Making Metered Data Work for You

Bill Chvala and Dave Hunt

Pacific Northwest National Laboratory

GovEnergy
www.govenergy.gov

Outline of Today's Presentation

- Why you should meter
- Metered data visualization
- Productive uses of metered data
  - Descriptions
  - Examples

Why Should You Meter?

- Energy Policy Act of 2005 (EPAct), Section 103, Energy Use Measurement and Accountability
- Good management practice
- Important to your bottom line ($$)

Key EPAct Requirements

- By October 1, 2012
- For efficient use of energy and cost reduction (electricity)
- Meter Federal buildings “where practicable”
- Use advanced metering devices

Definitions

- Advanced meters:
  - Measure and record interval data at least hourly
  - Communicate data at least daily
- Advanced metering system:
  - Collect data from advanced meters
  - Provide usage information at least daily
  - **Supports desired features and functionality**
- Standard meters – not advanced meters

Good Management Practice

Metering can cost effectively help you

- Manage energy use and costs
- Verify equipment operations
- Support decisions
- Benchmark facilities
- Verify utility bills
- Allocate costs
- And more

Phases of Technology Adoption*

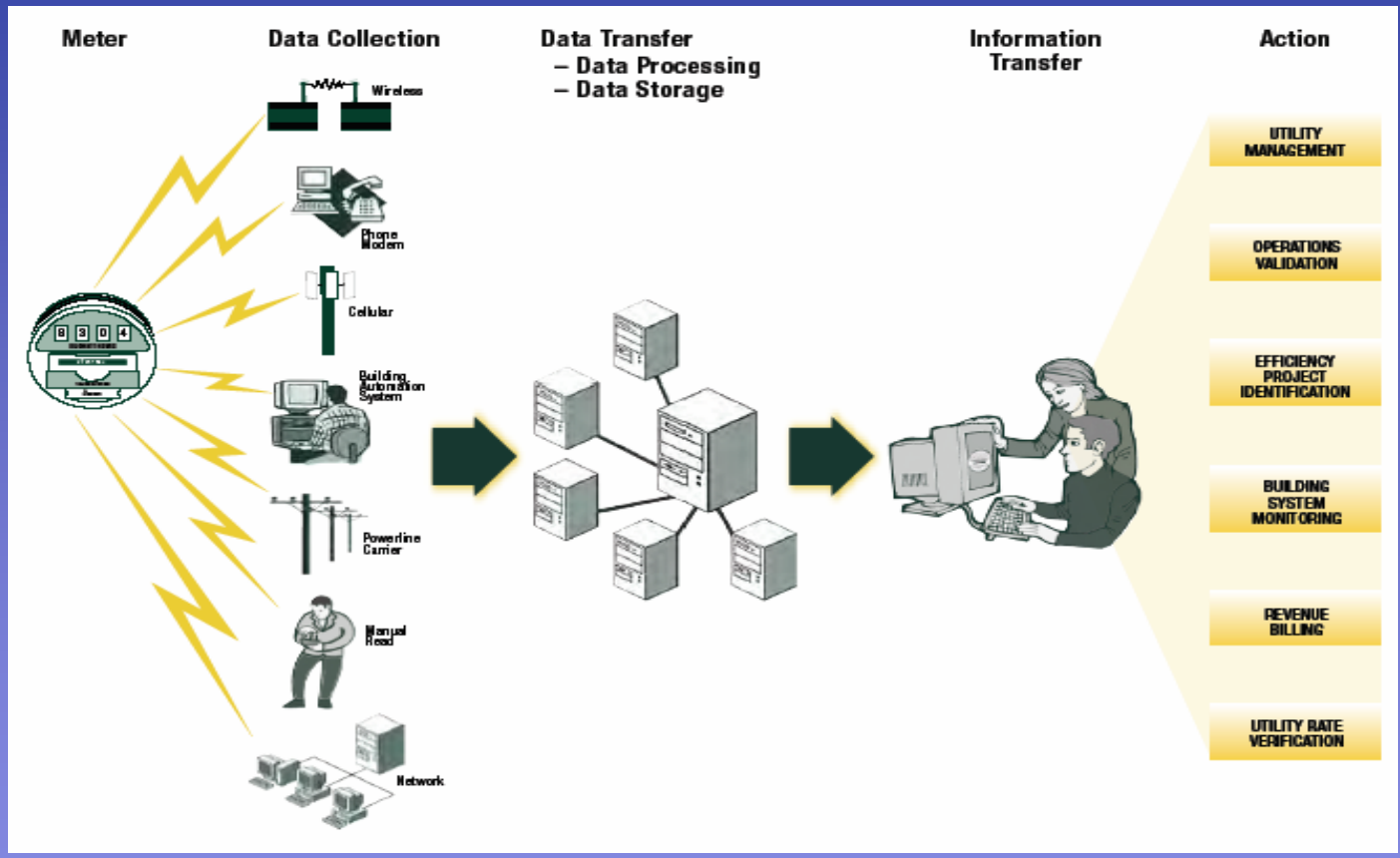
- Enthusiast – initial users
- Professional
  - Industry sees value to workplace
  - Design technology to be more productive
  - Cost goes down
- Consumer - deems essential for success but must be easy to
  - Learn
  - Use

* Adapted from MIT Technology Review, Volume 110, No. 3, *Bill Moggridge: What makes for good design*

Steps for Making Data Work

- Generate the right data
  - Supports analysis needs
  - Reliable
- Data collection and storage
- Data communication
- **Data analysis ←**
- **Action ←**

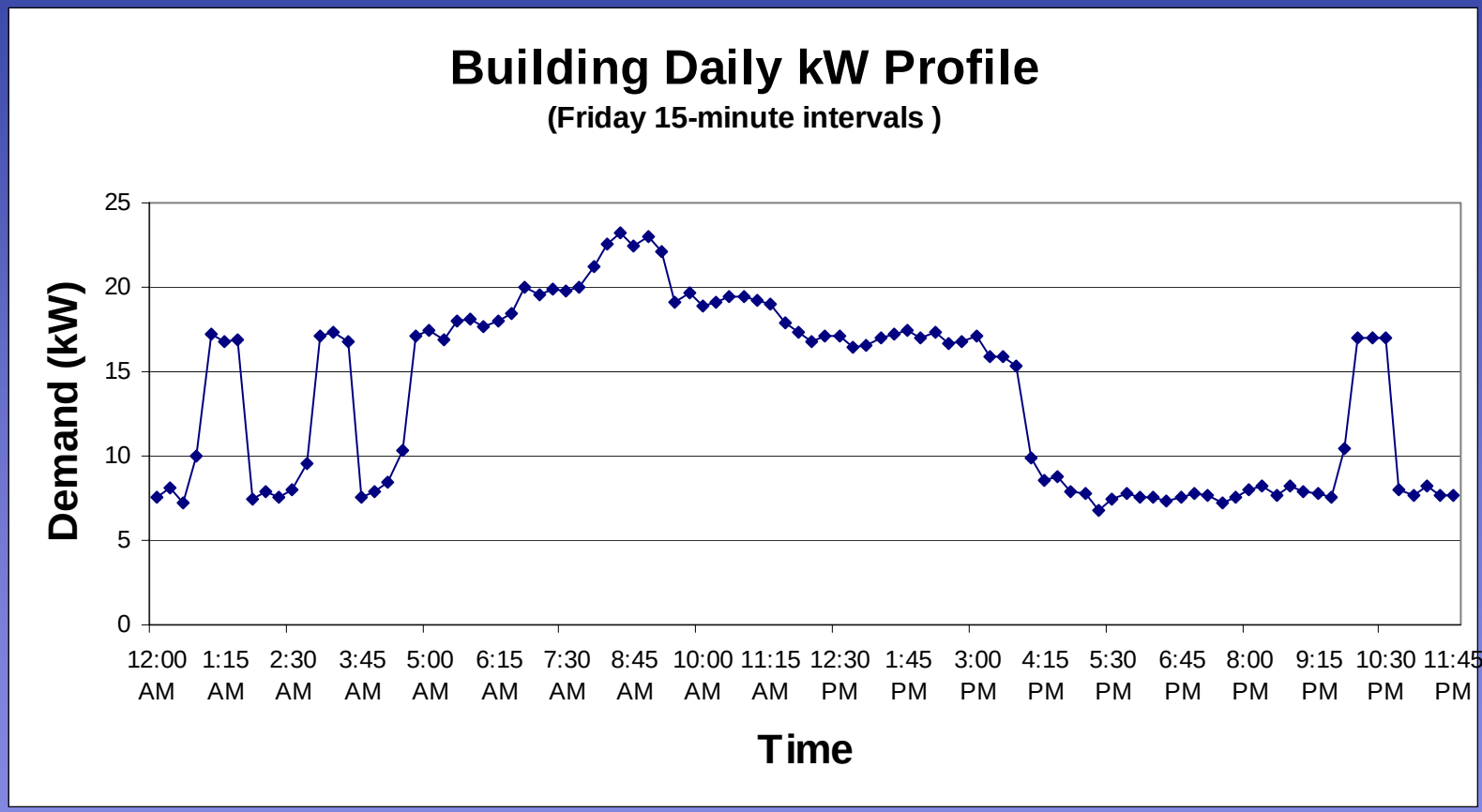
Metering System Path to Action



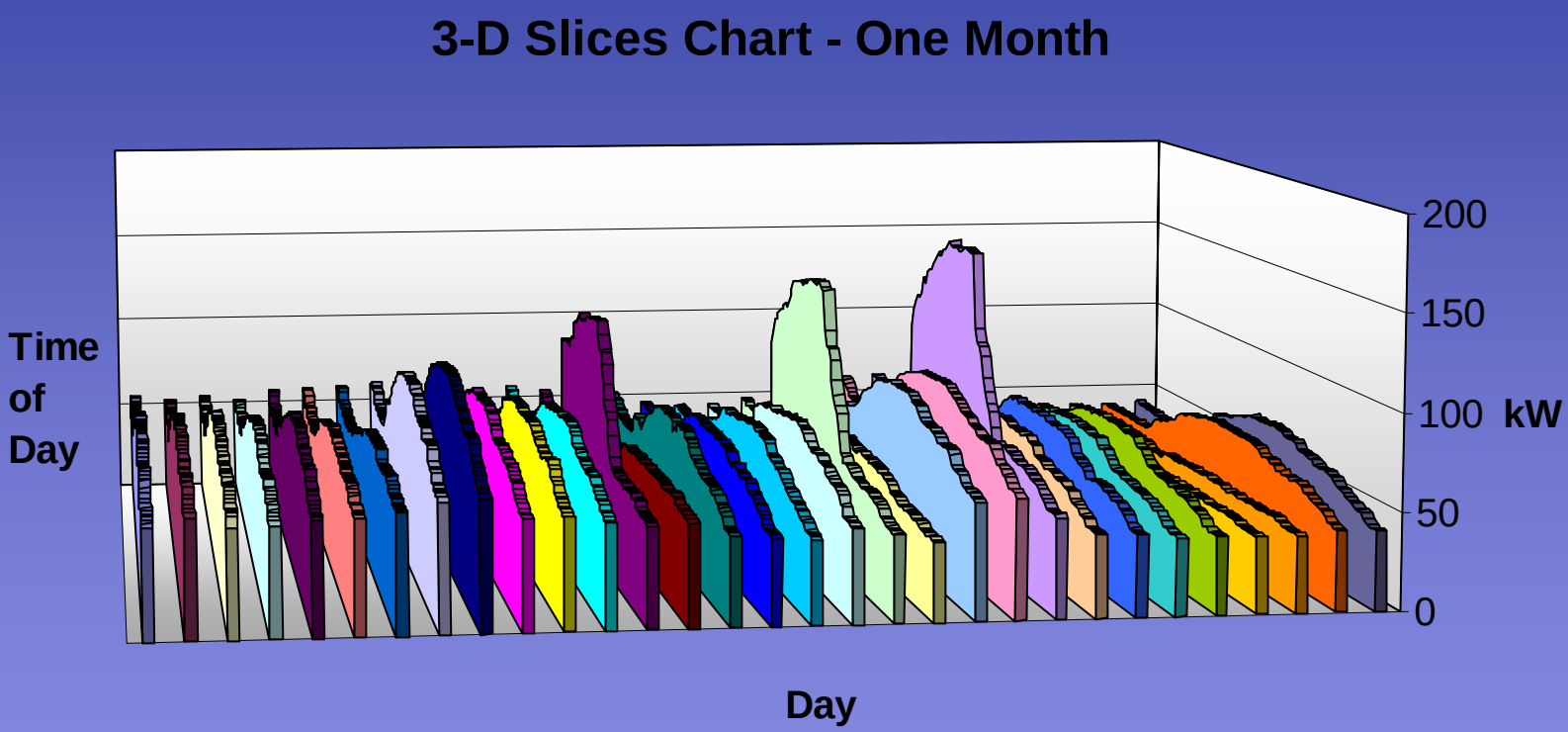
Data Visualization – A Key Ingredient

- Data plots
  - Quickly tell the story
  - Highlight events and anomalies
- Increasing capabilities
  - Interval data
  - Software
- Some basic samples to follow

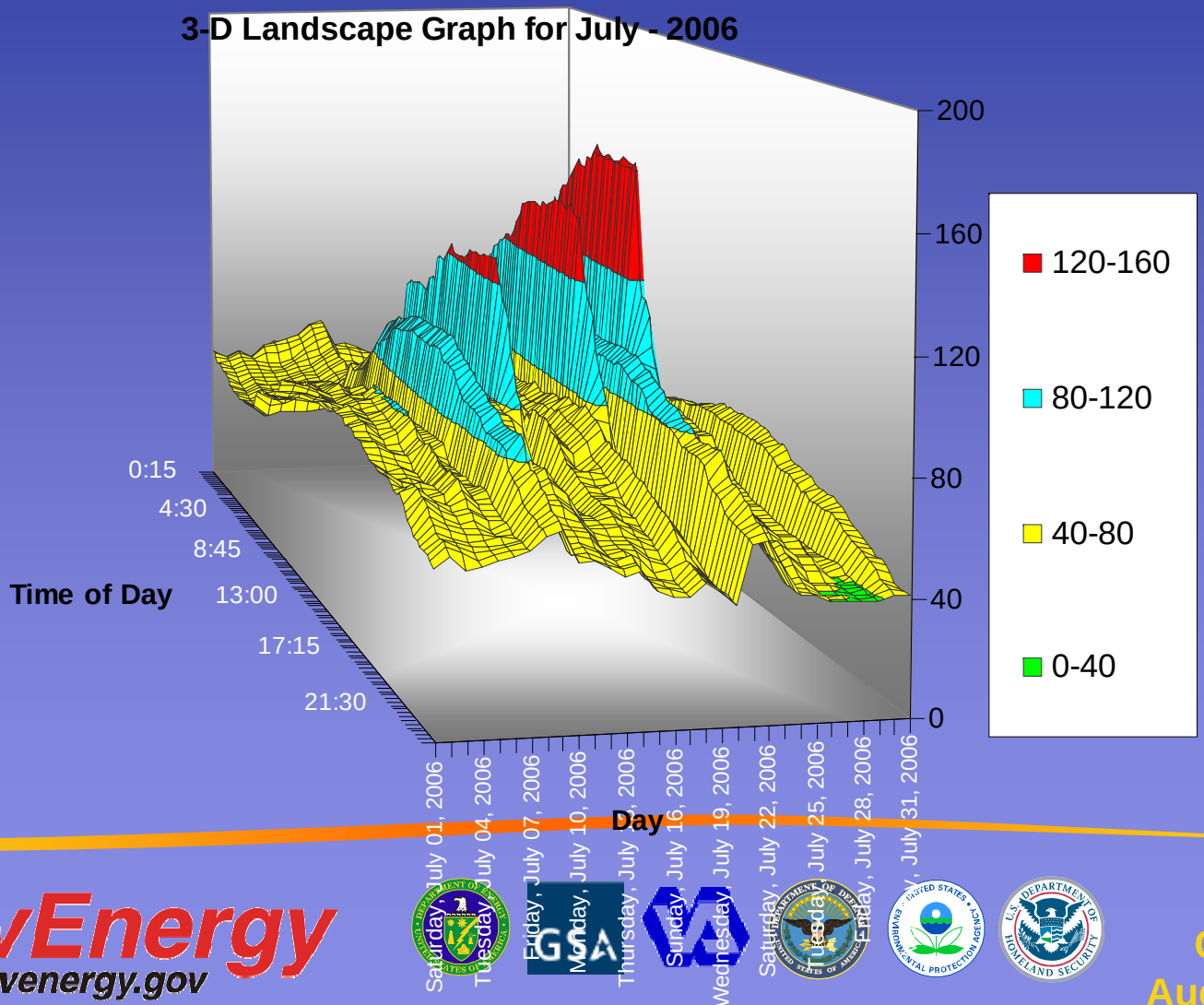
Sample Data Plot: Daily Electrical Demand



Sample Data Plot: Monthly Electrical Demand "Slices"



Sample Data Plot: Monthly Electrical Demand "3-D Landscape"



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Productive Uses of Metered Data

- Cost allocation
- Load Management (for time-based rates)
- Energy use diagnostics
- Power quality
- Measurement and verification
- Utility procurement analysis
- Planning and reporting

Cost Allocation

- Allocate costs based on actual usage
- Benefits:
  - Charge for actual use
  - Encourage planning, conservation, and action
- Multiple tenants/programs with distinct consumption
  - Campus-like installations
  - Multi-tenant buildings

Cost Allocation

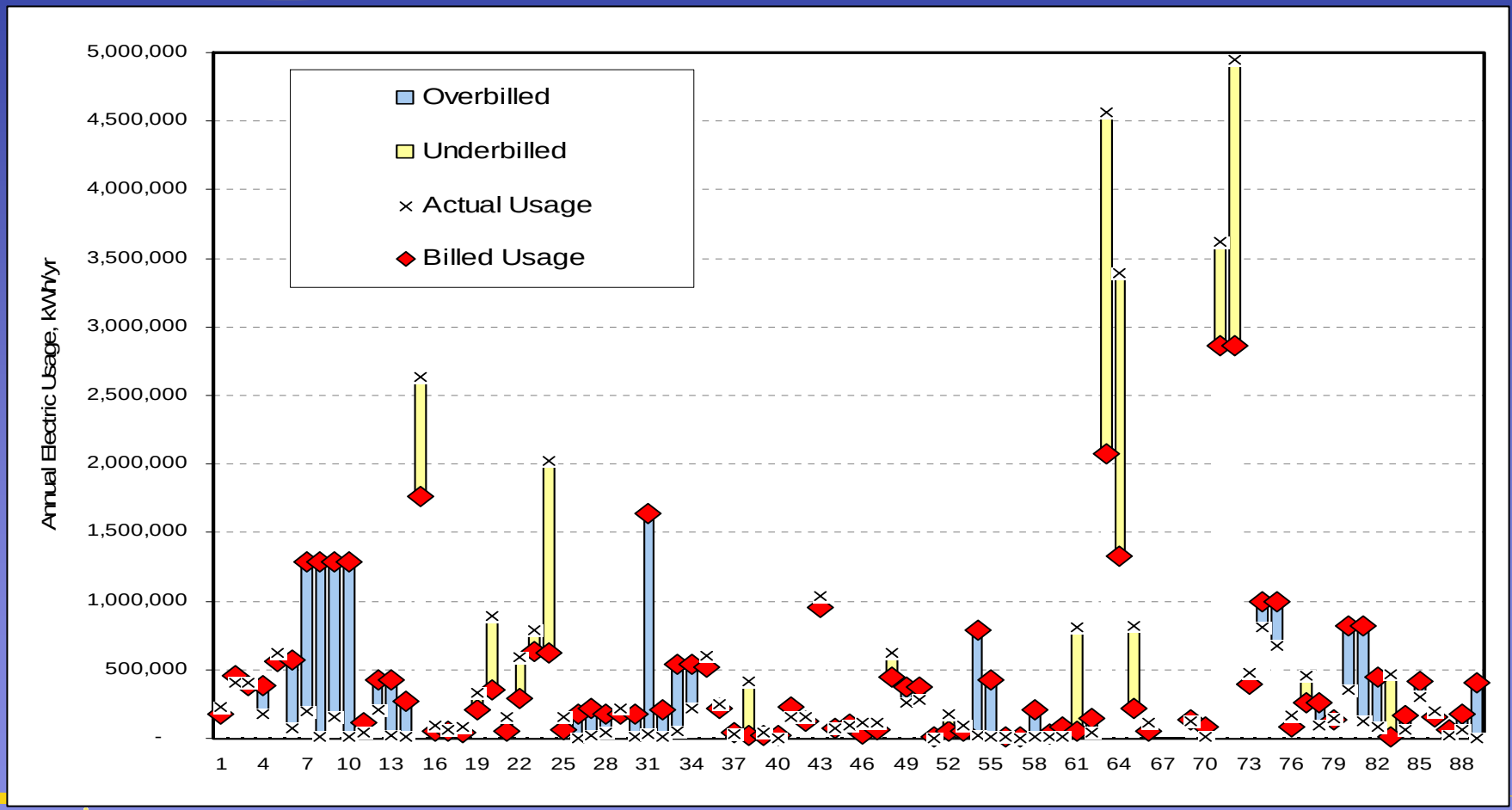
- Allocate metered elements
  - Electric: kW, kWh, power factor
  - Other: gallons, Btus, cubic feet, etc.
- Address fixed and/or prorated elements
- Must be able to bill tenants/programs

Cost Allocation

	% Building Square Footage	% Building Energy Use
Tenant 1	50	60
Tenant 2	25	10
Tenant 3	25	30

- Who has an incentive to manage energy use
  - When billed by square footage?
  - When billed by actual cost?

Estimated vs Actual Billing



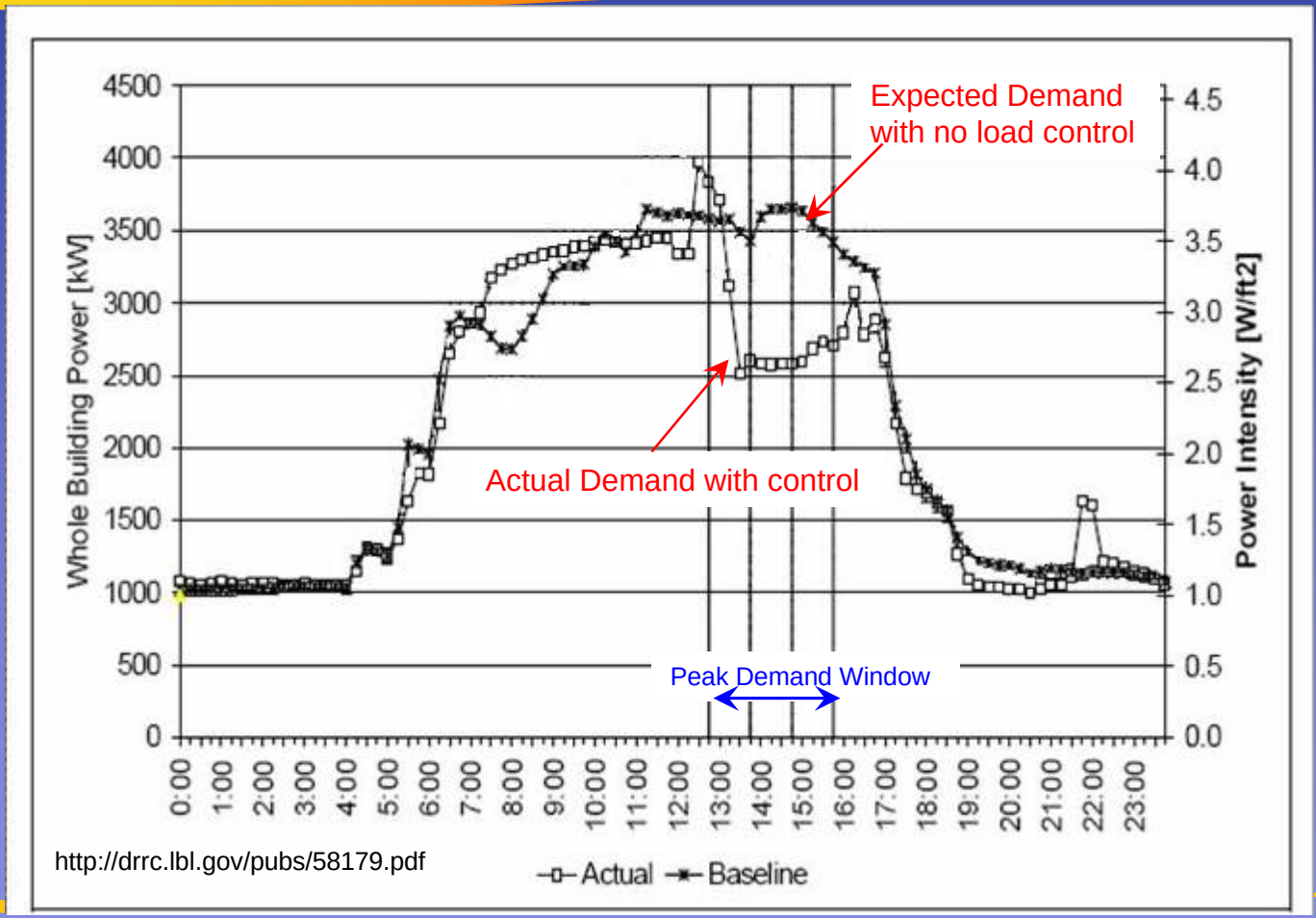
Metering for Load Management

- Electric rates vary based on when electricity is purchased:
  - Time-of-use (TOU) rates
  - Real-time pricing (RTP)
  - Interruptible rates
- Time-based rate offerings increasingly available

Metering for Load Management

- Benefit: Can significantly reduce cost but **must be managed effectively!**
  - Load management plan
  - Timely and accurate data
  - Ability and commitment to curtail loads when needed
- Strongly recommend tenant buy-in

Active Demand-Reduction



http://drrc.lbl.gov/pubs/58179.pdf

Load Management Plans

At a minimum …

- Identifies electricity users – tenants, buildings, and/or equipment including priorities
- Develop tiers for load shedding and establishes curtailment procedures
- Identifies
  - Key individuals and roles
  - Conditions initiating actions
- Requires periodic review

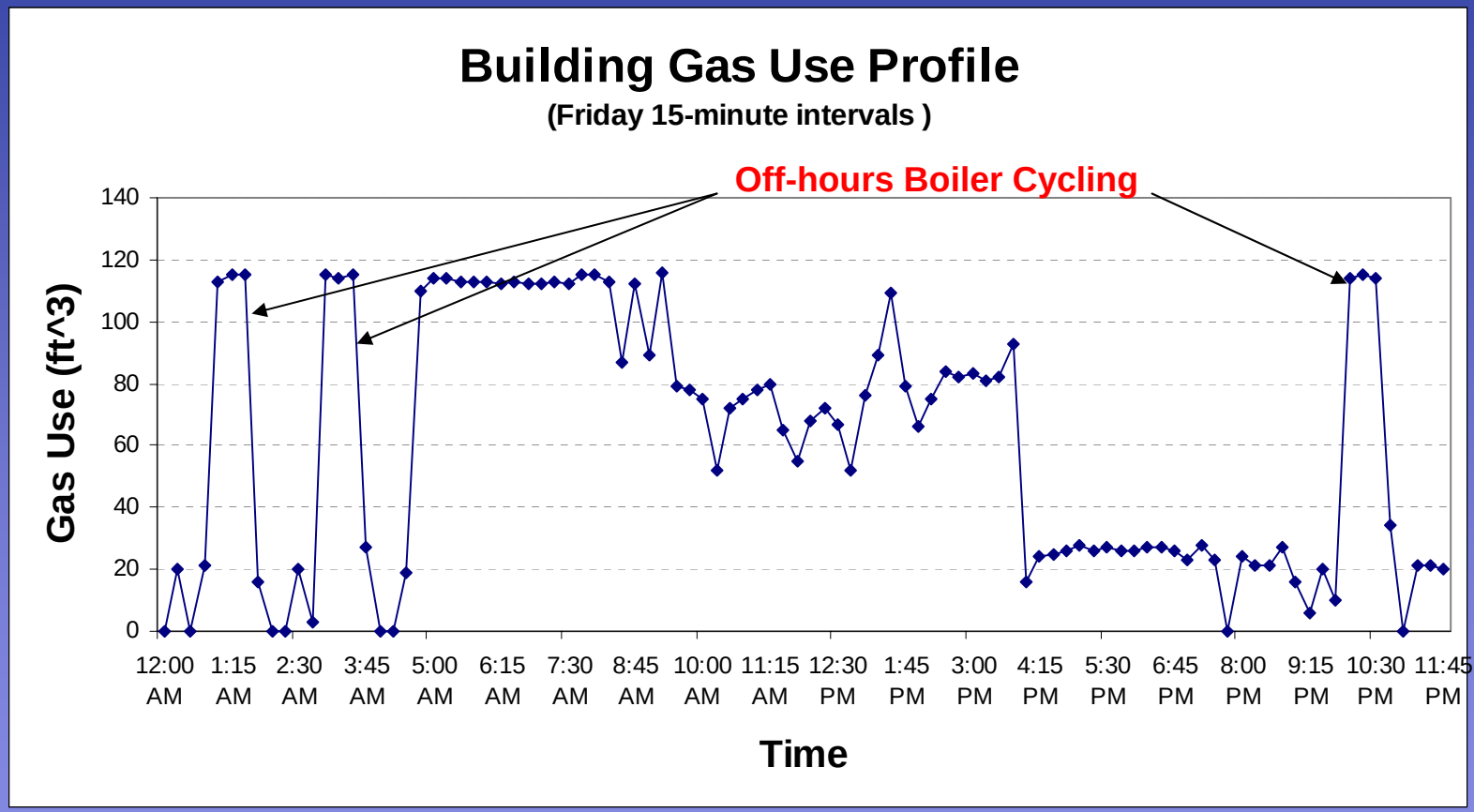
Energy-Use Diagnostics

- Use data to change operation resulting in reduced energy consumption
- Examples:
  - Identify unnecessary night-time lighting
  - Modify building HVAC start-up schedule
- Equipment sub-metering recommended for this application
- Requires on-going resources

Energy-Use Diagnostics

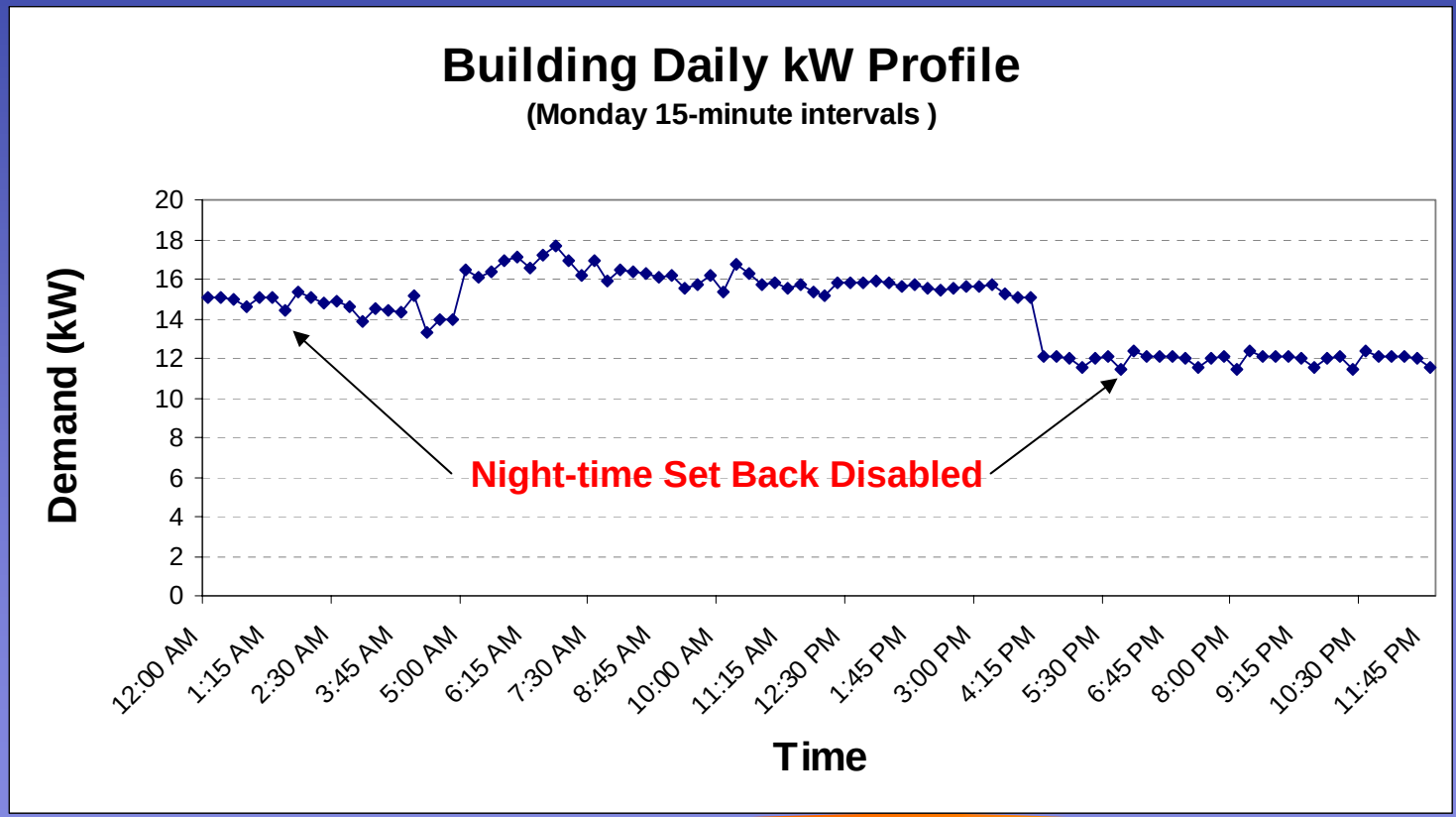
- Other applications incorporated into this category include
  - Trending energy use/efficiency
  - Benchmarking
  - Power factor correction
  - Proper scheduling
  - Verification of controls strategies
  - Project initiation

Energy-Use Diagnostics



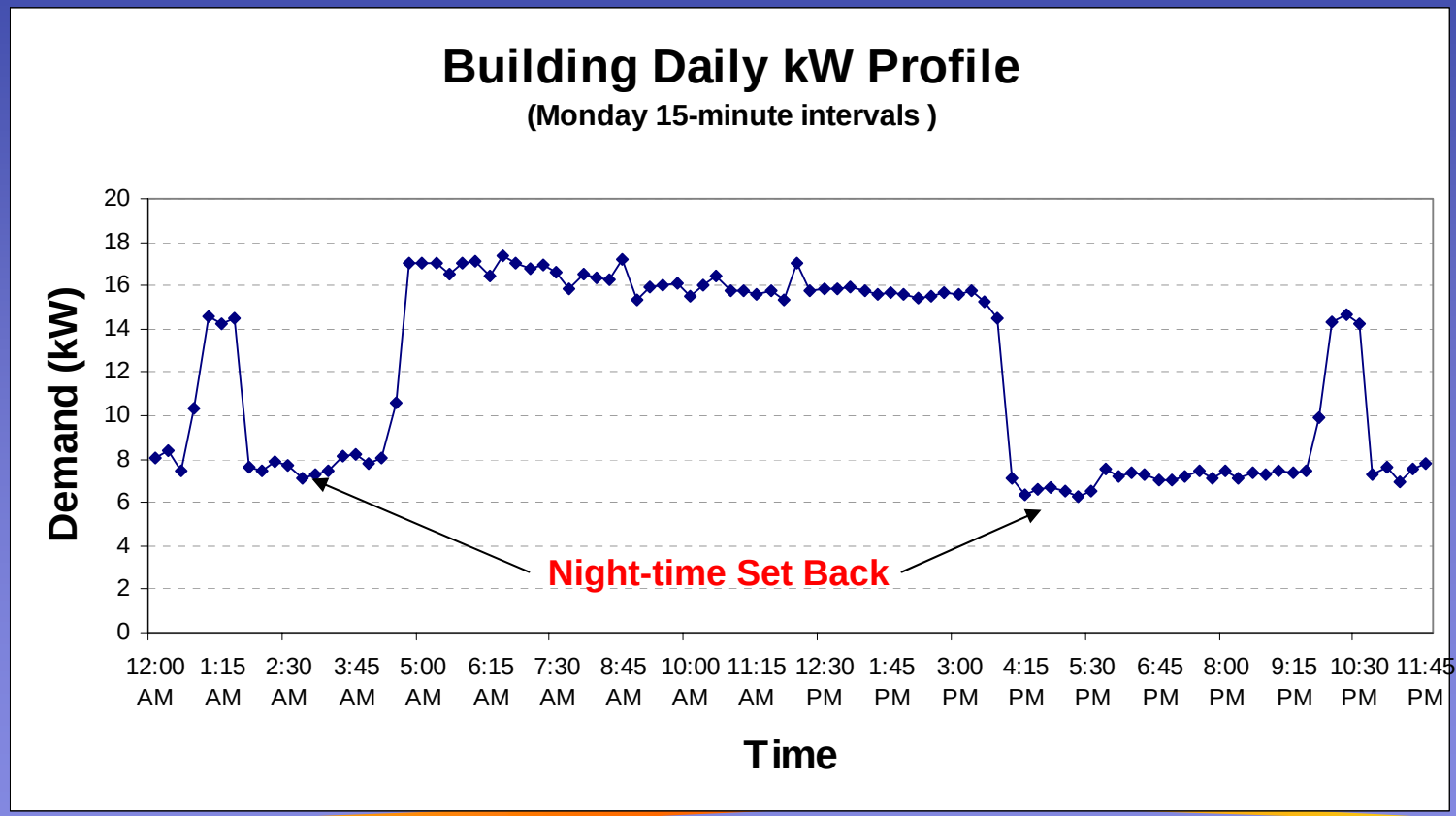
Energy-Use Diagnostics

Daily Demand Profile - Setback Disabled



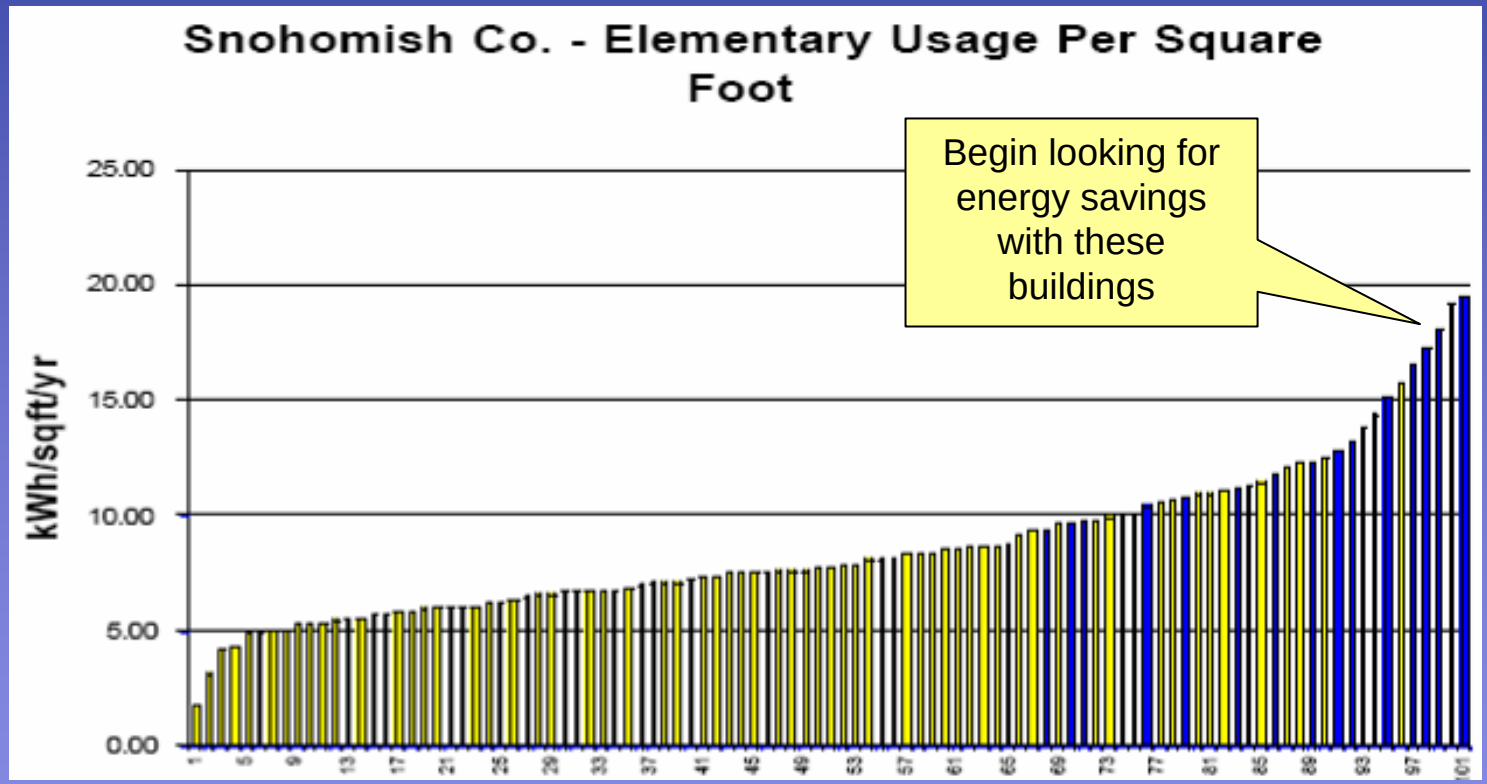
Energy-Use Diagnostics

Daily Demand Profile - Setback Enabled

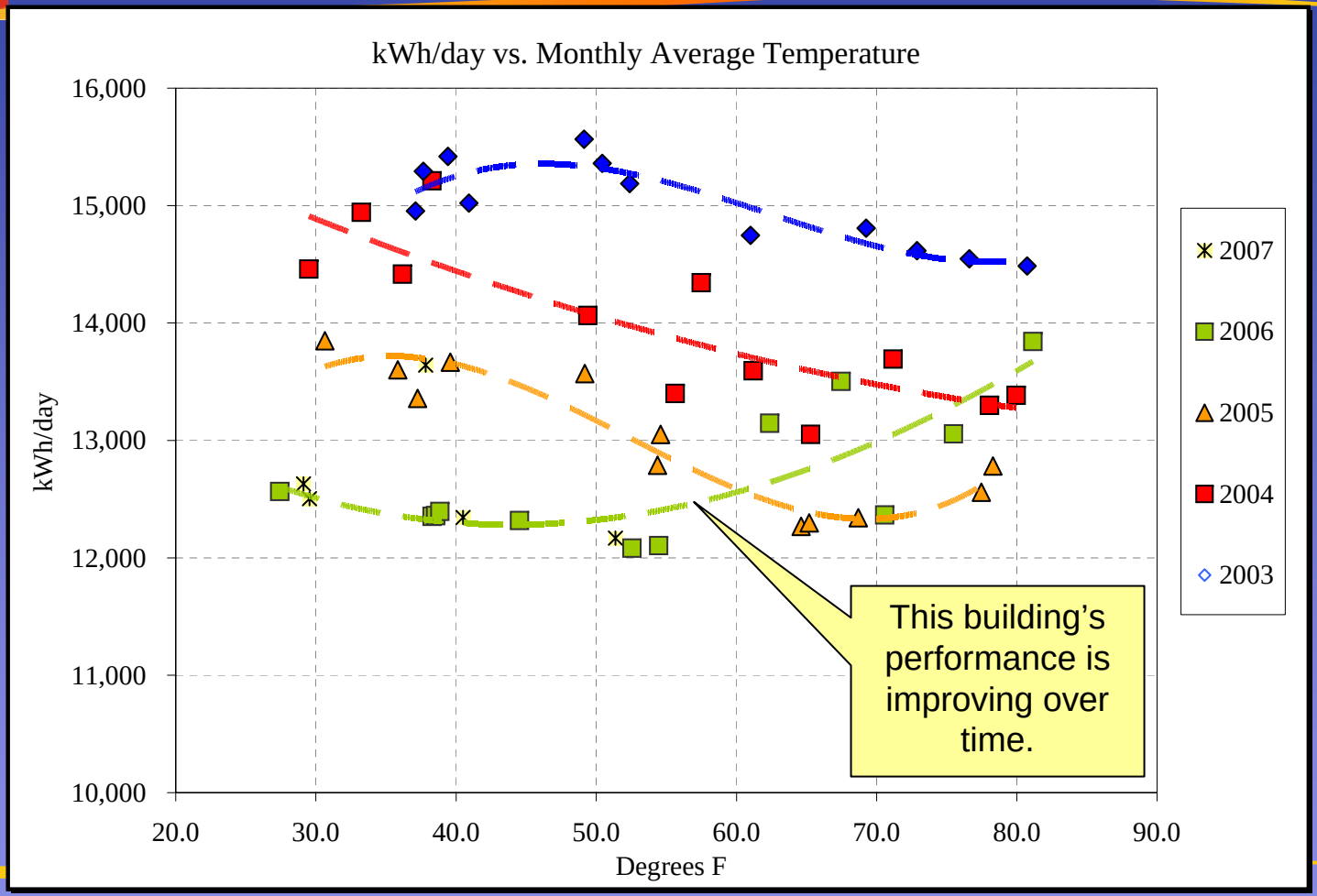


Energy Diagnostics: Benchmarking

- Compare similar buildings to identify poor performers



Energy Diagnostics: Historical Trending



Power Quality

- Definition: A power quality problem is any problem manifested in voltage, current, or frequency deviations that result in failure or mis-operation of equipment
- Power quality meters can be used to characterize electrical disturbances and troubleshoot power quality problems to protect critical loads.

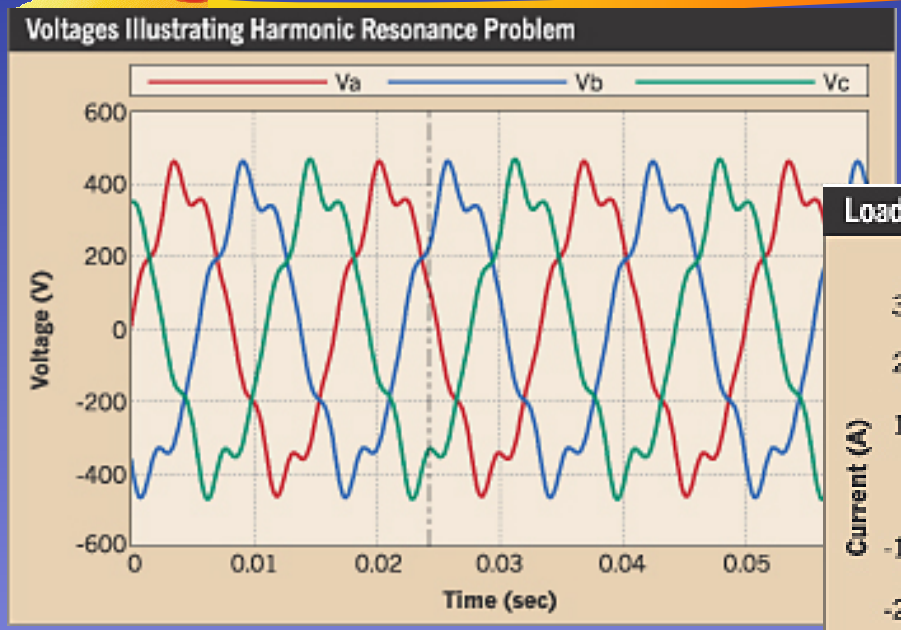
Power Quality

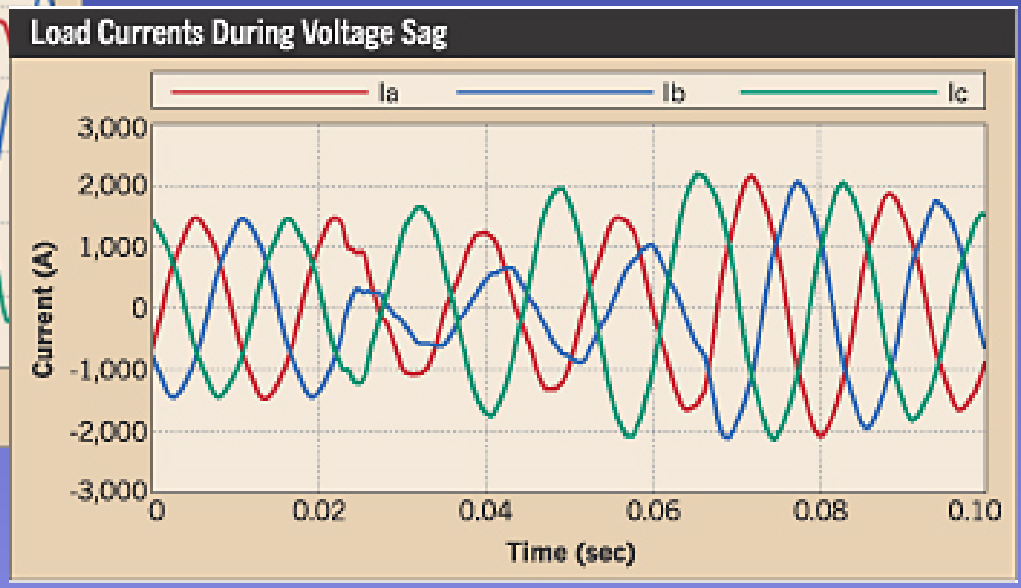
- Benefits: Can help minimize
  - Disruptions to production
  - Disruptions to mission readiness
  - Equipment and repair costs
- Cautions:
  - May not satisfy intent of EPAct
  - Can be very expensive
  - Need familiarity with NEC/IEEE standard best practices

Power Quality Considerations

- True root-mean-squared (RMS)
- Power factor
- Harmonics (%THD)
- Form factor
- Peak form
- Transient disturbance
- Voltage fluctuations, sags, swells, imbalance
- Frequency fluctuations

Power Quality





http://bg.ecmweb.com/ar/electric_learning_read_waveform

Power Quality Measurements

- How much is needed?
  - Get a flexible system, but don't over-buy
  - Many power quality measures are not logged on a time-series basis
  - Power quality problems can be addressed with one-time or portable metering
  - Unless someone is identified to use these measures, no one will

Measurement and Verification (M&V)

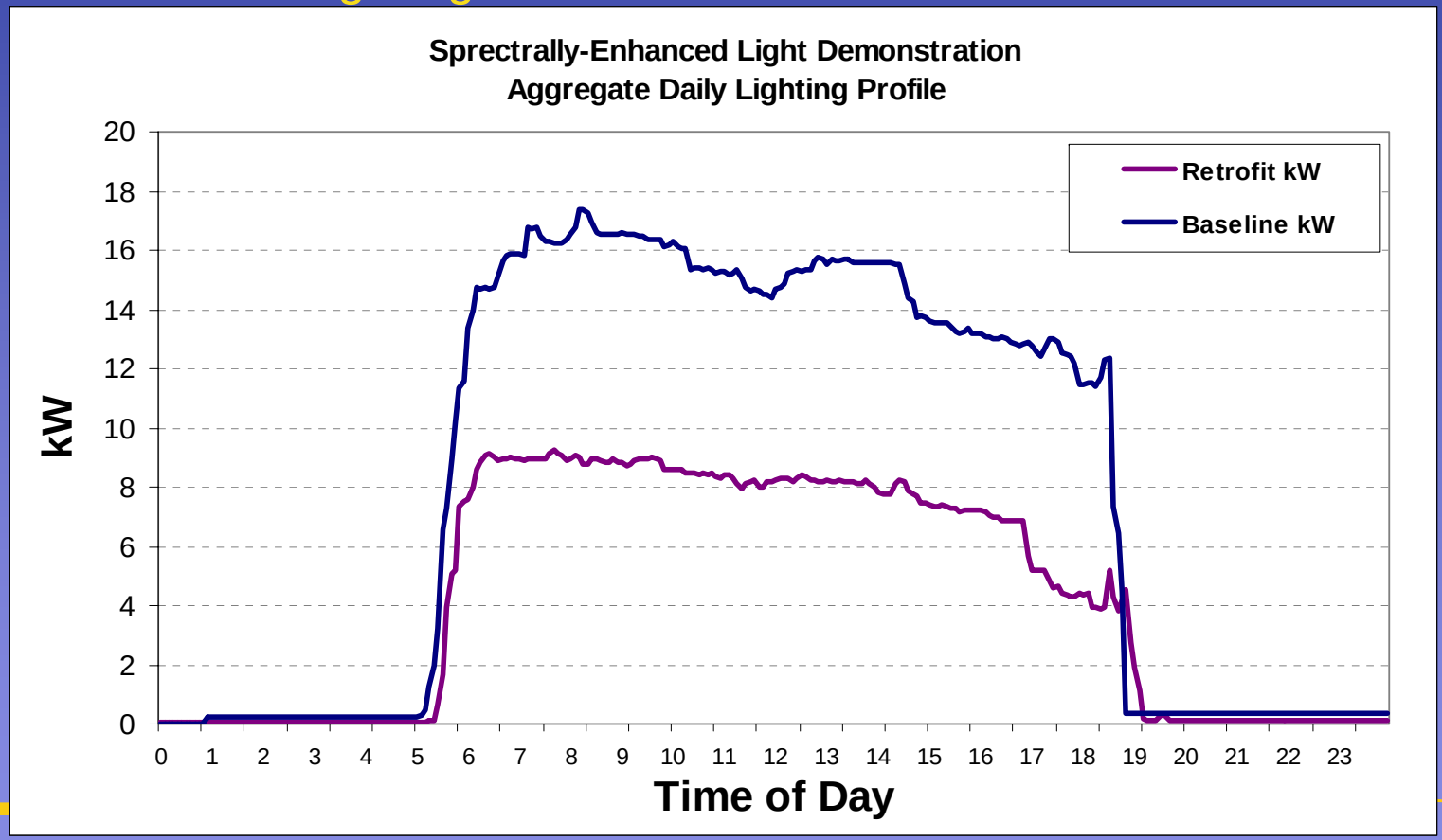
- Ensure that energy savings projected from retrofits or other actions are realized
- Meters can support ESPC M&V requirements
- Consider M&V outside of ESPCs

Measurement and Verification

- Metering requirements
  - ESPC:
    - Vary by adopted measures
    - Defined by IPMVP and project economics
  - EPAct: At building level
    - IPMVP Options C (whole building) and sometimes Option D (calibrated simulation)
- Make sure – advanced metering for ESPCs supports the contract M&V needs!

Measurement and Verification

Verification of Lighting Demonstration



Utility Procurement Analysis

- Select most advantageous electric rate tariffs based on usage history
- Ability to aggregate loads
- Successful rate selection may depend on effectively managing loads (demand)

Utility Procurement Analysis

- Other factors to consider in rate selection analysis
  - Scheduled energy efficiency measures
  - Planned construction and/or major equipment installations
  - Building and/or equipment decommissioning
  - Significant one-time events (e.g. natural disasters)
  - Changes in mission

Utility Procurement Analysis: SCE Medium Business Rate Schedules

- Rate Schedule GS-2
- Rate Schedule TOU GS-3
- TOU-GS-2-SOP
- Rate Schedule GS-2 with Time-of-Use Pricing
- Rate Schedule TOU-EV-4
- Summer Discount Plan – Basic GS-APS
- Summer Discount Plan – Enhanced GS-APS-E
- Optional Binding Mandatory Curtailment Plan
- Demand Bidding Program
- Basic Interruptible Program (TOU-BIP)
- Critical Peak Pricing

Planning and Reporting

- Metered data can be used to support
  - Progress and goal reporting
  - Agency and site utility budgets
  - Developing site utility master plans
  - Building designs

Planning and Reporting

- Progress and goal reporting
  - EPAct and executive order energy goals
  - Share with occupants – **promote awareness**
    - Updates against goals
    - Contests to conserve

Planning and Reporting

- Agency and site utility budgets
  - Develop based on historical usage at local (building) level
  - Monitor use and expenditures more closely
  - Perform impact assessments
    - Mid-year rate increases
    - Changing support requirements – troop deployments, increasing physical security, operating hour changes, etc.

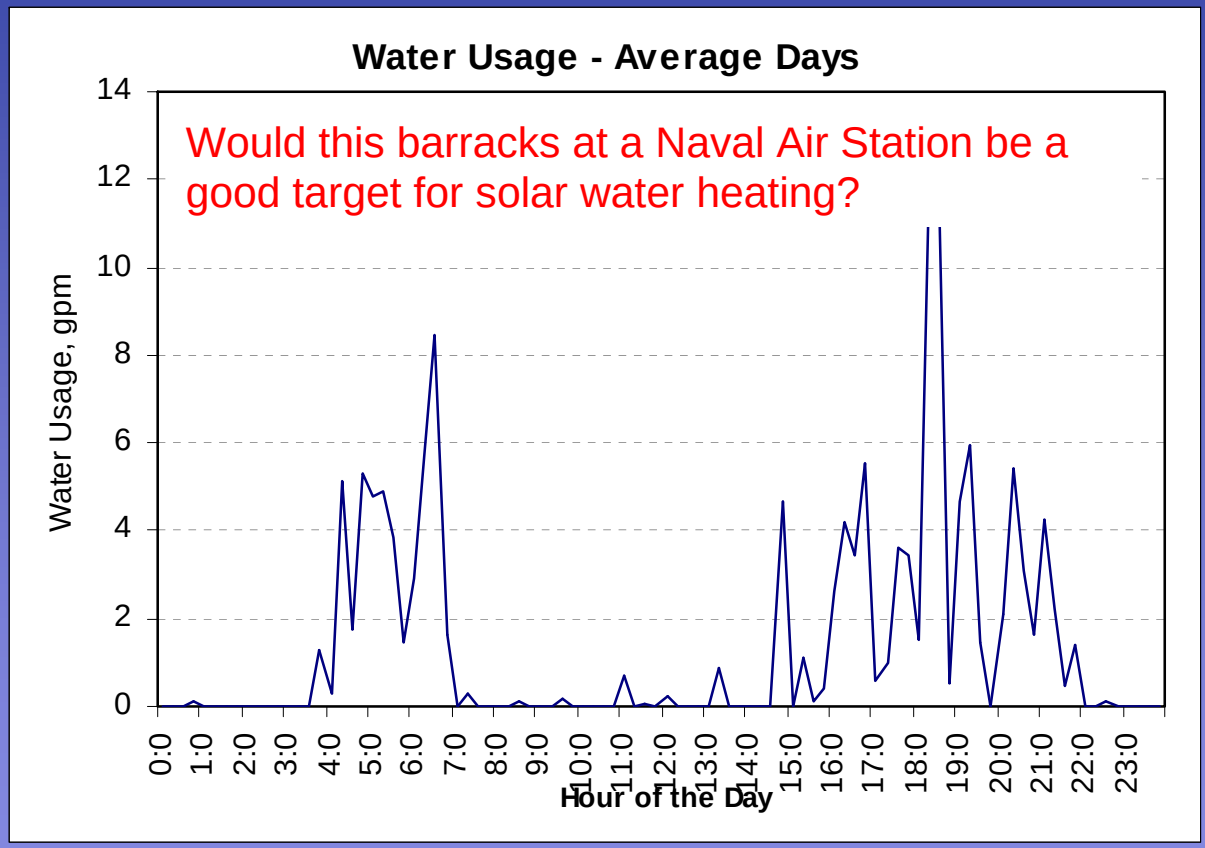
Planning and Reporting

- Developing site utility master plans – verify current distribution system supply requirements
- Building designs – verify availability of utility

Additional Thoughts on Productive Uses of Data

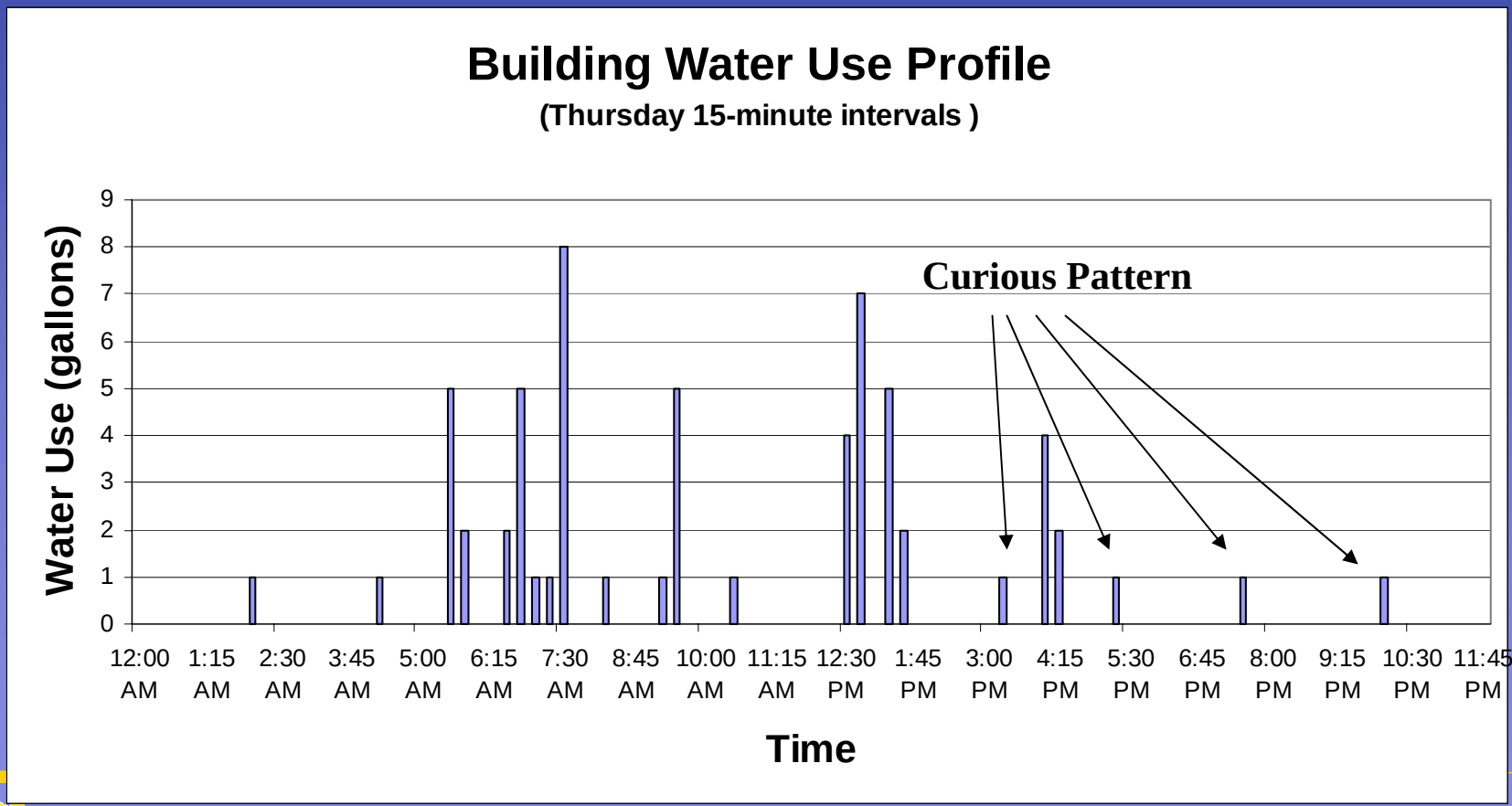
- You can cost effectively meter more than electricity
- You can use data in more than one way
- Some additional applications
  - Verification of utility bills
  - Project development
  - Leak detection

Using Time Series Data for Project Development



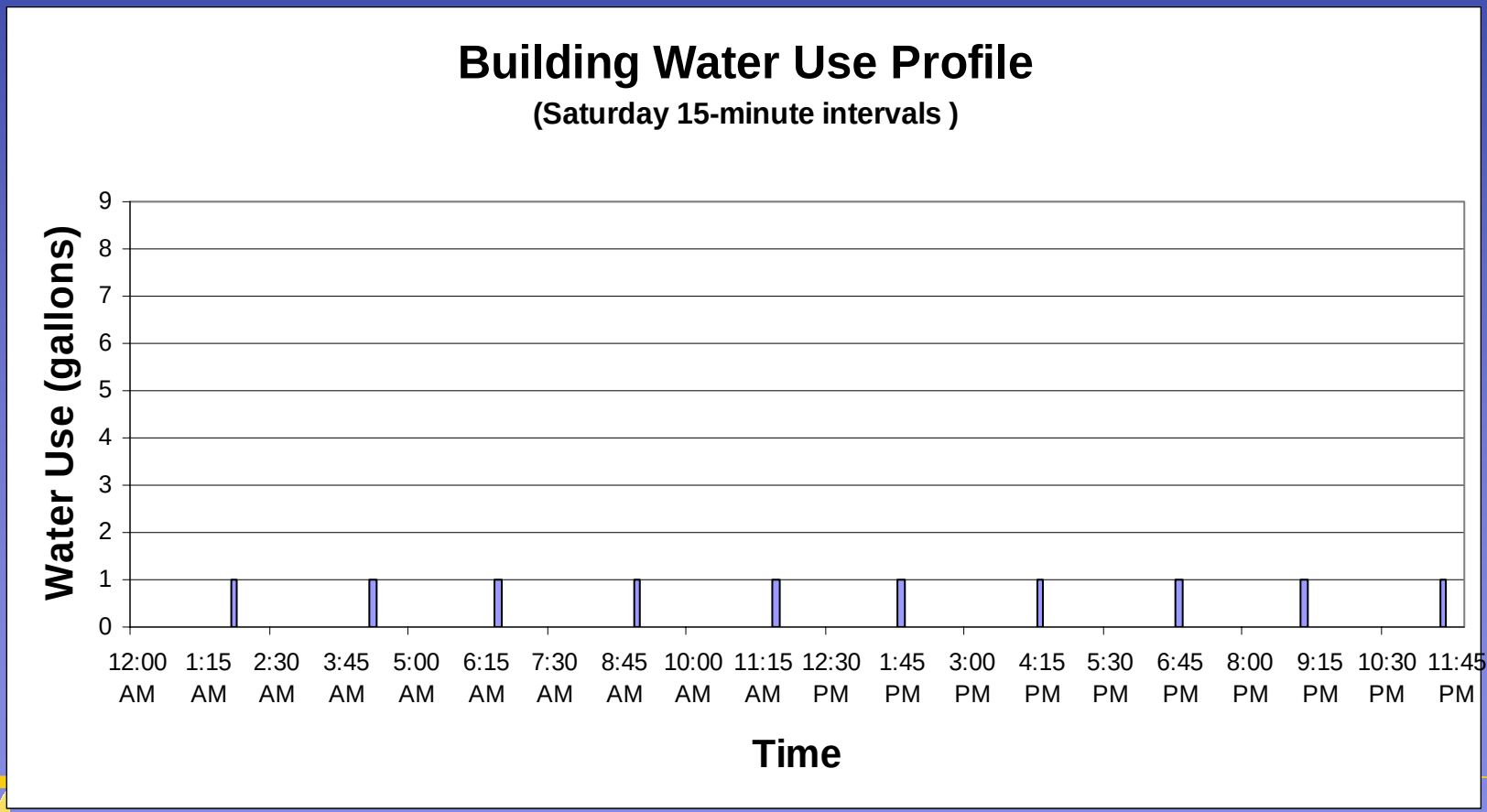
Efficiency Opportunity Identification

Suspicion of Water Leak

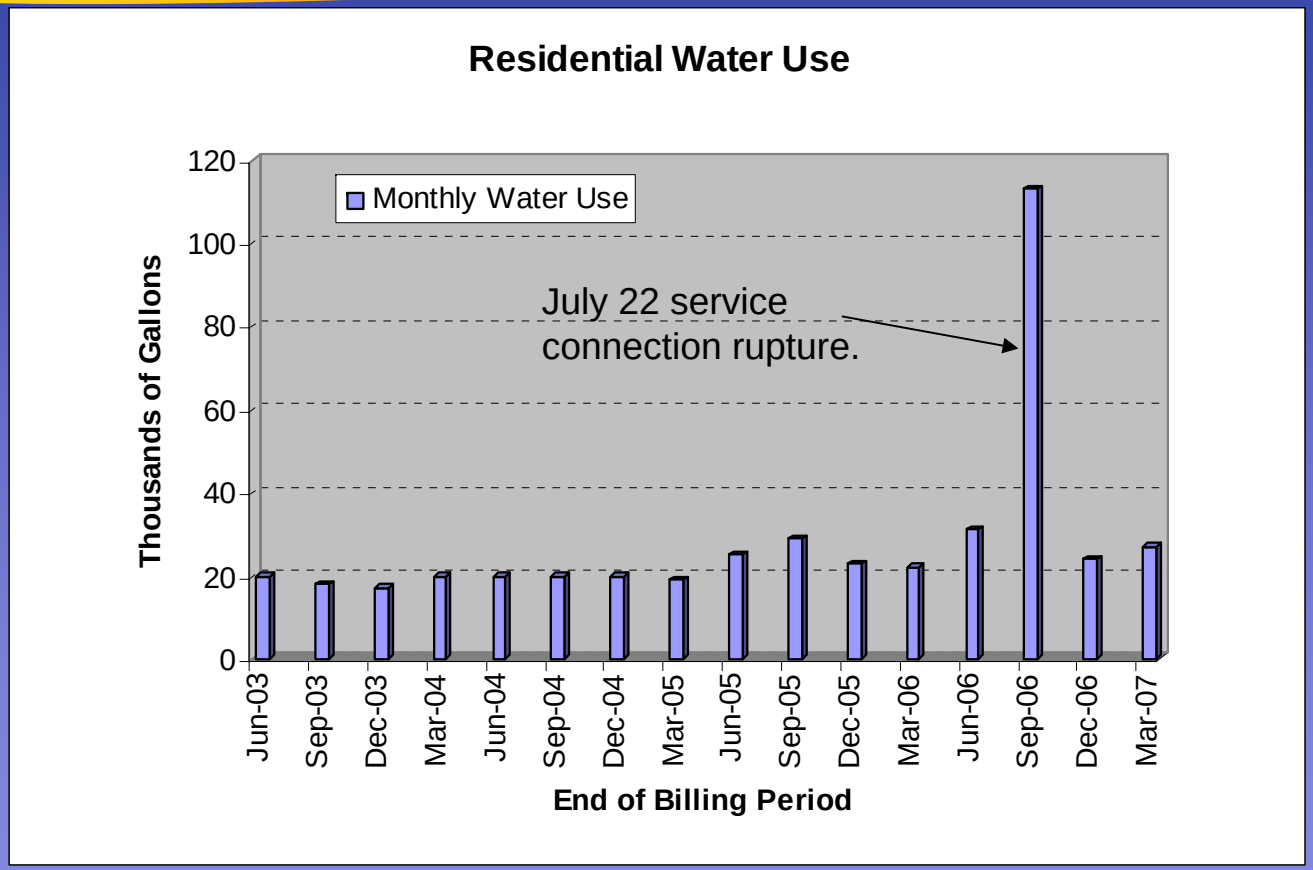


Efficiency Opportunity Identification

Verification of Water Leak



Leak Detection



What Works Best for You?

- Cost allocation:
  - Can building occupants (programs) benefit from reducing energy use?
  - Do building occupants have ability to significantly control energy use?
- Time-based rates:
  - Are or will time-based rates be available?
  - Will site commit to load management?

What Works Best for You?

- Utility procurement analysis:
  - Does your utility offer multiple rate schedules?
- Energy use diagnostics:
  - Do you have large energy consuming equipment?
  - Can your site support a retrocommissioning program?

What Works Best for You?

- Power quality:
  - Have you experienced power quality problems in the past?
  - Do you have critical loads that are sensitive to power quality?
- Measurement and verification
  - Are you considering an ESPC? What are the potential measures?
  - New equipment start-ups planned?

What Works Best for You?

- Planning and reporting:
  - What are your agency's annual utility reporting requirements?
  - What are local uses for data?

Data Analysis Software

- Software a critical component
- Organizes data and assists in analysis
- Available through
  - Vendors
  - Subscription services
  - On-site programming
- FEMP does not evaluate or recommend data analysis software or services.

Data Analysis Software Considerations

- Capabilities
- Ease of use
- Customer service
  - Training
  - On-line support
- Updates
- Flexibility/adaptability
- Costs
  - 1st cost
  - Maintenance/updates
  - Subscription rates

Actions

- Actions = directed changes = **results**
- Critical to successful metering program
- Staff accomplished
- On-going activity

Actions

- Review and analyze regularly
- Identify issues/anomalies
  - Impacts
  - Necessary actions
- Share/communicate results and recommendations
- Verify status of recommendations

Closing

- Think beyond minimal EPAct metering requirements
- Many potential data applications
  - Pick applications that work for you
- Close the circle – act on recommendations

For More Information

- Bill Chvala
  - william.chvala@pnl.gov
- Dave Hunt
  - dave.hunt@pnl.gov