Welcome to Today's Training on Energy Management Systems: Maximizing Energy Savings

Some Organizational Tips Before We Get Started . . .

- To dial in: 213-286-1201 + your individual access code
- Session will be recorded
- All attendee phone lines will be muted
- Please submit your questions via the "Questions" window
- Questions will be answered at the end of the session
- Presentation slides along with the questions and answers summary will be sent to attendees after the training

DOE Technical Assistance Program

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

The Parker Ranch installation in Hawaii

Energy Management Systems: Maximizing Energy Savings

October 15, 2010

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ICF International

What is TAP?

DOE's Technical Assistance Program (TAP) supports state, local and tribal officials implementing the Energy Efficiency and Conservation Block Grant (EECBG) and the State Energy Program (SEP).

TAP offers tools and resources needed to implement successful and sustainable clean energy programs.

How Can TAP Help You?

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TAP offers:

- One-on-one assistance
- Extensive online resource library, including:
  - Webinars
  - Events calendar
  - TAP Blog
  - Best practices and project resources
- Facilitation of peer exchange

On topics including:

- Energy efficiency and renewable energy technologies
- Program design and implementation
- Financing
- Performance contracting
- State and local capacity building

The TAP Blog

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Access the TAP Blog!
http://www.eereblogs.energy.gov/tap/

Provides a platform for state, local, and tribal government officials and DOE's network of technical and programmatic experts to connect and share best practices on a variety of topics.

Accessing TAP Resources

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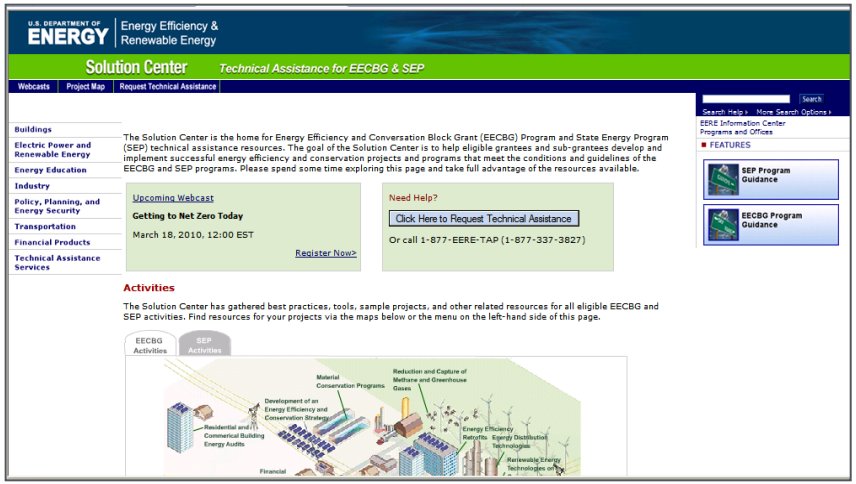
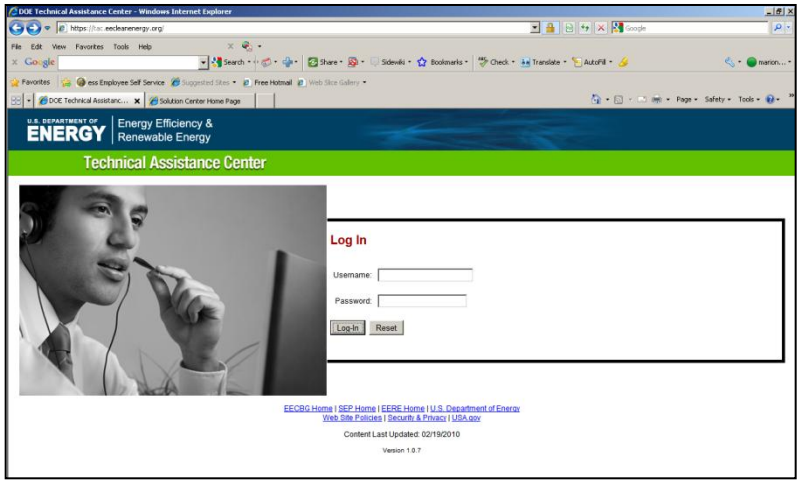
We encourage you to:

1) Explore our online resources via the Solution Center



2) Submit a request via the Technical Assistance Center



3) Ask questions via our call center at 1-877-337-3827 or email us at solutioncenter@ee.doe.gov

Goal for Today's Webinar

Help EECBG and SEP recipients

maximize energy savings and ROI by . . .

- Optimizing Installations of New Energy Management Systems
- Reviewing EMS Strategies following Lighting/HVAC Retrofit Projects
- Utilizing Excess EECBG Funding to Improve Control Options

Agenda

- Basic Rules for Energy Savings
- EMS Overview
- Top 10 Control Strategies for Government Buildings
- Optimizing an EMS
- Resources for Building Operators

Basic Rules for Energy Savings

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1. **Use it only when you need it**
   - Do the lights/heat/etc. need to be on?
   - Turn it OFF!
2. **Use only as much as you need**
   - Is the right amount of light/heat/etc. being provided?
   - Turn it DOWN!
3. **Get out as much as possible for what you put in**
   - Is light/heat/etc. being provided as efficiently as possible?
   - Select efficient equipment

#1 and #2 can be done most effectively with an EMS!

What is an EMS?

- A system to control and monitor energy-consuming devices (heating/cooling equipment, fans, pumps, dampers, and lighting)
- Three necessary elements: sensors, controllers, controlled devices
- Also known as “Building Management System”, “Building Automation System” or “Energy Management Control System”

Purpose of an EMS

- Maintain occupant comfort
- Operate equipment properly
- Ensure proper maintenance
- Maintain safety
- ***Achieve energy savings***

Time clocks/thermostats

Pneumatic control systems

Direct Digital Control (DDC)

EMS Capabilities

- **Scheduling** – manage the length of time that equipment uses energy
- **Setpoints** – manage the demand or need for energy based on space temperature, pressure, humidity, flow rates, light levels, CO^2, etc.
- **Monitoring and Trending** – monitor equipment operation to assess and optimize performance
- **Alarms** – report when devices have failed or sensor values are out of range
- **Safeties** – automatically initiate controls to maintain safety of equipment and occupants

Do it Right!!

Execution, Execution, Execution . . .

- Establish a Team
- Assemble and/or Update Documentation
  - User manuals, control drawings, points lists, sequences of operation, etc.
- Establish Operating Procedures
- Provide Training for Facilities Staff
- Communicate and Document Changes
- Commission New Installations
- Use Service Contracts to Optimize Operation
- Don’t Create More Complexity than you can Manage

Top 10 Control Strategies for Government Buildings

- Based on proven strategies in government buildings
- Individual opportunities will vary – each building is unique
- Order determined based on energy saving rules

Rule #1
Use it only when you need it

Rule #2
Use only as much as you need

- **Think about how you can make these strategies generate energy and cost savings for you!**

#1 Night Setup/Setbacks

Rule #1
Use it only when you need it

- Limits HVAC equipment use at night
- Set points are reduced in winter, increased in summer
- Turns equipment on only when necessary (e.g. 55F, 85F)
- Should include heating, cooling, and ventilation
- Can use Optimum Start/Stop

Can save 5-30% on heating and cooling costs

#2 Zonal Scheduling

Rule #1
Use it only when you need it

- Allows equipment to stay off when an area is not in use
- When only one portion of the building is occupied, only that area needs to be on
  (e.g. school gym, city hall meeting room)
- HVAC equipment is scheduled using different zones of the building
- Depends on HVAC system configuration

#3 Simultaneous Heating and Cooling Control

Rule #1
Use it only when you need it

- Reduces heating and cooling of the same air - the worst kind of energy waste!!
- Maintain a wide deadband between heating & cooling setpoints (e.g. 68F for heating, 74F for cooling)
- Lock out heating systems when outdoor air temp is high, and lockout cooling when outdoor air temp is low
- Watch out for reheat and electric baseboard heat

5 kW of electric heat operating 12 hrs/day all winter can cost $1000 per year

#4 Economizers (Air-side)

Rule #2
Use only as much as you need

- Utilizes “free cooling” and reduces mechanical cooling
- When outdoor air temperatures are low but cooling is still required, opens dampers and brings outdoor air directly into the space
- Best in office buildings with high internal loads
- Can be controlled based on dry bulb temperature or enthalpy control (total heat content, including moisture)

Make sure dampers are operating as intended

#5 Resets

Rule #2
Use only as much as you need

- Adjusts the temperature or volume of air or water supplied based on demand
- Example:
  - Hot water supply temperature - reduce as outside air temperature gets lower, or as the difference between supply and return water temperature gets lower
- Other reset opportunities
  - Chiller supply water temperature, VAV supply air temp, VAV fan duct pressure, entering condenser water temperature

Can save 5-15% on heating and cooling costs

#6 Boiler and Chiller Optimization

Rule #2
Use only as much as you need

- Optimizes the number of boilers or chillers operating at one time
- Boilers - Maximizes efficiency by scheduling boilers to minimize partial loading, and give preference to most efficient boiler
- Chillers - Maximizes efficiency by staging units based on part load efficiency and capacity to determine the most efficient mix of chillers

#1 Demand Controlled Ventilation (DCV)

Rule #2
Use only as much as you need

- Reduces fresh air intake and the energy required to heat and cool that air
- ASHRAE 62.1 sets requirements for fresh air (cfm/ft^2 or cfm/person) based on a default occupancy density
- Ventilation can be set based on actual occupant density
  - Measured by CO^2 sensors, occupancy sensors, or other means
  - Outdoor air dampers open when thresholds are met
- Opportunities in auditoriums, cafeterias, meeting rooms

Can save $0.05 to $1.00 per square foot, depending on the space (FEMP)

#8 Interior Lighting Control for Unoccupied Spaces

Rule #1
Use it only when you need it

- Turns off interior lights when spaces are unoccupied
- A few options:
  - On/Off Schedules
  - Lighting Sweeps
  - Occupancy Sensors
- Best choice for government buildings may be occupancy sensors – connection to the EMS may not be necessary

In a 50,000 sq. ft. building, reducing lighting run time by 1 hr/day can save $2000/yr

#9 Exterior Lighting Control

Rule #1
Use it only when you need it

- Turns off exterior lights based on scheduling and exterior light levels
- Photocell ensures that lights only come on when dark
- Schedules limit the time lights can be on
  - Can begin the scheduled time around 4pm
  - Can end the scheduled time when occupants are gone

#10 Daylighting

Rule #2
Use only as much as you need

- Reduces light supplied when daylight is sufficient to illuminate interior spaces
- Different options for control
  - On/off control of a portion of lights
  - Dimming of all lights
- Connection to the EMS allows for flexibility in adjusting light levels and controlling light fixtures

Studies have shown that daylighting in schools can increase students' test performance

Advanced Control Strategies

- **Trending** – monitor equipment operation to identify opportunities for savings
- **Energy use monitoring** – monitor energy consumption to identify opportunities for savings
- **Alarms** - report sensor failure to ensure persistence of energy savings
- **Load shedding** – limit whole building load to reduce peak demand charges
- **Sequential startup** – stage equipment to reduce peak demand charges
- **Demand response** – reduce loads during times when the grid is strained

Optimizing EMS

- **Check all setpoints and schedules**
- **Calibrate sensors** – air temperature, water temperature, static pressure, photosensors
- **Check damper positions** – RTUs, terminal units
- **Functional Testing** – verify operation according to control sequences
- **Retro-commissioning** – hire a vendor

Retro-commissioning

- Systematic process for improving building energy performance
- Focus on operational improvements
- Best opportunities
  - Medium to large buildings
  - Buildings that have had an EMS in place for several years
  - High energy intensity (kBtu/sq. ft.)
- Payback of 2 years or less is common
  - Savings of 5 - 25%
  - Cost of $0.10 to $1.00 / sq. ft.

Resources

- ***Energy Management Systems – A Practical Guide***
  - Part of the O&M Best Practices Series by Portland Energy Conservation, Inc.
  - Funded by EPA and DOE
  - http://www.peci.org/documents/PECI_PracticalGuide1_0302.pdf
- ***O&M Best Practices – A Guide to Achieving Operational Efficiency***
  - Federal Energy Management Program
  - Section 9.6 Energy Management/Building Automation Systems
  - http://www1.eere.energy.gov/femp/pdfs/omguide_complete.pdf
- ***ENERGY STAR Building Upgrade Manual***
  - *http://www.energystar.gov/index.cfm?c=business.bus_upgrade_manual*

Upcoming Webinars

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Please join us again:

Title: **Driving Demand #2: Lessons from the Field**
Host: Merrian Fuller, Lawrence Berkeley National Lab
Date: October 19, 2010
Time: 2:00-3:15 EDT

Title: **Overcoming Common Pitfalls: Energy Efficient Lighting Projects**
Host: Jeffrey Schwartz, ICF International and Heidi Steward, Pacific Northwest National Lab
Date: October 21, 2010
Time: 12:00-1:30 EDT

Title: **Tips and Tools for Promoting Your Energy-Efficiency Project**
Host: Nancy Raca, ICF International and Jim Arwood, NASEO
Date: October 22, 2010
Time: 12:00-1:00 EDT

Title: **Quality Assurance for Residential Retrofit Programs**
Host: David Keefe and Jim Grevatt, VEIC
Date: October 26, 2010
Time: 2:00-3:00 EDT

Title: **RETScreen Training 101**
Host: Sarah Busche and Jimmy Jones, NREL
Date: October 27, 2010
Time: 3:00-4:15 EDT

Title: **Benchmarking Your Building's Energy Using EPA's ENERGY STAR Portfolio Manager**
Host: Peter Flippen, ICF International
Date: October 28, 2010
Time: 12:00-1:00 EST

For the most up-to-date information and registration links, please visit the Solution Center webcast page at www.wip.energy.gov/solutioncenter/webcasts