

Charting a Course to Energy Independence

**Providence, RI
August 9-12, 2009**



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Make Your Meters Pay for
Themselves





Topics

- Energy metering versus power monitoring
- Budget costs for submetering
- Options for other utilities
- 4 sample strategies
- Savings from 4 sample strategies
- Questions and answers



Power monitoring vs. energy metering

Power monitoring

- Key focus is quality, not quantity or cost
- Measures high speed events and quality issues such as harmonics, transients, etc
- Appropriate for primary service, IT buildings
- Typical cost is \$5,000 to \$10,000 per building

Energy metering

- Focus on consumption and demand
- Measures kWh and kW (also gas, water, steam)
- Appropriate for buildings with non-critical power quality issues (i.e., most buildings)
- Typical cost is \$1,500 to \$2,500 per building



Budget costs for submetering

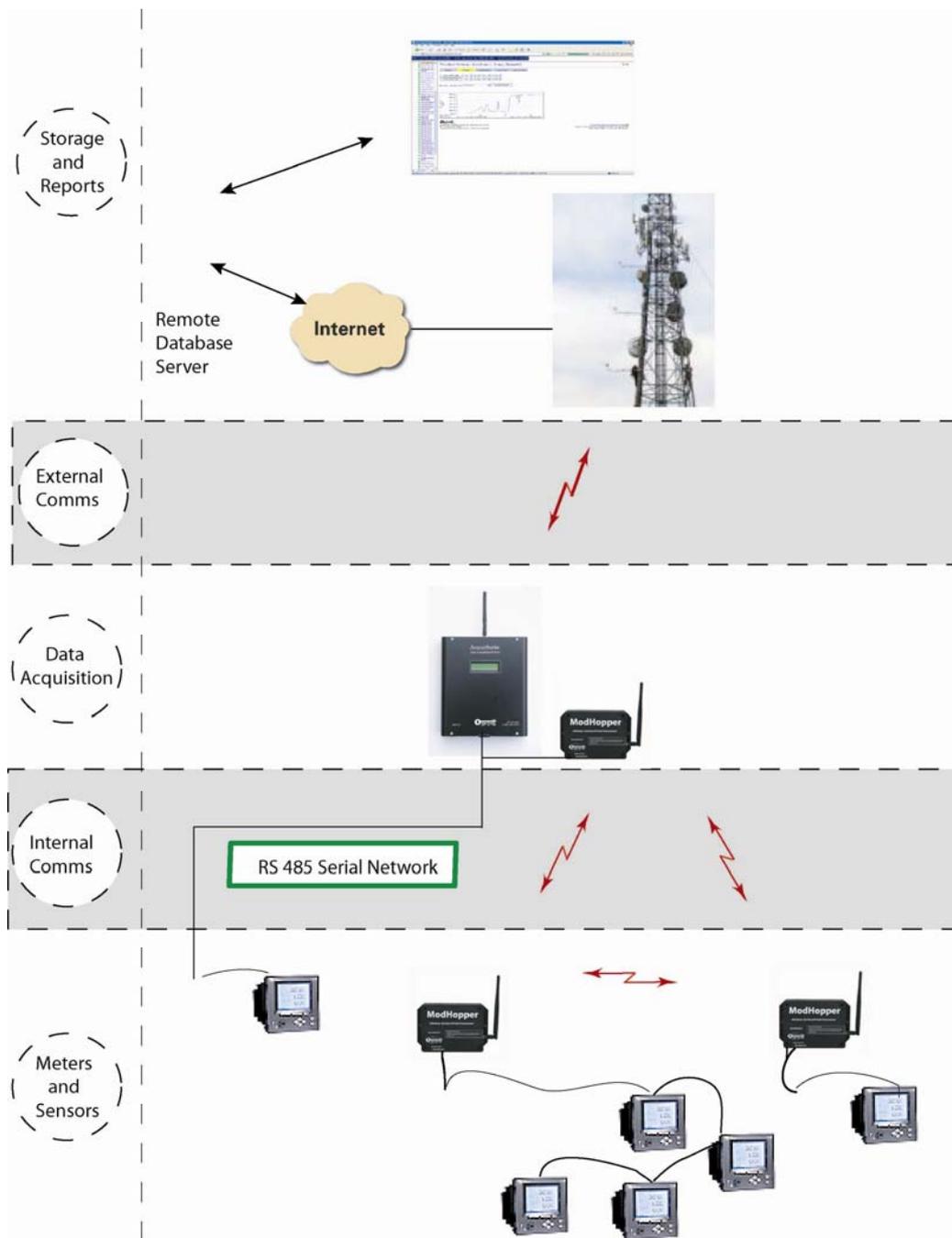
| <u>Item</u> | <u>Low</u> | <u>High</u> |
|----------------------------|------------|-------------|
| Electrical submeter | 400 | 1000 |
| Data acquisition and comms | 600 | 1000 |
| Wiring | 200 | 200 |
| Miscellaneous | <u>300</u> | <u>300</u> |
| Totals | \$1500 | \$2500 |

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System architecture







Options for other utilities

- Data acquisition server can handle pulses or analog outputs for additional utilities including:

Gas

Water

Steam

Chilled water

BTU's

Compressed air



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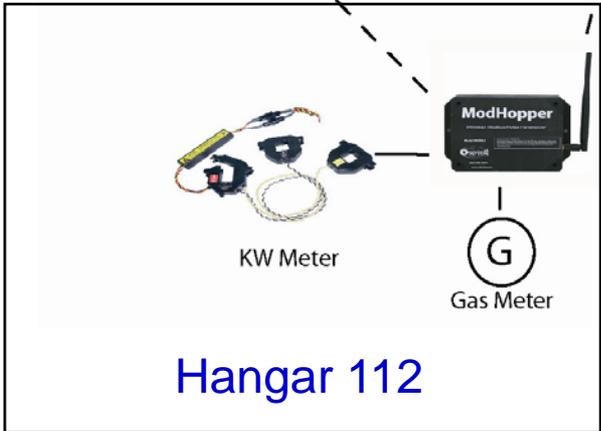
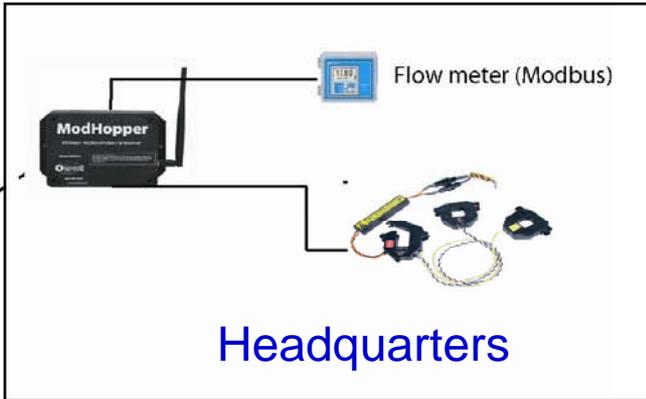
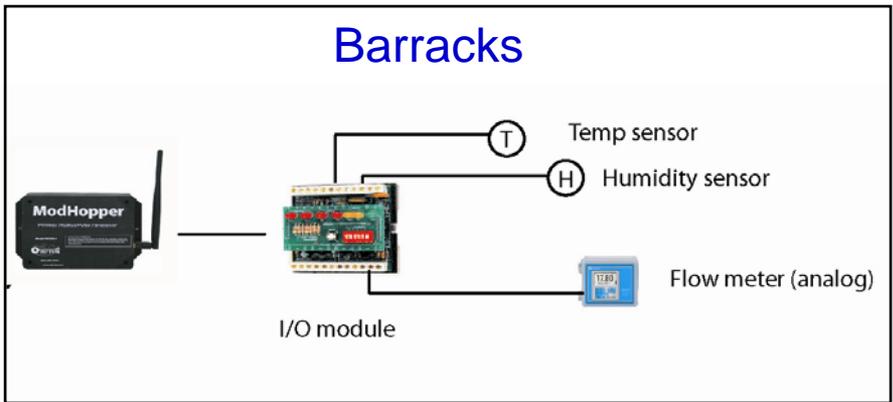
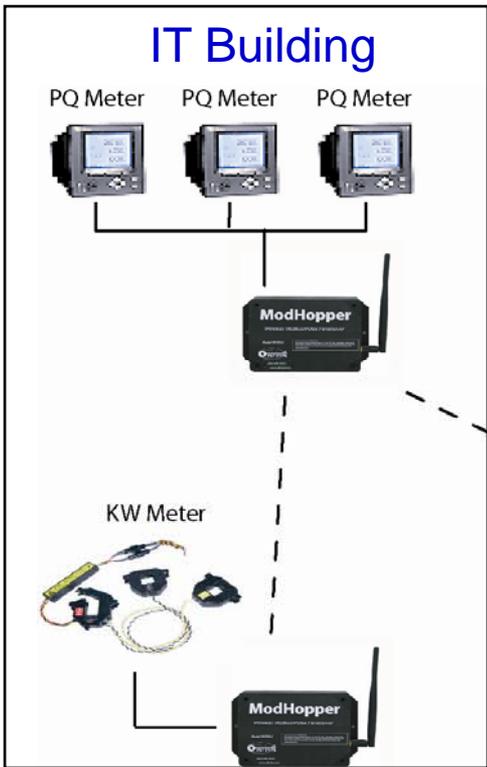
Communication Options





Meter wiring options

- Meters hard-wired (RS485 daisy chain) – max of 4000 ft between buildings
- Meters wireless – up to 14 miles line of sight between buildings



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Using submeter data – 4 strategies





Submetering: process, not project

“Metering alone produces \$0 savings... it's the appropriate actions that follow when something is discovered that is ‘not optimal’ that result in energy savings.”

Paul Allen, Energy Manager for Disney World



Sample strategies for submetering

1. Install meters only with software for collecting data
2. Metering with cost allocation software
3. Metering with cost allocation and operational analysis and fine-tuning (Building Tune Up)
4. Metering with cost allocation, intensive monitoring of major energy consuming equipment using specialized software and outside review of operations and verification of savings (Continuous commissioning)



Strategy 1 – Submetering only

1. Meters and data collection



Strategy 1 – Meters Only

- Install submeters in buildings for:
 - Storing energy data from individual buildings
- Major actions and outputs:
 - Storing of information



Strategy 1: Metering only

Building Manager Online - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address <http://www.obvius.com/members/index.php>

BUILDING MANAGER ONLINE

Status Report

- Lewis
- Bi-Lo Stores
- Eckhoff Services
- Burger King
 - Burger King - Plym
 - Burger King P
- Dennys
- MSNCountry
- Miratron
- Main Building
 - Energy Meter
 - UKWH Power
 - Loading Dock
- Obvius
- Veris Industries
- Secure Design

Energy Meter

Status Graph Configuration View Data Export Data

Pick Start Date Sep 5 2003 11:00

Pick End Date Sep 12 2003 11:00

8hr, 1dy, 1wk, 1m, 1yr, Real Power Update Graph

Min 0.55
Max 16.17

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support@buildingmanageronline.com
Current time: Friday, September 12 2003 11:59:33 PDT
Username: jlewis, Timezone: US/Pacific

Done

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Strategy 2 – Cost allocation

- Meters and data collection +
- Cost allocation to tenants



Strategy 2 – Cost allocation process

- Install submeters in buildings for:
 - Accountability for meeting conservation goals
 - Cost allocation to departments and outside vendors
- Major actions and outputs:
 - Monthly reports for all departments
 - Monthly bills to outside vendors



Cost allocation report

Building Manager Online - Microsoft Internet Explorer

Address: http://www.obvius.com/members/index.php

BUILDING MANAGER ONLINE

Status Report

- Lewis
- Bi-Lo Stores
- Edkoff Services
- Burger King
- Dennys
- MSHCountry
- Miratron
- Obvius**
- Veris Industries
- Secure Design

Obvius: Consumption Report

AcquiSuite Inventory | Userlist | **Consumption Report**

Note: this report page is under development, and is not fully functional. If you have any suggestions for features or useability, please contact support@obvius.com

Pick Start Date: Sep 20, 2003 14:00
Pick End Date: Oct 21, 2003 14:00
Cost per KWh: \$0.05 Update Table Data

| Name | Serial Number | Device | Point | Consumption | Cost |
|-------------|---------------|------------------------------------|--------------------|-------------------|------------|
| Demo Case 2 | 0090960EC1B4 | Enercept Power Meter | Energy Consumption | invalid (no data) | |
| Test System | 444D5000060A | Enhanced IO Module - A8923-4 v1.11 | ION6200 DO#1 | 45798 KWh | \$ 2289.90 |
| Test System | 444D5000060A | Enhanced IO Module - A8923-4 v1.11 | Pulse #3 | 0 kwh | \$ 0.00 |
| Test System | 444D5000060A | Enhanced IO Module - A8923-4 v1.11 | MegaPower | 0 MWh | \$ 0.00 |
| Test System | 444D5000060A | Veris H8163-CB | Energy Consumption | invalid (no data) | |
| Test System | 444D5000060A | Squared H8163-CB | Energy Consumption | invalid (no data) | |
| Test System | 444D5000060A | Squared Enercept Enhanced | Energy Consumption | 131.92 kWh | \$ 6.60 |
| Test System | 444D5000060A | Squared Enercept Basic | Energy Consumption | 116.63 KWh | \$ 5.83 |
| Test System | 444D5000060A | Veris H8036 | Energy Consumption | invalid (no data) | |
| Test System | 444D5000060A | Veris H8035 | Energy Consumption | 117.86 KWh | \$ 5.89 |
| Test System | 444D5000060A | MCM Meter #1 | Energy Consumption | 0 kWh | \$ 0.00 |
| Test System | 444D5000060A | MCM Meter #2 | Energy Consumption | 0 kWh | \$ 0.00 |
| Test System | 444D5000060A | MCM Meter #3 | Energy Consumption | 0 kWh | \$ 0.00 |
| Test System | 444D5000060A | MCM Meter #4 | Energy Consumption | 0 kWh | \$ 0.00 |
| Test System | 444D5000060A | MCM Meter #5 | Energy Consumption | 0 kWh | \$ 0.00 |

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Cost Allocation

Microsoft Excel - bill_example.xls

File Edit View Insert Format Tools Data Window Help Adobe PDF

Arial 10 B I U

G44 =

| | A | E | C | E | F | G | H | I | J | K | L | M | N | O | P |
|----|---|---|-------------|-------------|---|------------|---------------------|---|------------------------|-------------------|---|---|---|---|---|
| 4 | | | | | | | | | | | | | | | |
| 5 | For Utility Service | | | | | | | | | | | | | | |
| 6 | Environmental Systems | | | | | | | | Account Number | 10-EVS-NPLLC | | | | | |
| 7 | 10 Norden Place | | | | | | | | Statement Date | 10/22/2003 | | | | | |
| 8 | Norwalk CT. 06854 | | | | | | | | Service address | Norden Place LLC | | | | | |
| 9 | | | | | | | | | | Norden Place | | | | | |
| 10 | Att: Accounts Payable | | | | | | | | | Norwalk CT 06851 | | | | | |
| 11 | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | |
| 13 | Delivery Services | | CL&P | | | \$1,348.90 | | | | | | | | | |
| 14 | Supplier Services | | CL&P | | | \$2,678.00 | | | | | | | | | |
| 15 | Total Current Electric | | Charges | | | \$4,026.90 | | | | | | | | | |
| 16 | | | | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | | | | |
| 19 | Current Charges | | \$4,026.90 | Current Use | | 61,792 KWh | Cost per KWH | | | \$0.065169 | | | | | |
| 20 | | | | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | | | | |
| 24 | Billing Period | | From | | | To | | | | Days | | | | | |
| 25 | | | 12-May | | | 28-Aug | | | | 108 | | | | | |
| 26 | | | | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | | | | |
| 28 | Environmental Systems Energy Usage | | | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | | | | |
| 30 | Electricity Use | | | | | | | | 47,470 KWh | \$3,093.55 | | | | | |
| 31 | | | | | | | | | | | | | | | |
| 32 | | | | | | | | | | | | | | | |
| 33 | | | | | | | | | | | | | | | |
| 34 | | | | | | | | | | | | | | | |

Environmental_Systems | Bill_Dates

Ready NUM

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Strategy 3 – Building tune-up

- Meters and data collection +
- Cost allocation to tenants +
- Building tuneup – regular review of building operations and energy consumption with building occupants and internal personnel



Strategy 3 - Building tune-up process

- Install submeters in buildings for:
 - Accountability for meeting conservation goals
 - Cost allocation to departments and outside vendors
 - Identification of inefficient operations
 - Fine-tuning of building controls
- Major actions and outputs:
 - Monthly reports for all departments
 - Monthly bills to outside vendors
 - Internal review and adjustment of building operations (time schedules, etc,)

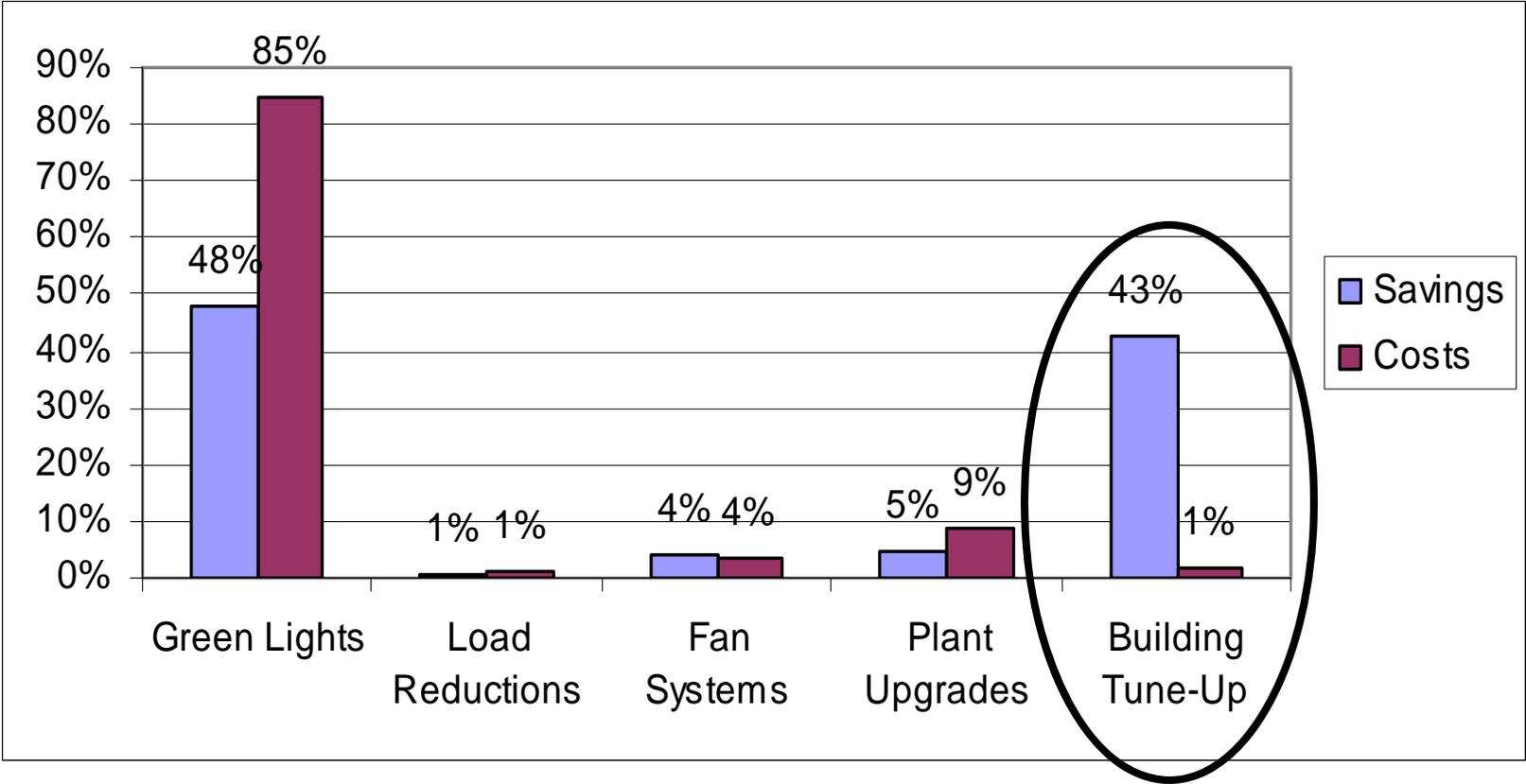
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Does it work?



Energy Star Results – Disney World



Overall Program Results – 44% IRR

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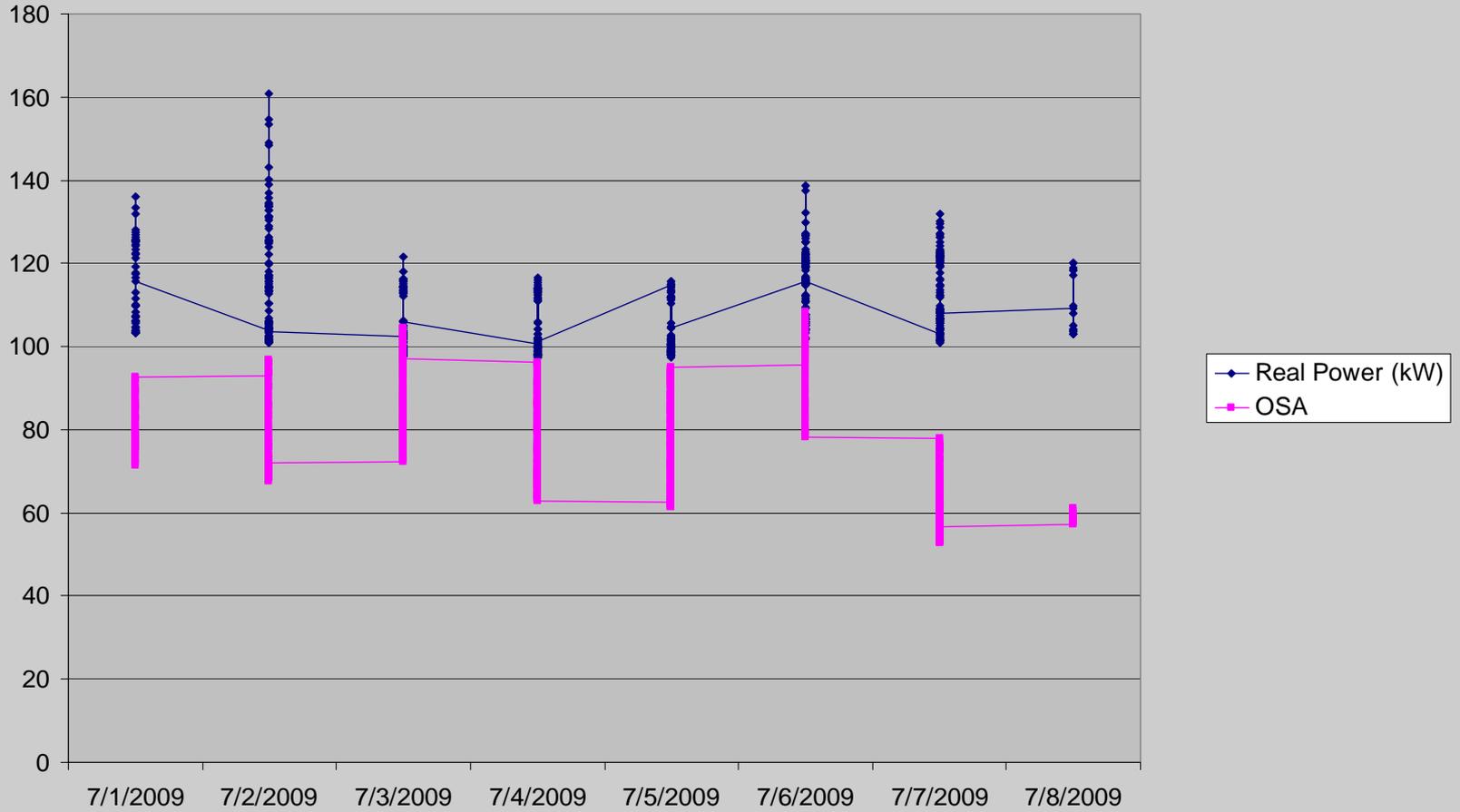
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How does it work?





kW vs Outside Air Temp





Pearson Product Moment Correlation Coefficient

•The equation for the Pearson product moment correlation coefficient, r , is:

$$r = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \sum (y - \bar{y})^2}}$$

where \bar{x} and \bar{y} are the sample means `AVERAGE(known_x's)` and `AVERAGE(known_y's)`.
RSQ returns r^2 , which is the square of this correlation coefficient.



Just kidding!!

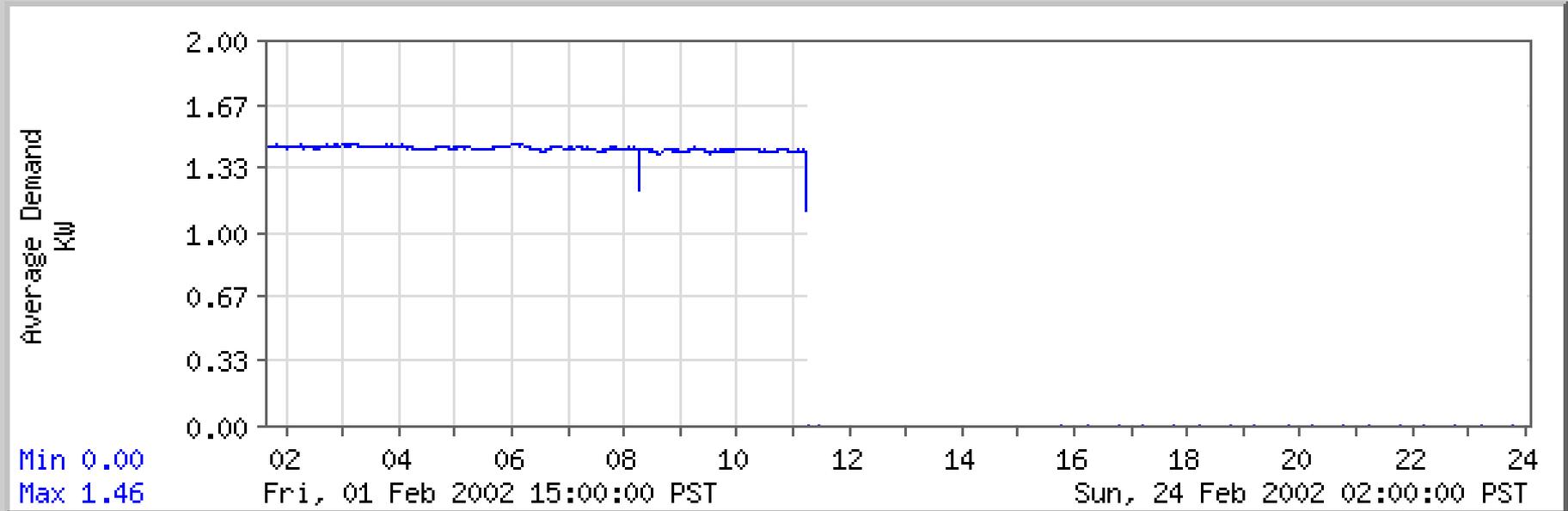


Using meter data for fine-tuning

- Review interval data regularly for:
 - Variance between occupancy and run time
 - Benchmarking between similar buildings
 - Seasonal variances in start/stop time
- Benchmark and evaluate:
 - Major energy projects (ECM's)
 - ESPC projects
 - Minor adjustments to building operations



Load profile example





Load profile example





Load profile example





Strategy 4 – Continuous commissioning

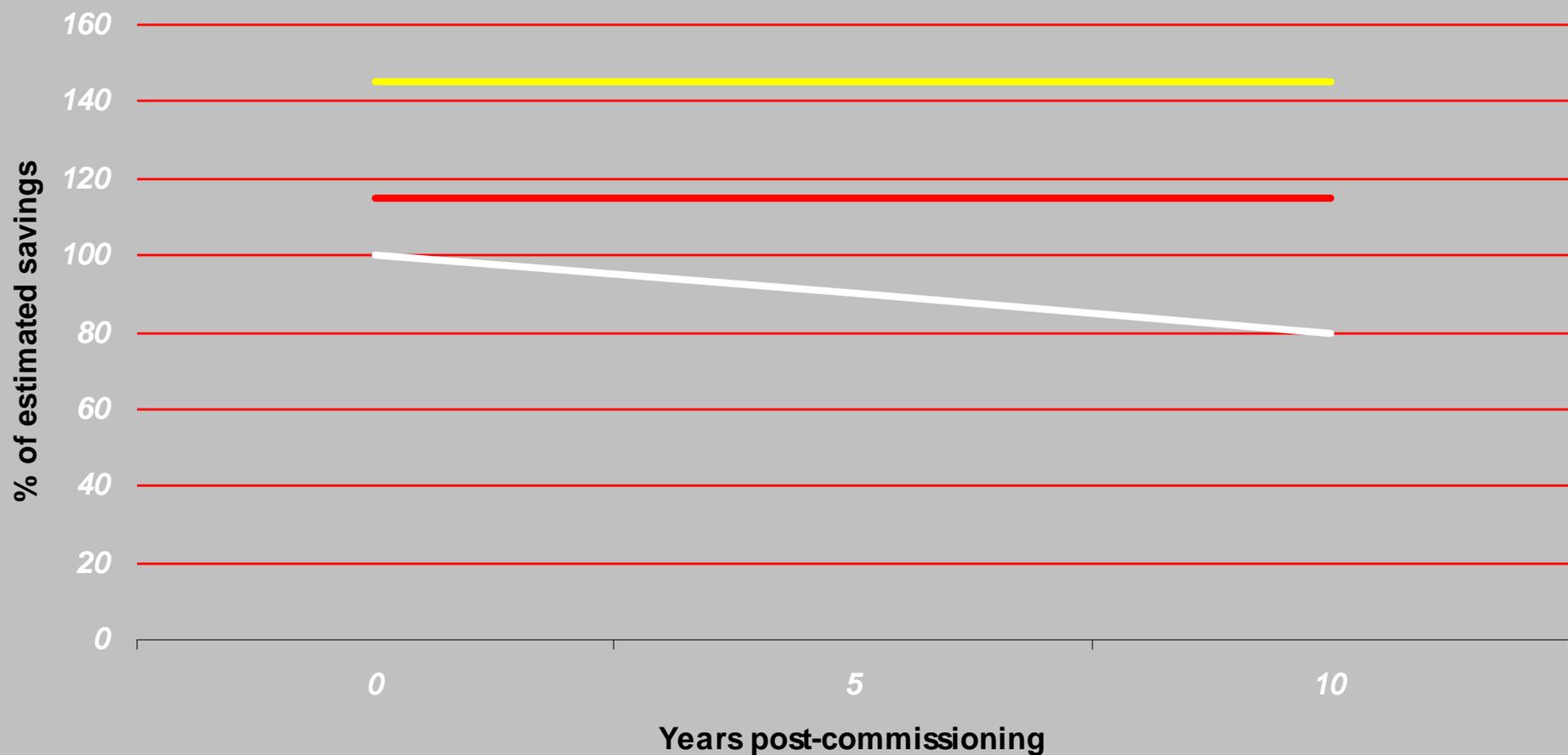
- 1) Meters and data collection +
- 2) Cost allocation to tenants +
- 3) Building tune –up +
- 4) Formalized process to continuously monitor and adjust equipment operations in conjunction with internal personnel and outside consultants/experts



Strategy 4 - Continuous commissioning

- Install submeters and specialized software for:
 - Accountability for meeting conservation goals and verifying savings from energy conservation measures (ECM's)
 - Cost allocation to departments and outside vendors
 - Continuous commissioning of energy using systems
 - Outside review of energy savings goals with staff
- Major actions and outputs:
 - Monthly reports for all departments
 - Monthly bills to outside vendors
 - Action plan and fine tuning for high energy users
 - Review with building staff and outside consultants to verify energy savings of ECM's

Savings from Monitoring, Diagnostics and Verification



— Poor M&V — Good M&V — Continuous commissioning

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Savings from sample submetering
strategies





Typical savings from sample strategies

- Installation of meters – 0%
- Bill allocation only – 2 ½ to 5%
- Building tune-up (BTU) process – 5 to 15%
- Continuous Commissioning process – 15 to 45%

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Questions?





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Click on the BMO LOGIN button

Type the login guest

Type the password guest