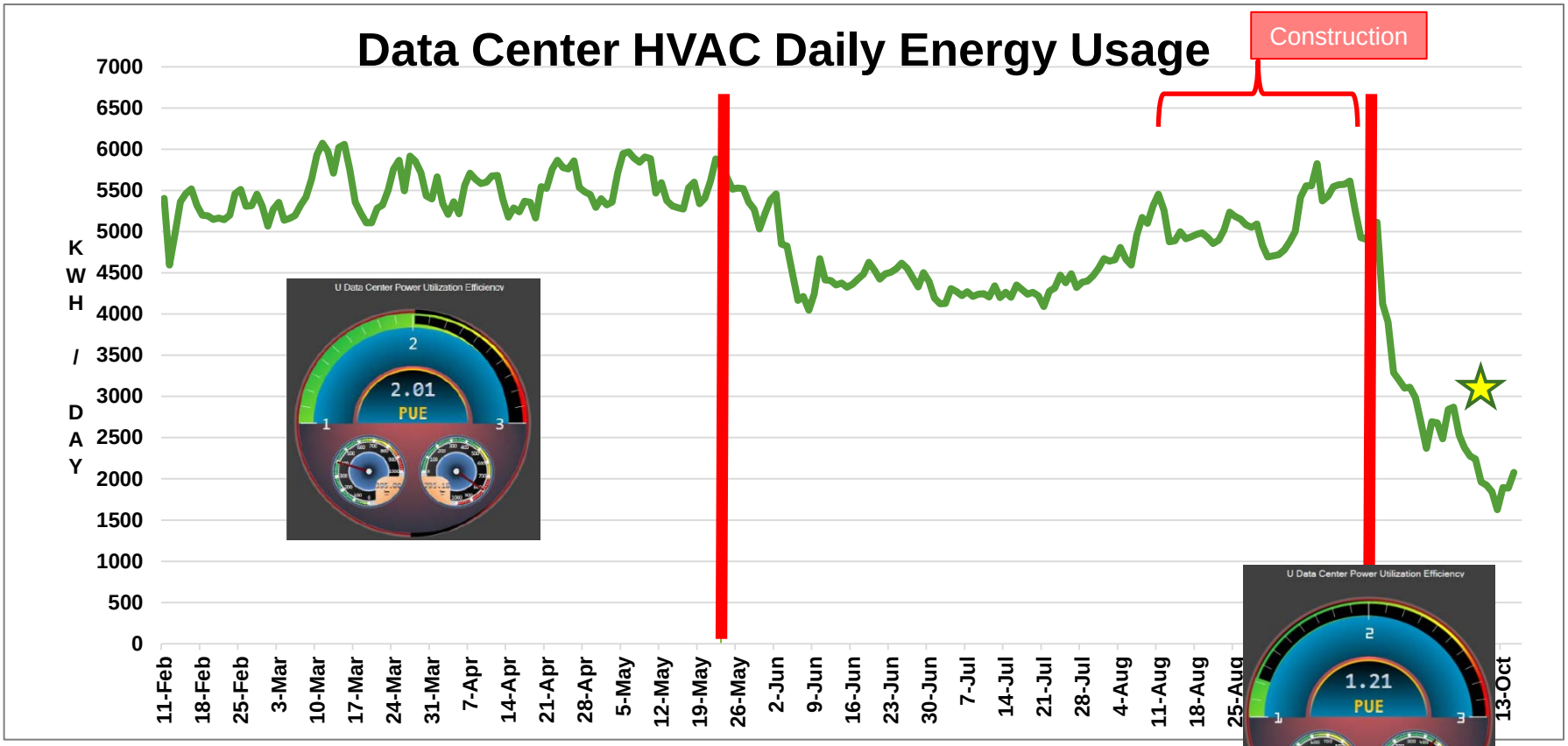
Store Renovation



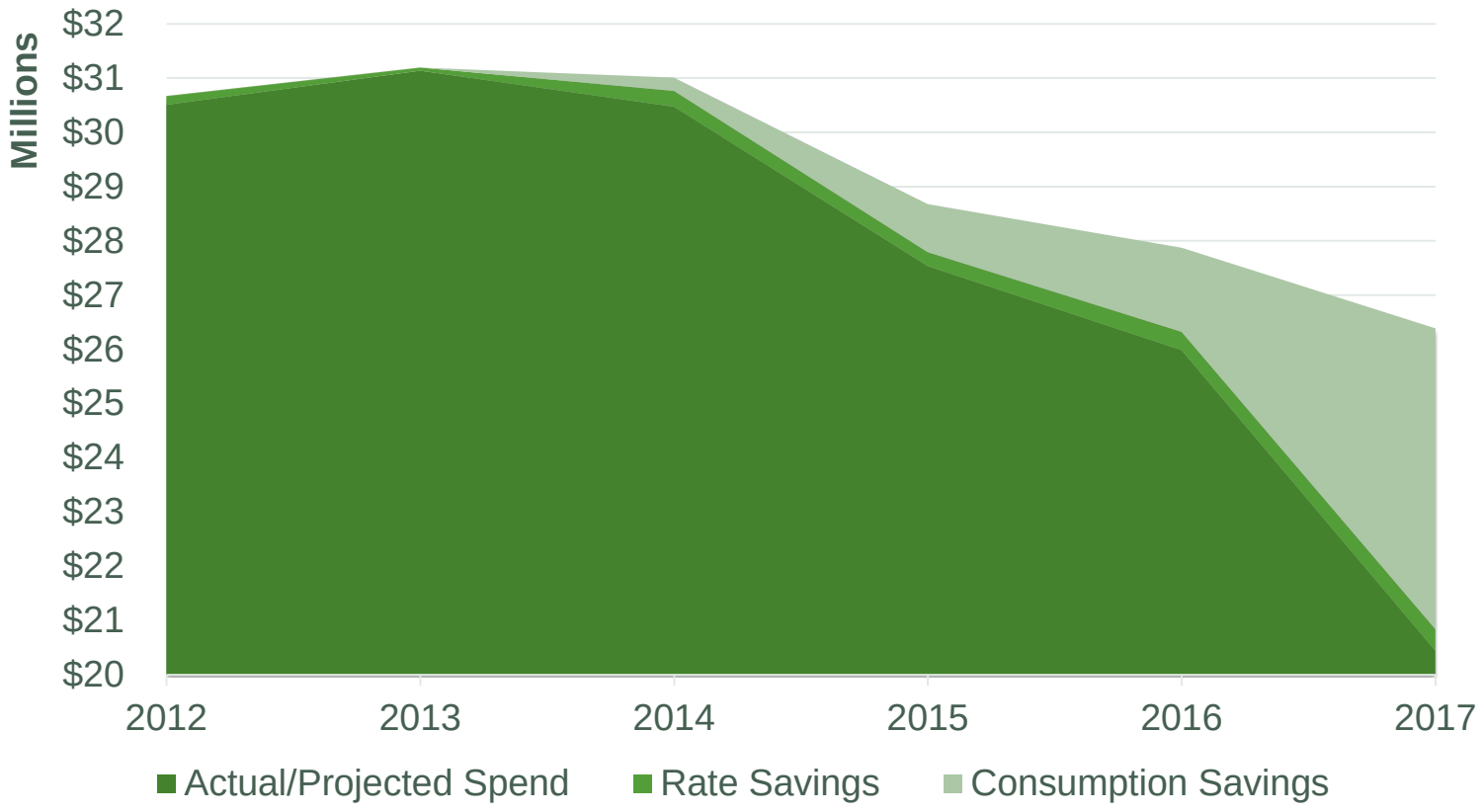
Operational Changes



Energy Improvement Project



Electrical Consumption Savings



Jonathan Flaherty

Tishman Speyer

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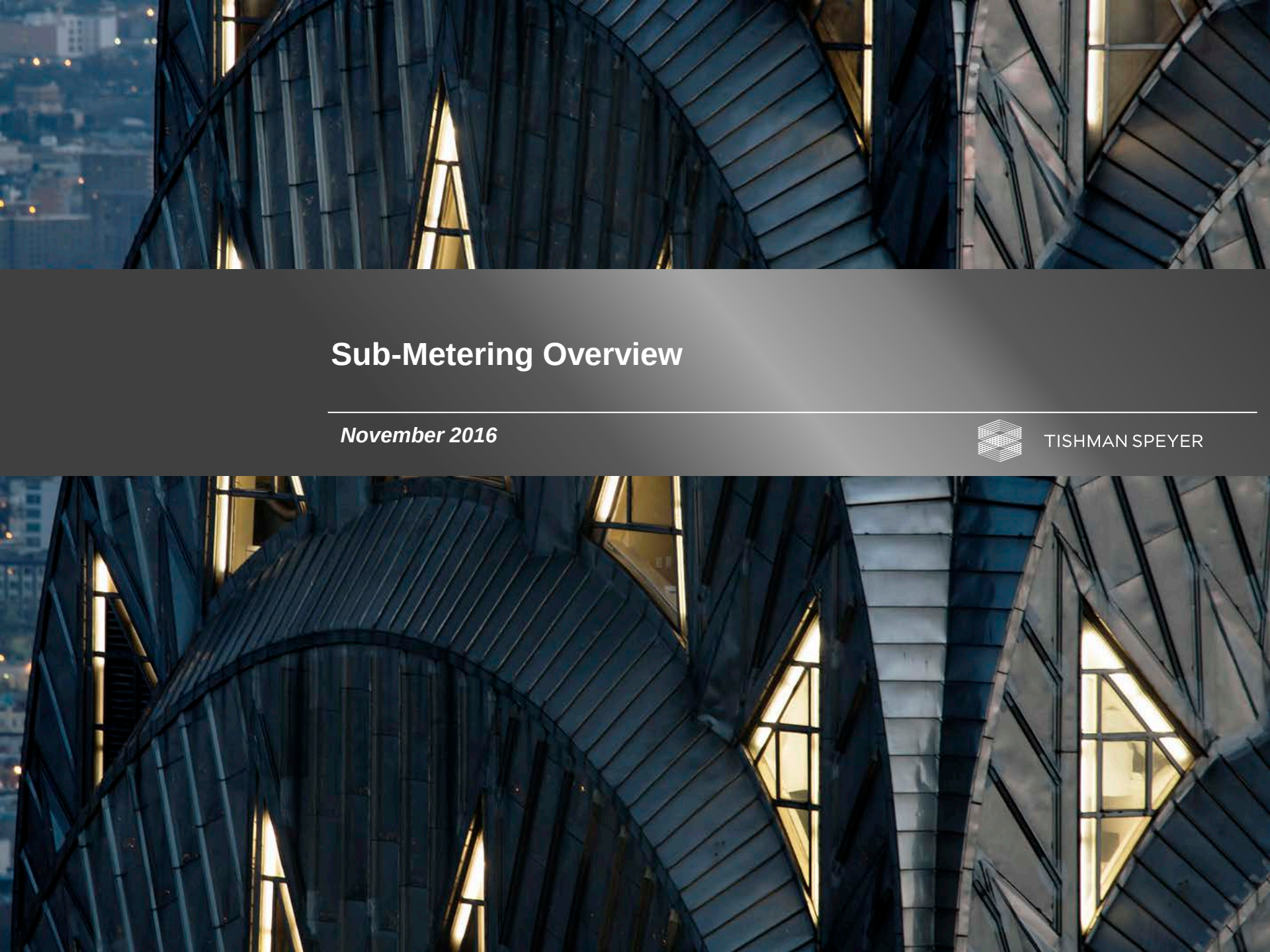


Sub-Metering Overview

November 2016

TISHMAN SPEYER

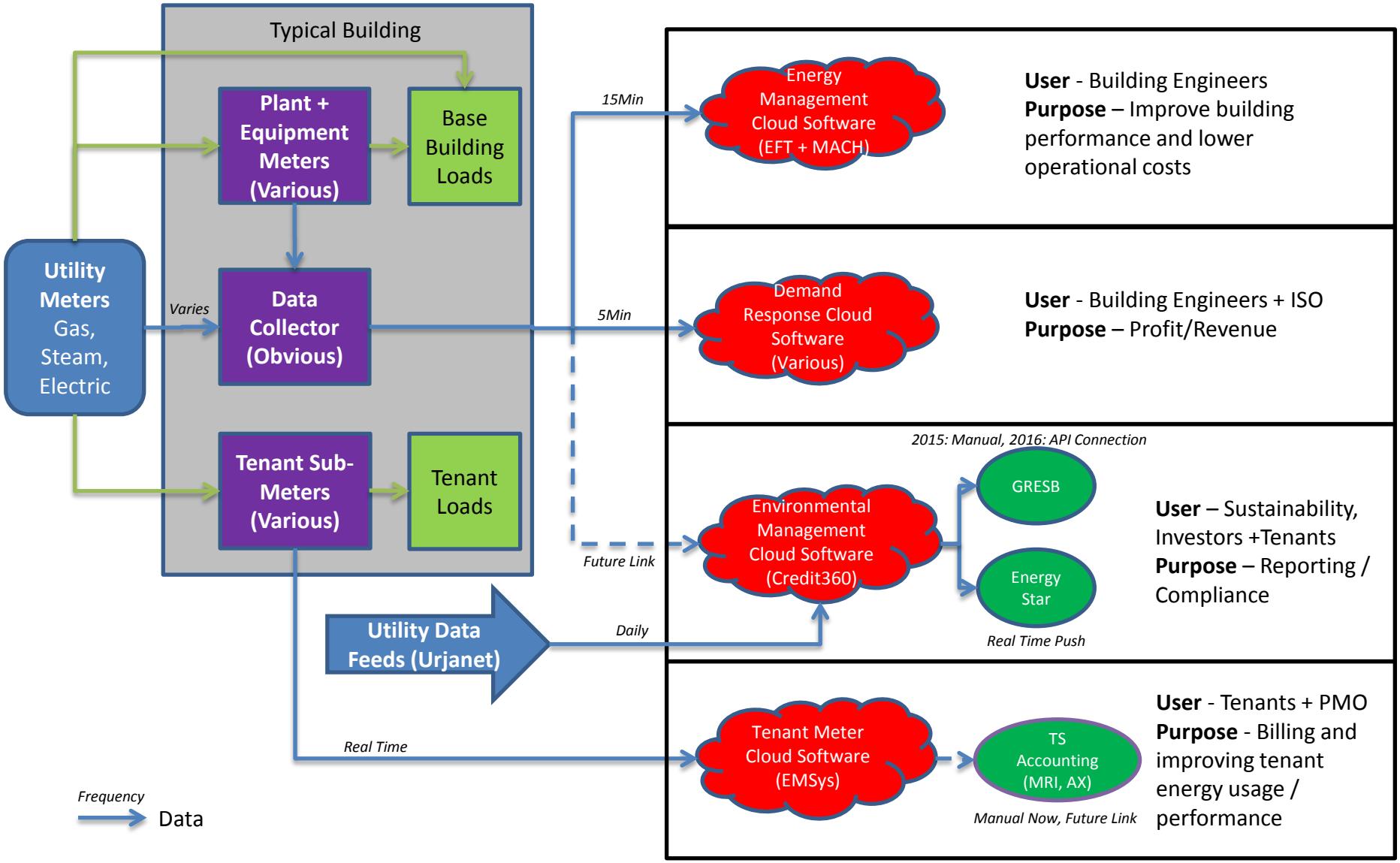
I. Sub-meter Architecture and Systems

TISHMAN SPEYER

Rockefeller Center, New York

Energy and Environmental Management Systems Operations

TISHMAN SPEYER



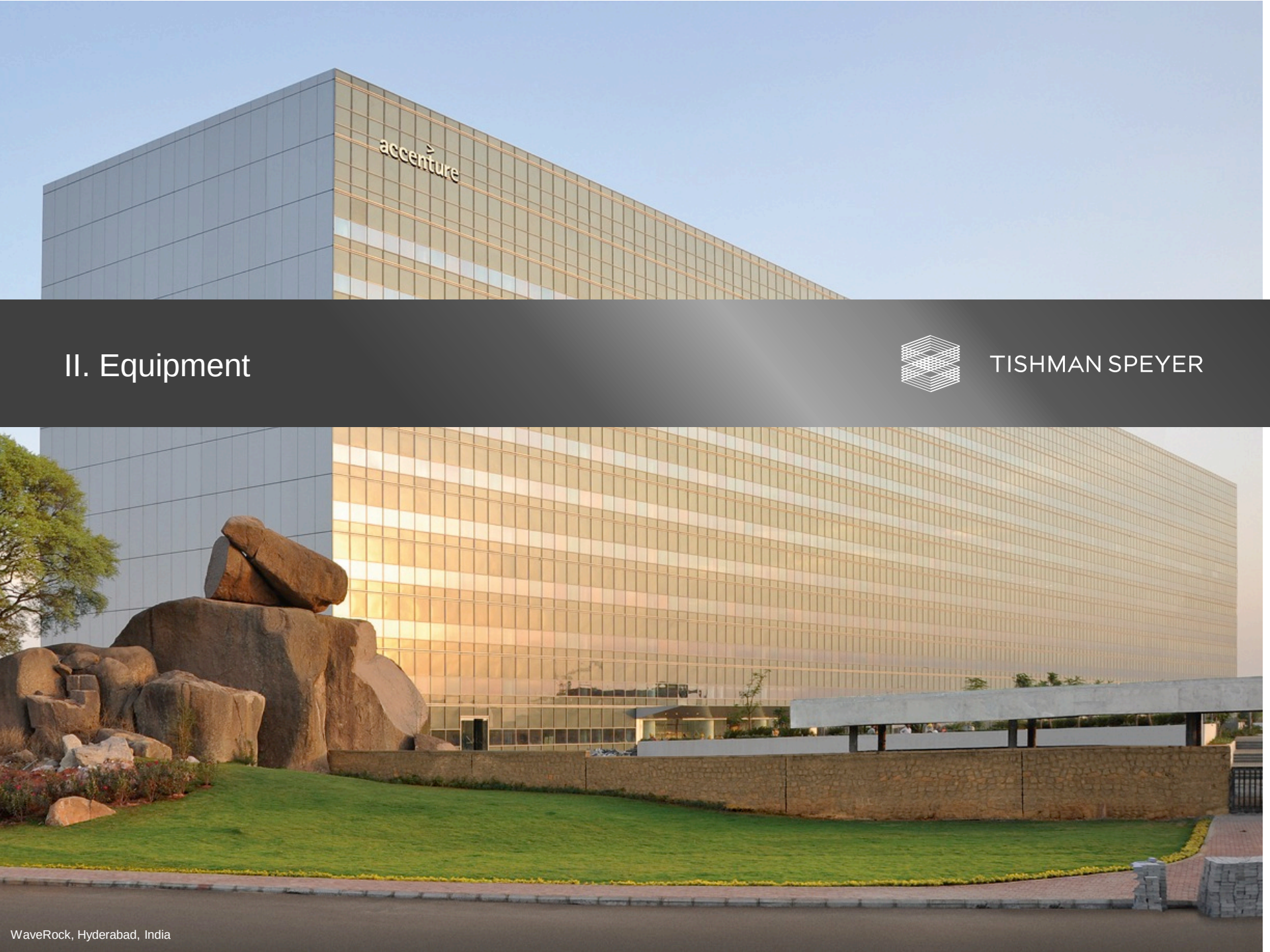
Energy and Environmental Management Systems Operations

TISHMAN SPEYER

Energy Management Cloud Software (EFT + MACH)	**User** - Building Engineers **Purpose** – Improve building performance and lower operational costs	*Current Deployment* All US operating properties
Demand Response Cloud Software (Various)	**User** - Building Engineers + ISO **Purpose** – Profit/Revenue	*Current Deployment* NYC and Chicago operating properties *Future* All US operating properties
2015: Manual, 2016: API Connection Environmental Management Cloud Software (Credit360) GRESB Energy Star *Real Time Push*	**User** – Sustainability, Investors +Tenants **Purpose** – Reporting / Compliance	*Current Deployment* All global operating properties
Tenant Meter Cloud Software (EMSys) TS Accounting (MRI, AX) *Manual Now, Future Link*	**User** - Tenants + PMO **Purpose** - Billing and improving tenant energy usage / performance	*Current Deployment* Some NYC and CA properties *Future* All NYC and some other US properties

II. Equipment

TISHMAN SPEYER



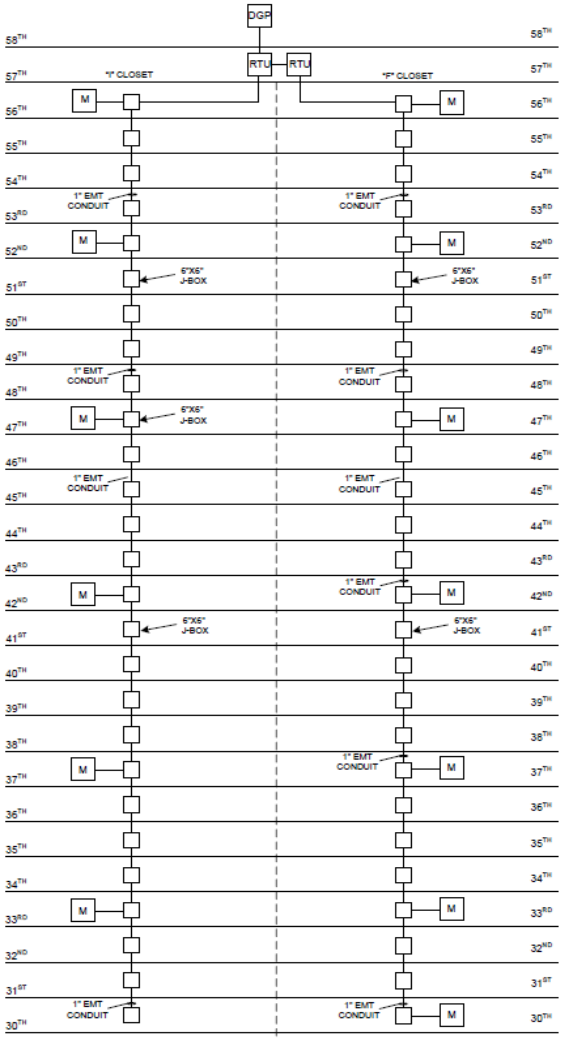
WaveRock, Hyderabad, India

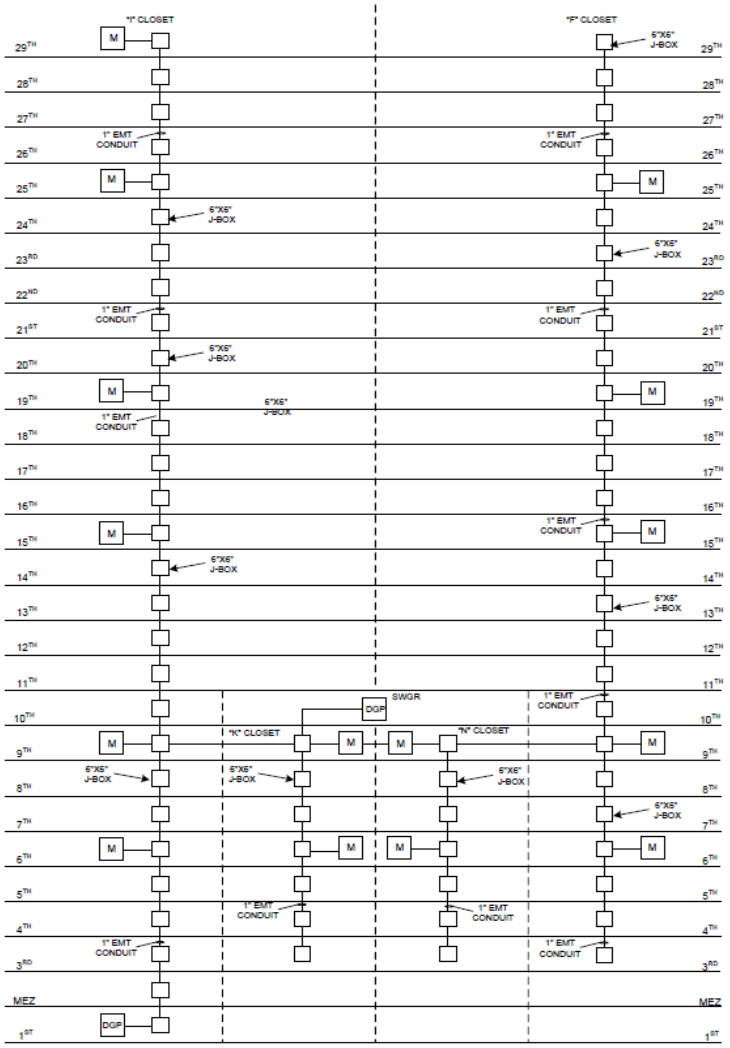
Data Acquisition Device

A8812 [x] Close

Approximately $1,500

Typical Tenant Sub-Meter Design





Multi Channel Meter

Approximately $4,000 - $5,000

Single Channel Meter

Approximately $1,200

Remote Terminal Unit

Approximately $6,500

Steve Greenberg

Lawrence Berkeley National Laboratory

U.S. DEPARTMENT OF ENERGY

Practical Considerations for Data Center Metering and Power Usage Effectiveness

Steve Greenberg, PE

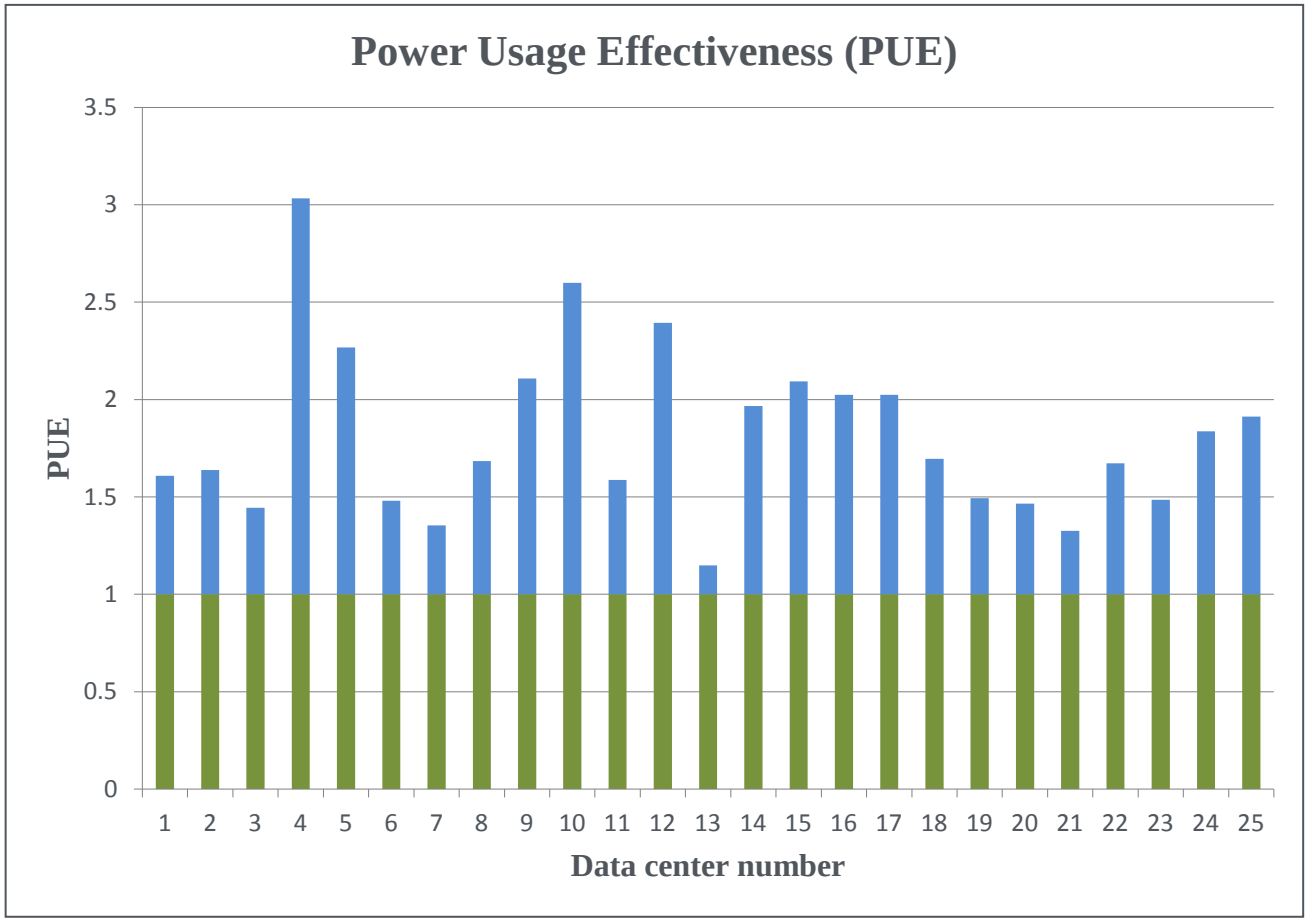
Lawrence Berkeley National Laboratory

Power Usage Effectiveness

- The ratio of total energy use to that of the information technology (IT) equipment
- A measure of how efficiently the data center infrastructure uses energy

$$\text{PUE} = \frac{\text{Total Data Center Facility Annual Energy Use}}{\text{IT Equipment Annual Energy Use}}$$

Power Usage Effectiveness, cont.



PUE Measurement Categories Recommended by the Green Grid

Table 1: PUE measurement categories recommended by this task force.

	PUE Category 0*	PUE Category 1	PUE Category 2	PUE Category 3
IT energy measurement location	UPS output	UPS output	PDU output	IT equipment input
Definition of IT energy	Peak IT electric demand	IT annual energy	IT annual energy	IT annual energy
Definition of Total energy	Peak Total electric demand	Total annual energy	Total annual energy	Total annual energy

*For PUE Category 0 the measurements are electric demand (kW).

Courtesy of TGG

PUE Levels and Measurement Points

Table 1. High-level breakdown of The Green Grid's three-level approach to PUE measurement

	Level 1 (L1) Basic	Level 2 (L2) Intermediate	Level 3 (L3) Advanced
IT Equipment Energy	UPS Outputs	PDU Outputs	IT Equipment Input
Total Facility Energy	Utility Inputs	Utility Inputs	Utility Inputs
Measurement Interval	Monthly/Weekly	Daily/Hourly	Continuous (15 minutes or less)

- Focus on Level 1, the default for Better Buildings
- Note table assumes standalone data centers where total is measured by the utility inputs

Stand-alone Data Center Total Metering

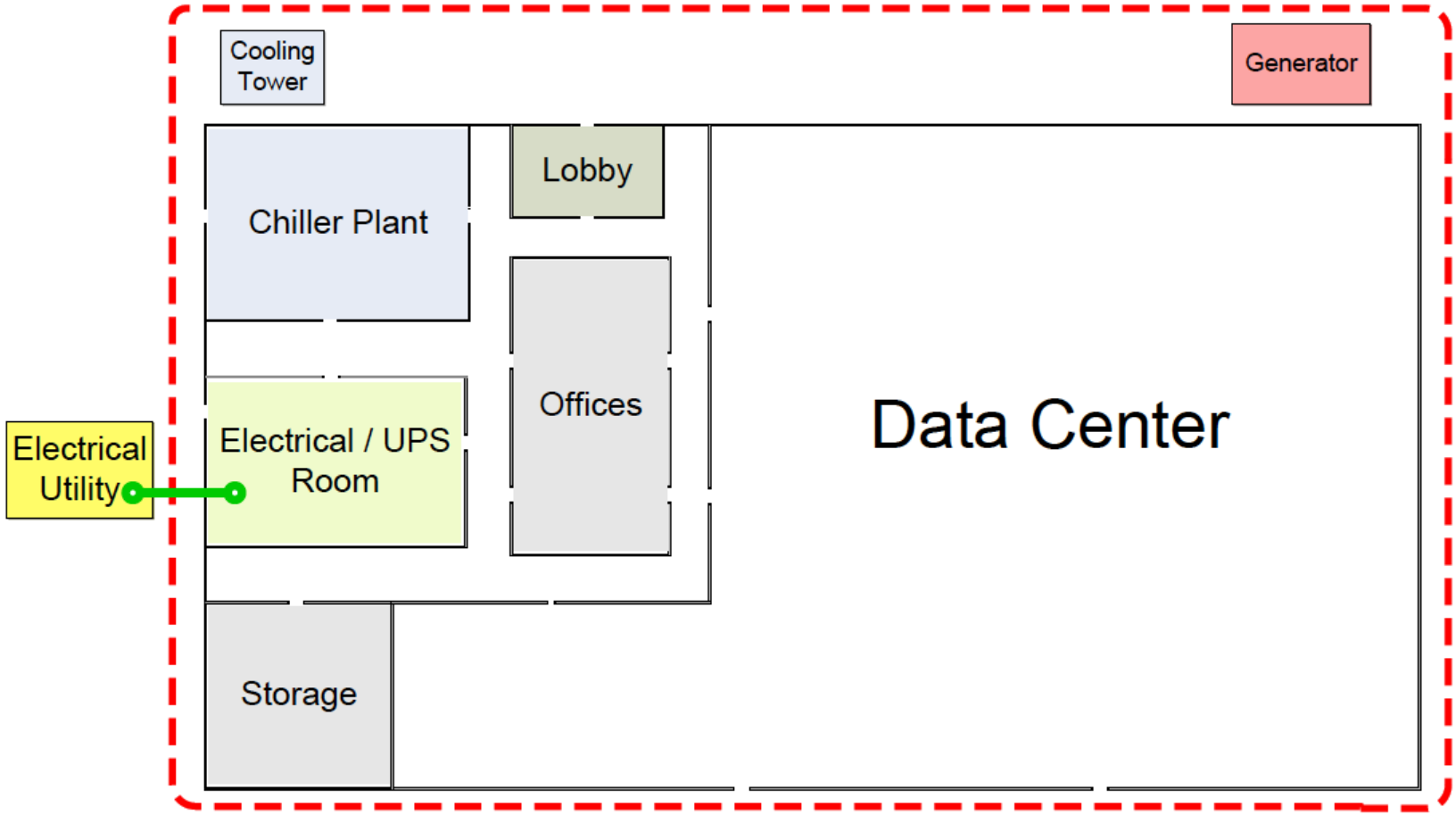


Figure 12. Control volume for a dedicated data center

Embedded Data Center Metering of Power and Cooling (Proxy for Total)

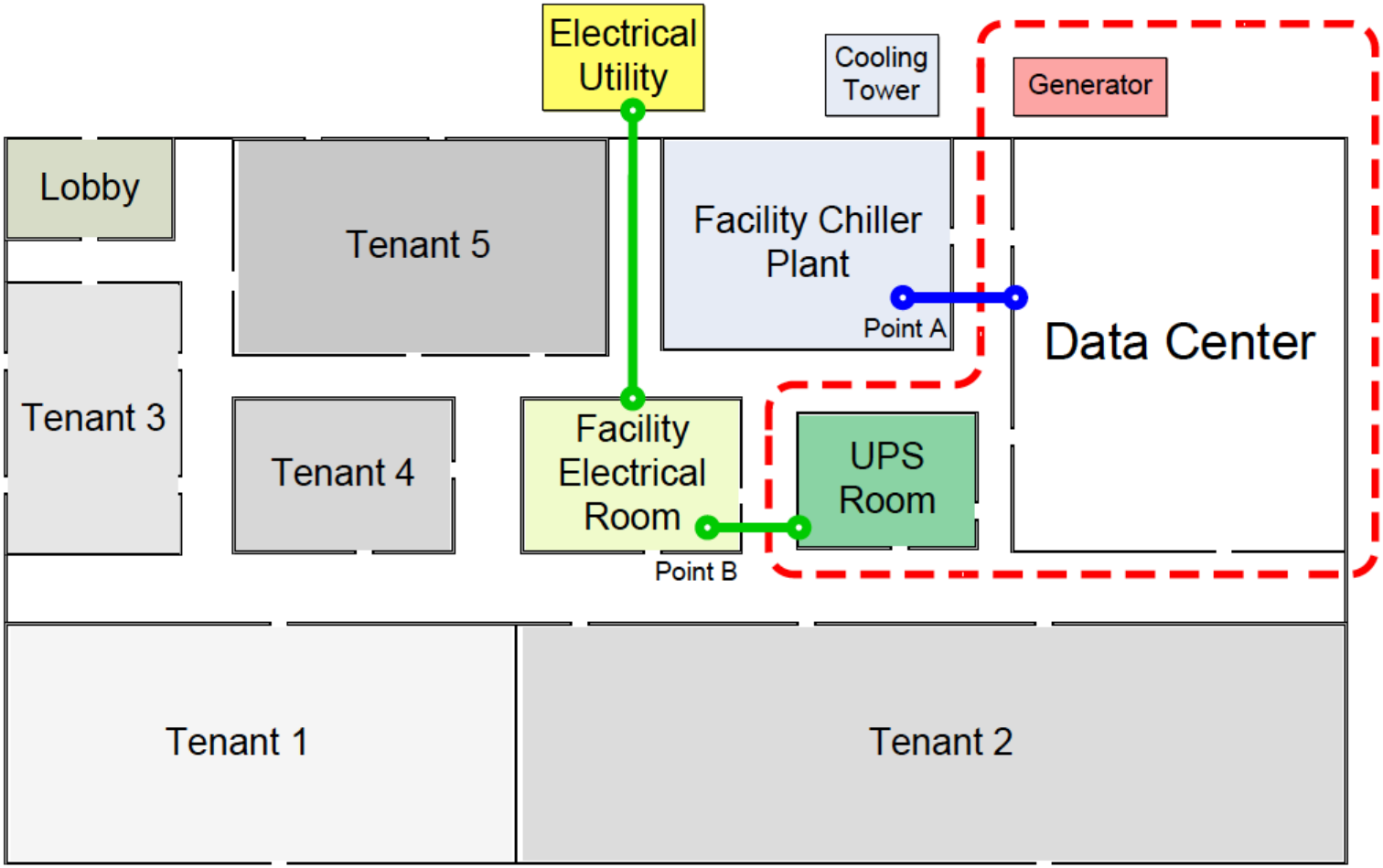


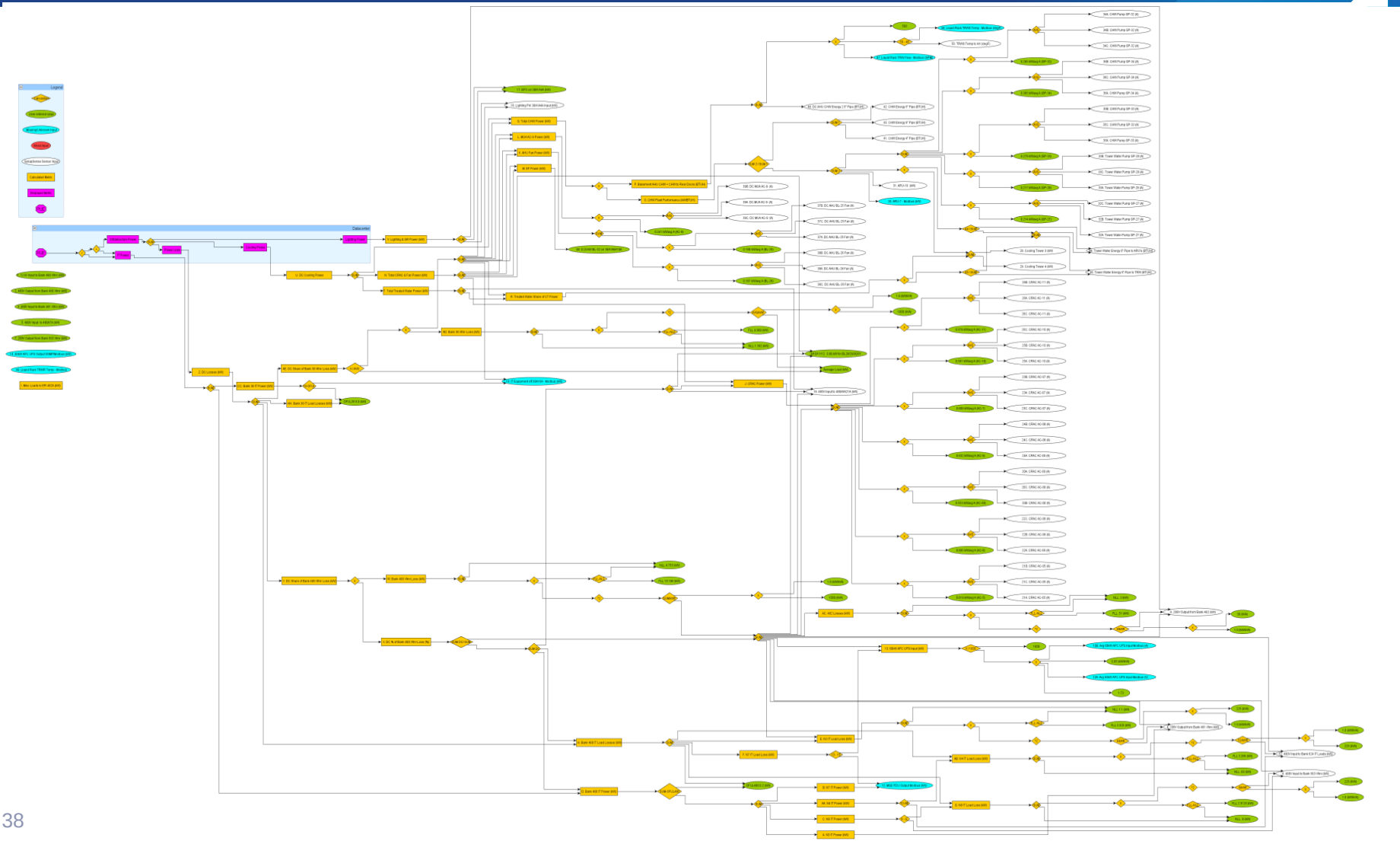
Figure 13. Control volume for a data center within a mixed-use building

Infrastructure Components

- Energy using Power and HVAC components contributing to the total data center energy use
- Each could require one or more meters in an embedded data center

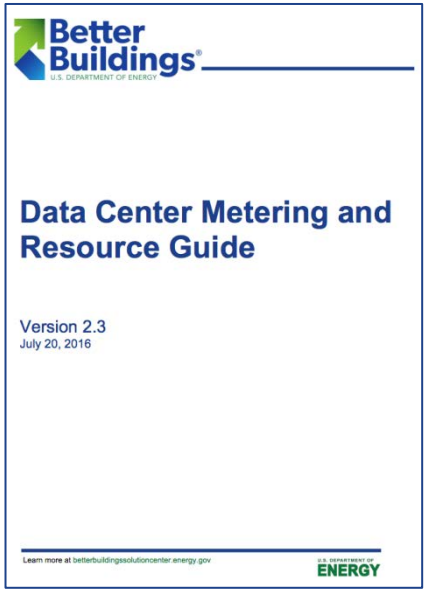
Power
Automatic transfer switches (ATS)
Switchgear
UPS
DC batteries/rectifiers (non UPS – telco nodes)
Generators
Transformers (step down)
Static transfer switches (STS)
Power distribution units (PDUs)
Rack distribution units (RDUs)
Breaker panels
Distribution wiring
Lighting
Heating Ventilation and Air Conditioning (HVAC)
Cooling towers
Condensers and condenser water pumps
Chillers
Heating Ventilation and Air Conditioning (HVAC)
Chilled water pumps
Water treatment systems
Well pumps
Computer room air conditioners (CRACs)
Computer room air handlers (CRAHs)
Dry coolers
Air compressors
Supply fans
Return fans
Air economizers
Water-side economizers
Dehumidifiers
Humidifiers
Heaters
In-row and in-rack cooling solutions
Condensate pumps

PUE Calculation Diagram



Getting Started

- Data Center Metering and Resource Guide
  - A practical guide to measuring PUE



datacenters.lbl.gov/resources/data-center-metering-and-resource-guide

Estimates don’t tell the whole story

- While such compromises allow one to estimate PUE it does not allow one to track performance and improvement over time…

Meter What is Important

- Need to meter enough to show changes (improvements with energy efficiency measures)
- Compromises reduce ability to compare to others but perhaps not to self
  - Estimate some small loads such as:
    - Generator heaters
    - Lights
    - Transformer and cable losses
    - Estimates based on:
      - Engineering calculations
      - One time measurements of constant loads
  - Estimate efficiencies
    - Chiller plant (design, control panel readouts, BMS)
    - UPS (manufacturer's curve)

Lessons Learned Determining PUE at LBNL (based on 3 cases)

- Is case-by-case—every center is different
- Takes advantage of existing meters
- Minimizes estimation
- Typically involves numerous meters

- How much is enough?
- How much is too much?
- Triage for cost-benefit

Additional Resources

U.S. DEPARTMENT OF ENERGY

Resources

- Data Center Metering and Resource Guide

  datacenters.lbl.gov/resources/data-center-metering-and-resource-guide

- PUE: a Comprehensive Examination of the Metric

  thegreengrid.org/en/Global/Content/white-papers/WP49-PUEAComprehensiveExaminationoftheMetric

- Center of Expertise for Energy Efficiency in Data Centers

  datacenters.lbl.gov/

Q & A

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Learn about ways and available tools to find funding for energy efficiency projects and how to avoid common pitfalls.


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