

Selecting and Evaluating New and Underused Energy Technologies

FEMP FIRST THURSDAY
SEMIN@RS 



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FEMP 
Federal Energy Management Program

Core Competencies Addressed in this Seminar

Energy/Sustainability Managers

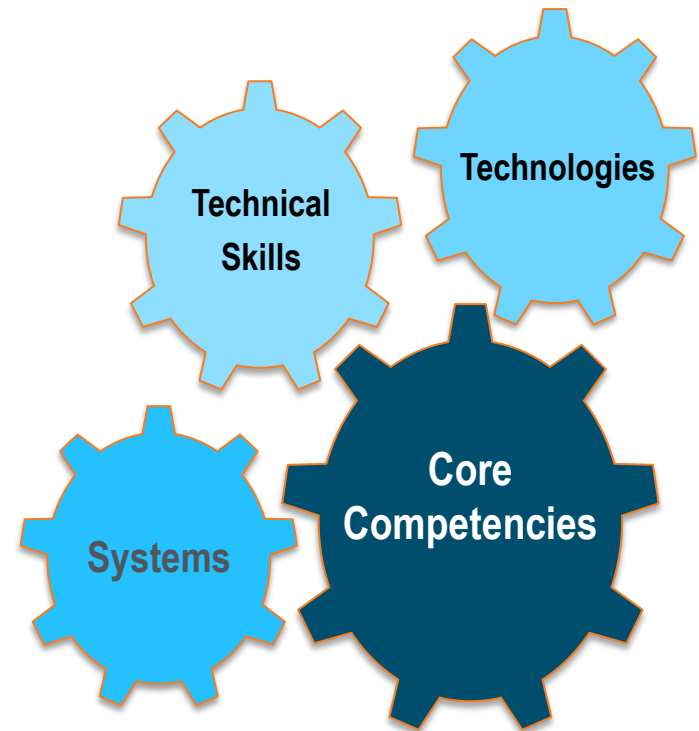
- Industry Trends
- Building Technologies
- Improving Energy Efficiency

Facility Managers

- Industry Trends
- Managing Facility Projects

Operating Engineers/Building Technicians

- Industry Trends
- Building Technologies
- Maintenance Management



Results and Expectations

Employ the ideal energy saving technologies in your facility or facilities based on an analysis of the options that best meet the facility needs



Results and Expectations

Take advantage of the
**FEMP Technology
Deployment Matrix**
to meet your site specific needs

Consider how new and underused
technologies can be integrated
into an alternatively financed project



The Technology Deployment Matrix

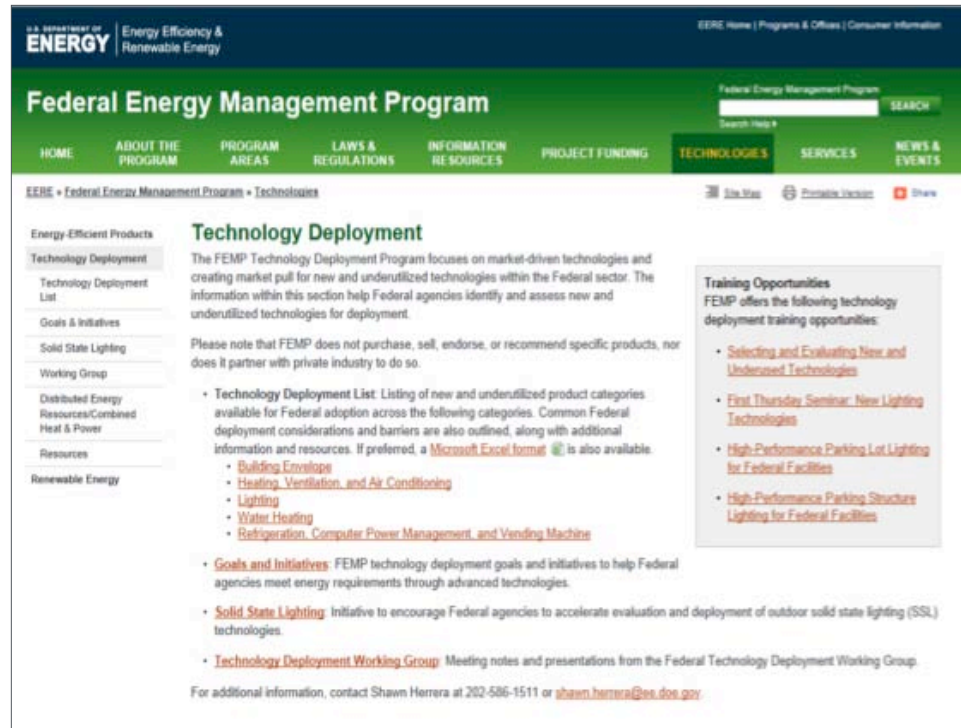
Technology Deployment Matrix

- Excel multi-tabbed workbook tool to assist agencies and ESCOs
- Identifies **50 top ranked** underused technologies for Federal ESPC/UESC projects
- Ranked to maximize energy savings impact
- Saves research time and provides better direction in making Energy Conservation (ECM) decisions

FEMP Top 20 Technologies for Deployment

Rank	Technology	Category	Weighted Score
1	Spectrally Enhanced Lighting	Lighting	91
2	Low Ambient / Task Lighting	Lighting	88
3	Condensing Boilers	HVAC	86
4	Super T8 Lighting	Lighting	79
5	Commercial Ground-source Heat Pumps	HVAC	66
6	High R-Value Windows	Building Envelope	65
7	Duct Sealants	HVAC	63
8	LED / Solid State Lighting - Interior	Lighting	61
9	LED / Solid State Lighting - Exterior	Lighting	59
10	PC Power Management	Other	58
11	Condensing Water Heaters - gas	Water Heating	58
12	Water Cooled Oil Free Magnetic Bearing Compressor	HVAC	54
13	Integrated Daylighting Systems	Lighting	53
14	Cool Roofs	Building Envelope	53
15	Bi-level Garage / Parking Lot / Pedestrian Lighting	Lighting	53
16	Wrap Around Heat Pipes	HVAC	53
17	Window Films	Building Envelope	53
18	Commercial Energy Recovery Ventilation Systems (ERV)	HVAC	52
19	Air-side Economizers and Filters for Data Centers	HVAC	52
20	Induction Lighting	Lighting	51

Posted on the FEMP website

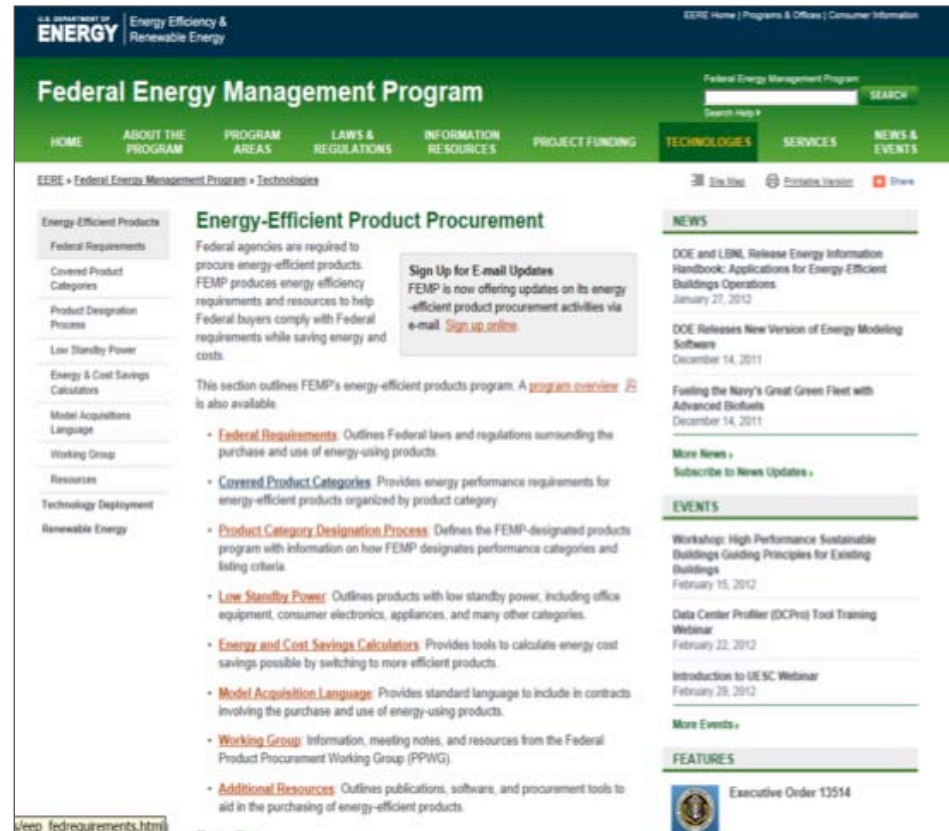


http://www1.eere.energy.gov/femp/technologies/new_technologies.html

The Technology Deployment Matrix

Best available for efficiency as represented by

- FEMP Designated
- Energy Star Products

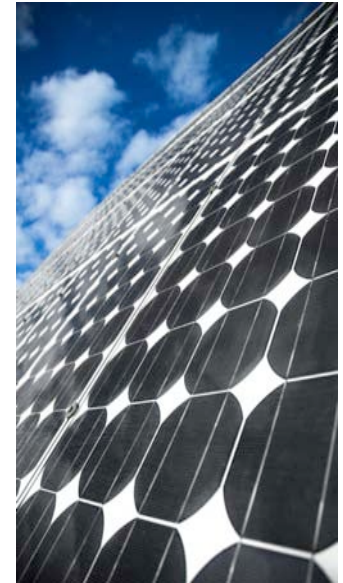


Attributes for Ranking

- Overall Federal market impact
- Energy savings potential
- Cost effectiveness
- Strength of supply chain
- Past demonstrations or pilots
- Available reports, briefs and other publications
- Receptiveness of potential “buyers”

ECM Categories

Building Envelope
HVAC
Lighting
Water Heating
Other



Ranking and Weighting

Energy Savings Potential
Cost Effectiveness
Probability of Success

Ranking Criteria	Weighting
Federal Impact	50%
Cost Effectiveness	30%
Probability of Success	20%

Top Technologies in the Technology Deployment Matrix

Lighting

- Accounts for around **20%** of average Federal energy consumption in facilities
- Significant advances in lighting technology in recent years
- The FEMP technology deployment list contains **8** lighting technologies in the Top 20



Spectrally Enhanced Lighting (SEL)

- Lamps with an enhanced color spectrum in higher color temperature ranges (more blue), allow people to see more clearly and make spaces appear brighter
- Light levels are reduced with the same visual acuity
- DOE studies show a **20% - 45% reduction** in power with the same occupant satisfaction



Spectrally Enhanced Lighting (SEL)

- Spaces lit with **SEL** [using lamps with a correlated color temperature (CCT) of 5000K] appear brighter than conventional 3500-4100K lamps
- Energy savings are achieved by using fewer lamps, lower ballast factor ballasts, and dimming
- Ideal in office environments that include occupant-controlled dimming
- For more information, watch the February First Thursday presentation on SEL



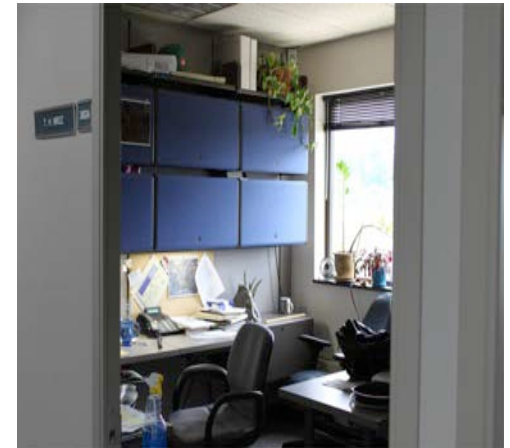
Low Ambient and Task Lighting

- Design strategy adds user-controllable task-light fixtures
- Reducing the overhead (ambient) light level and provide task light where it's needed
- Less power is required because the closer a light source is to the task, the more illumination it provides
- FEMP estimates potential 15 to 25% reduction in lighting energy; more with task lighting controls



Low Ambient and Task Lighting

- Task lights can use lower wattage than overhead lights to achieve the needed light level
- Non-work spaces (such as aisles and floors) are illuminated to a lower level
- A task-ambient design strategy lights the general area to a lower illumination (say under 30 footcandles)
- Controls for turning off task lighting when not required are important



Solid State Lighting (SSL) - Exterior Applications

Emerging light-emitting diodes (LED) technology offers:

- potential energy savings
- improved directionality
- better cold-weather performance
- good color rendition
- long life, multi-level switching
- instant-on capabilities





Solid State Lighting (SSL) - Exterior Application Resources

- FEMP sponsors the Outdoor SSL Deployment Initiative
www.eere.energy.gov/femp/technologies/ssl_resources.html
- Watch the FEMP On Demand training on Exterior SSL
High- Performance Parking Structure Lighting
http://apps1.eere.energy.gov/femp/training/course_detail_ondemand.cfm/CourseId=88

High-Performance Parking Lot Lighting
http://apps1.eere.energy.gov/femp/training/course_detail_ondemand.cfm/CourseId=87
- DOE SSL Program offers technical information, product testing (CALiPER), demonstrations (GATEWAY), model specifications, and more
www.eere.energy.gov/buildings/ssl/

SSL – Interior Applications

- LED retrofits viable for indoor applications
 - Down lights, under cabinet, task lighting
- Competitive with CFL, with better dimming characteristics
- L-Prize winner
 - Over 900 lumens for less than 10 Watts
 - 30,000-hour rated life
 - Dimmable down to 10%
 - 92 CRI and 2700K CCT



SSL – Interior Applications

- Replacements for linear fluorescent luminaires may be viable for high cost maintenance areas and where dimming control is advantageous
- Apply where directionality, instant-on, long-life, and dimming provide benefit



Integrated Daylighting Systems

- Use control systems such as:
 - electronic dimmable fluorescent ballasts
 - photo sensors
 - workstation controls
 - network components
 - building management options
- Dim the lights to reduce the power draw and reduce energy used for lighting and cooling



Integrated Daylighting Systems

- Because daylighting may cause glare, use
 - Experienced design team
 - Good commissioning practices
 - Proactive maintenance
- Easiest to apply to fluorescent and LED lighting
- Works well with Task/Ambient strategy



Bi-level Garage, Parking Lot and Pedestrian Lighting

- Uses lights with two power levels combined with motion sensors
- Saves energy by reducing the light level when no occupants are present
- Appropriate with instant-on capability such as fluorescent or LED
- More unoccupied = more savings potential



Bi-level Lighting

- Use where inappropriate or unsafe to turn lights off
- Occupancy sensors have limited fields-of-view, can be obstructed, and require commissioning and maintenance
- Case study - First Thursday Seminar on New Lighting Technologies: DOL garage, Washington, DC



Heating, Ventilation, Air Conditioning (HVAC)

Consumes an average of **40%**
of the energy in Federal facilities

- Space heating **>30%**
but depends on location
- Southern states are
dominated by space cooling



Condensing Boilers

- Gas-fired boilers with enhanced heat exchangers that extract more heat energy from exhaust gases to achieve higher efficiency
- Improves combustion efficiency by more than 10%
- Same technology is applicable to water heaters



Condensing Boilers

The cooler the inlet water temperature the better

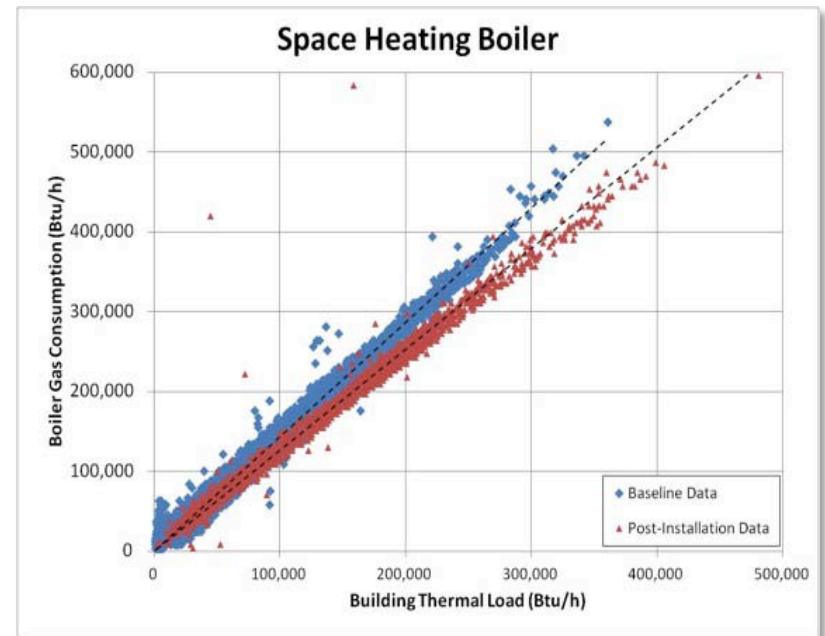
- Works well with hot water systems that operate at lower temperatures
- May not condense when inlet water temperature is above 120° - 130°

Condensate can be neutralized inline by using limestone



Demonstration at US Marine Corps Facility

- Demonstration sponsored by the Navy Techval Program
- Improved boiler's average thermal efficiency from 69% to 79%
- Reducing annual natural gas for space heating by ~12 to 13%
- EWT ranges from 140 to 157°F



Duct Sealants

- Aerosol-suspended sealant reduces leaks in ductwork
- Allows HVAC to deliver more conditioned air to the controlled zone
- Useful in older facilities where ductwork is not sealed to today's standards
- Important to test ductwork for air leakage before moving forward



Duct Sealants

- Works well with variable-air volume (VAV) systems because ventilation system can rebalance automatically
- For constant-volume ventilation systems, manual rebalance may be required
- Navy demonstrations documented HVAC savings ranging from 7 to 50% with simple payback from 6 to 11 years in limited applications

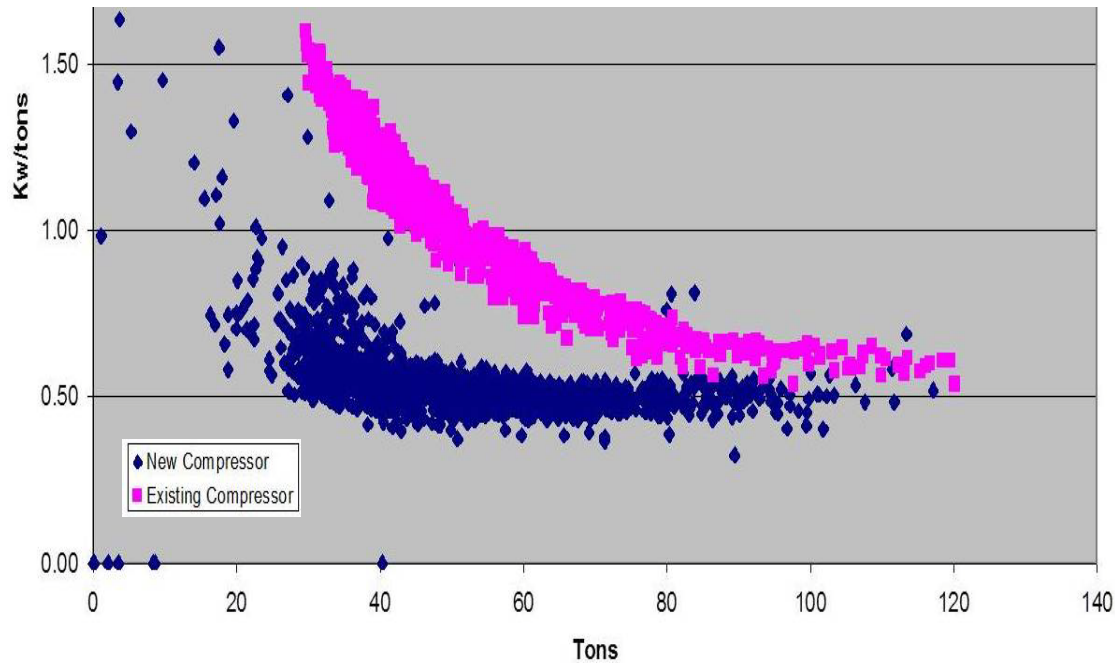


Variable-speed, Water-cooled, Oil-free, Magnetic-bearing Chiller Compressor

- A highly-efficient centrifugal chiller compressor with an internal variable-speed drive and magnetic bearings
- Excellent partial-load efficiency, where chillers operate most frequently
- Modular systems stacked for larger capacities
- Savings of 40 to 60% in annual cooling energy documented by Navy Techval Program

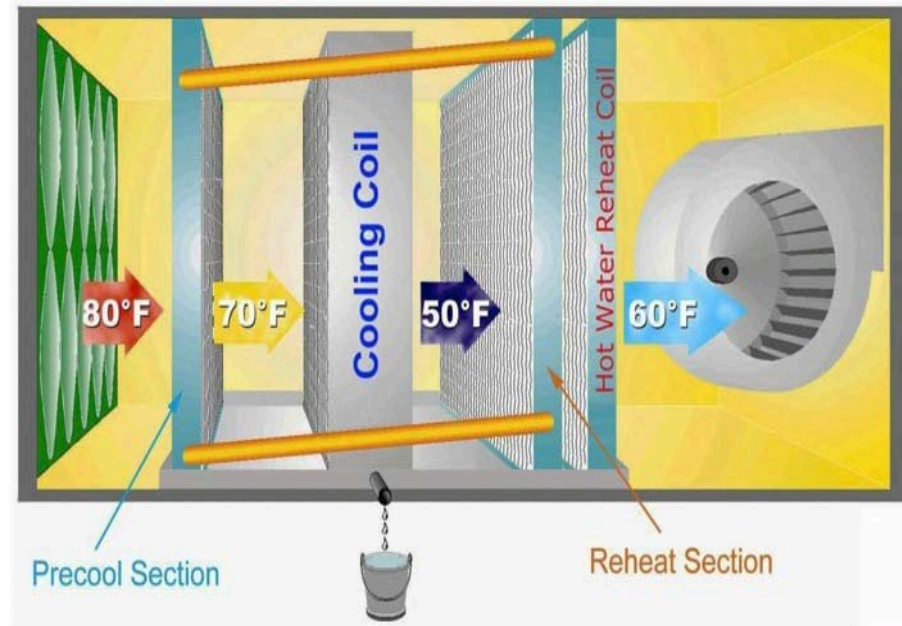


Navy Demonstration 240-ton Compressor Retrofit



Wrap-Around Heat Pipes

- Enhance dehumidification, eliminate reheat, and reduce chiller load
- Pre-cools the air entering the cooling coil
- Re-heats the air leaving the cooling coil



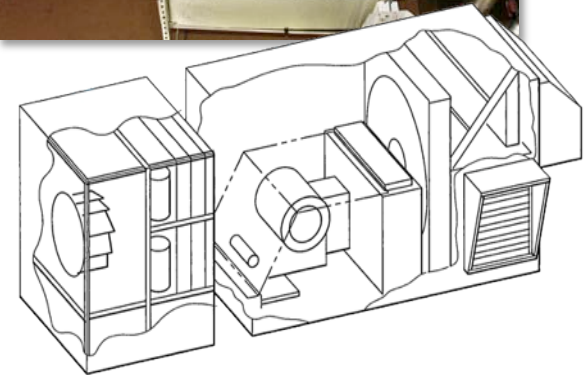
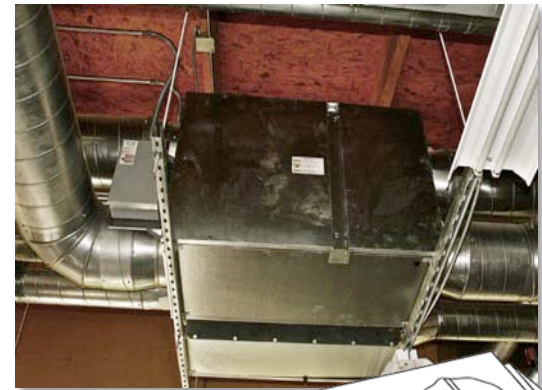
Wrap-Around Heat Pipes

- Best applied where humidity control is important and where reheat energy can be offset such as southeast and eastern coastal states
- More cost effective in new construction where capital costs can be reduced
- Available for capacities ranging from 1,000 cfm to over 20,000 cfm



Commercial Energy Recovery Ventilation (ERV) Systems

- Exchange heat between the outgoing exhaust air and the ventilation air, reducing load on HVAC system
- Can reduce energy required to condition make-up air by 50%
- Heat and energy recovery wheels, energy recovery loops, heat pipes, plate exchangers



Commercial Energy Recovery Ventilation (ERV) Systems

- More effective in cold climates because temperature difference is greater
- Use in facilities with centralized make-up air systems closely located to exhaust air
- Watch for conflict with outside-air economizer controls



Service Hot Water

Water heating accounts for as much as **15%** of energy consumption in Federal facilities



Condensing Water Heaters (Gas Fired)

- Condense moisture out of the flue gas to achieve higher efficiency
- Improve combustion efficiency by **10 to 15%**
- Used where hot water use is high: hospitals, laundries, gyms, lodging
- Navy currently monitoring two applications. Results will be presented at GovEnergy 2012 in St. Louis



Condensing Water Heaters

Similar limitations as condensing boilers

- Need to watch inlet water temperature
- Demand-flow systems should work well because of low make-up water temperature
- Storage and recirculating systems may not benefit as much because of the entering water temperature



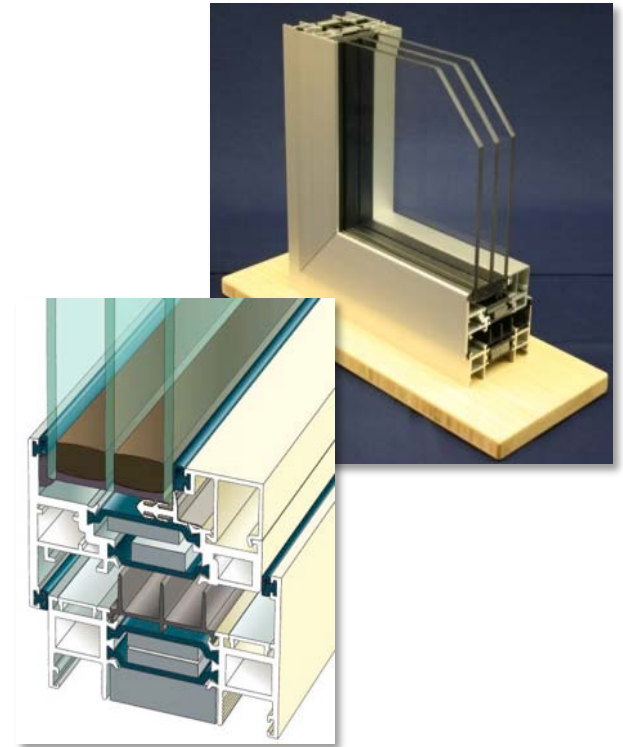
Building Envelope

The building envelope may not consume energy directly but it does directly impact the load on the HVAC system, and indirectly, the lighting system.



High R-Value Windows

- Windows account for about **30%** of HVAC energy. High-performance windows can reduce that by half
- High-performance windows are R-5 and greater windows (U value 0.22 and lower)
 - Typical code requirement is less than R-3
- In new construction, high R-windows can mean lower first cost resulting from smaller capacity heating and cooling equipment



High R-Value Windows

- Windows that are highly-insulating include features such as
 - triple-pane
 - spectrally-selective coatings
 - thermal breaks
- Also reduce infiltration, manage solar heat gain, and improve comfort



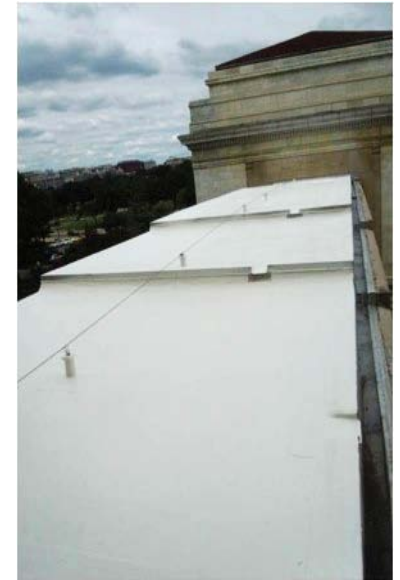
Cool Roofs

- Reduce heat flow from the roof to building interior, reducing space cooling load
- Lower roof temperature up to **50° to 60°F** during peak summer daytime
- Especially beneficial in warm, sunny climates



Cool Roof

- Cool roof does not mean white roof
 - Cool roofs available in multiple colors
- Specification should focus on
 - High solar reflectance (albedo)
 - High thermal emittance
- Cooler roof will extend roof life
- Benefit depends on roof design but added cost to a re-roof or new roof can be minimal



Rounding Out the Top 20 Technologies

Check out the **FEMP Technology Deployment List** for information on

- Benefits,
- Applications,
- Climate and regional considerations,
- Key factors, and
- Information resources



www.eere.energy.gov/femp/technologies/new_technologies.html

Technology Deployment and ESPCs

Technology Deployment and ESPCs

- Projects require a mix of motivation and tolerance among partners:
 - Partners are either motivated to incorporate the technology or tolerant to have it as part of the project
- Technologies can be the idea of the Federal agency, ESCO, and /or third party
- Perceived risks need to be identified, managed, and/or mitigated



Technology Deployment in ESPCs

- Risk can be reduced by being properly shared among the parties, and by acquiring more detailed technical information
- Demonstrations in the IGA phase can help reduce risks and uncertainties



Technology Deployment in ESPCs

- Utilize technology experts from the National Labs and private sector to educate stakeholders, emphasizing value/benefits
- Positive relationships and trust among all parties is critical
- Need to be flexible and provide a customized approach to meet customer needs
- Applicable financial incentives can help offset first costs

Technology Deployment in ESPC Working Group

- Increase the utilization of FEMP Designated Product Specifications (top 25% in efficiency) for selected technologies in ESPC
- Accelerate deployment of new technologies through ESPC with particular emphasis on use of the FEMP Technology Deployment Matrix
- Open to new participants



Project Examples

USCG Puerto Rico – ESPC Project

Investment Grade Audit scope

- Cool roofs
- Variable refrigerant volume (VRV) air-conditioning
- Baseline and post-retrofit conditions were measured before award (for each ECM)
- USCG funded demonstration
- Reduced price, installation and performance risk



House Office Building ESPC Project

- Aerosol duct sealing ECM
- Limited “trial” demonstration
- Savings were less than anticipated
- Helps mitigate ESCOs performance risk



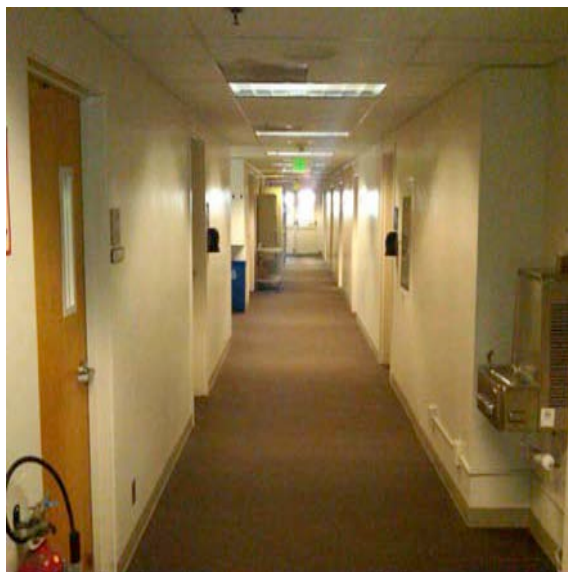
GSA Region 7

Three concurrent ESPC projects with three separate ESCOs

- LED Lighting
- Induction lighting
- Turbocor chillers
- Wind
- Roof Integrated PV and cool roofs
- Data center efficiency measures



SEL – NASA JPL



3500° K lamps



5000 ° K lamps

Additional case studies under development include cool roofs, duct sealing, turbocor magnetic bearing chillers and variable refrigerant volume A/C

Technology Deployment in ESPC Projects

Outdoor LED Lighting:

US Army Korea DOE Forrestal
USCG PYE GSA Region 7

Induction Lighting:

Ft. Irwin USCG Puerto Rico
USCG PYE GSA Region 7

Lab/Air Flow/Fume Hoods:

BNL LANL
ORNL, NETL, USFS FPL



Technology Deployment in ESPC Projects

Variable Refrigerant Volume (VRV) A/C:

USCG PR Tinker AFB

Turbocor Chillers:

USDA Gainesville GSA Region 7

USCG PYE NASA JPL

Roof Integrated PV:

GSA 7 Luke AFB

LED Airfield Lighting: USCG PYE



Technology Deployment in ESPC Projects

Duct Sealing:

Architect of the Capitol, House Office Building

Biomass Cogen/Boilers:

NETL, NREL, ORNL

Savannah River Fairton FCI

BOP Pittsburg

Forest Service Regions 1, 2 & 4

Cool/Green Roof:

NETL, USGS, GSA Region 7

PJJK Fed Bldg



Technology Deployment in ESPC Projects

Wind power:

NETL USFS Regions 2 & 4

GSA Region 7 Pantex

Spectrally Enhanced Lighting:

NASA JPL

ORNL

US Army Korea

GSA HI, Long Beach and Santa Ana, CA



Resources

Technology Deployment Web Page

Technology Deployment Matrix Working Group



http://www1.eere.energy.gov/femp/technologies/new_technologies.html

Training Opportunities on FEMP Website

- On Demand
 - Compressed Air Assessment Basics
 - Calculating Energy Savings of Cool Roofs
 - FEMP Exterior Solid State Lighting Initiative
 - Parking Lot Lighting
 - Parking Structure Lighting



<http://apps1.eere.energy.gov/femp/training/>

Other Resources

GovEnergy 2012

<http://www.govenergy.com/Index.aspx>



FEMP News

<http://www1.eere.energy.gov/femp/news/news.html>

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