

Military Construction Energy Conservation Trends

SAME Open House 2013

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Outline

- Sustainability/Energy References
- Current Requirements
- Trend
- Enterprise Design Approach
- Regional Centers of Expertise
- Available Now
- Coming Soon



Sustainability/Energy References

- National Energy Conservation Policy Act
- National Defense Authorization Act 2012
- Energy Policy Act 2005
- Energy Independence and Security Act 2007
- Executive Order 13423
- Executive Order 13514
- Federal Leadership in HPSB MOU (Guiding Principles)
- UFC 3-400-01 Energy Conservation (Change 4-2008)
- UFC 4-030-01 Sustainable Development (2007)
- Army Sustainable Design and Development Policy Update 2010-10-27
- DoD Implementation of Storm Water Requirements under EISA 2010-01-19
- ECB 2006-2 – LEED requirement
- ECB 2011-1 – Energy/LEED requirements (List of Enhancements)
- ECB 2011-13 – Revision/clarification of ECB 2011-1
- ECB 2012-14 – Prohibition on LEED Gold/Platinum



Current Requirements

■ Federal

- ▶ Reduce water consumption from 2007 baseline 16% by 2015.
- ▶ Reduce greenhouse gas emissions from 2003 baseline 30% by 2015.
- ▶ Reduce energy in stock of Federal buildings from 2003 baseline:
 - **2013 – 24%**
 - 2014 – 27%
 - 2015 – 30%
- ▶ Percentage of electric energy consumption to be from renewables:
 - 2010-2012 – 5 %
 - **2013 – 7.5%**



Current Requirements

- Federal
 - ▶ Reduce fossil fuel energy use in Federal buildings from 2003 baseline:
 - **2015 – 65%**
 - 2020 – 80%
 - 2025 – 90%
 - 2030 – 100% - **NET-ZERO!!!**



Current Requirements

- Federal

- ▶ Advanced metering electricity, natural gas, and steam.
- ▶ 30% reduction new Federal Buildings from 2003 baseline (exclude plug/process).
- ▶ Procure Energy Star or FEMP Designated Products
- ▶ Certification system for green Federal facilities
- ▶ 30% hot water from solar hot water heaters
- ▶ Permanent authorization of ESPCs
- ▶ Comprehensive energy/water conservation program for “covered facilities”
- ▶ Storm water management (LID)



Current Requirements

- **Army**
 - ▶ **Comply w/ ASHRAE 189.1-2009**
 - ▶ LCCA for major systems
 - ▶ LEED Silver Certification
 - ▶ Solar hot water heating
 - ▶ More detailed metering requirement
 - ▶ Cool roofs
 - ▶ Reduce indoor water use by 30%
 - ▶ Reduce outdoor water use by 50%
 - ▶ Include building envelope, storm water management systems, water treatment systems, and IT systems in commissioning.
 - ▶ Consider list of “Viable Energy and Sustainability Enhancements” (ECB 2011-1)



Current Requirements

■ USACE

- ▶ **Energy - Reduce building energy use by 30% (inc. plug/process loads) and comply w/ ASHRAE 189.1-2009**
- ▶ LCCA required when beyond minimum energy requirement
- ▶ Exterior lighting to meet DoE, EPA, or 3rd party quality standards, 5 yr warranty, and LCCA for renewable power.
- ▶ Specific LEED Credit Requirements

Examples:

- **Enhanced Commissioning**
- Measurement & Verification
- 100% outdoor potable water reduction



Current Requirements

- Louisville District

- ▶ Policy Document clarifying District interpretation of the Army Sustainable Design and Development Policy Update 2010-10-27.
- ▶ Literal interpretation of the ASA memo. Partial compliance with ASHRAE 189.1.



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MEMORANDUM FOR: SEE DISTRIBUTION

SUBJECT: Sustainable Design and Development Policy Update (Environmental and Energy Performance)

1. References.

- Memorandum, DASA (I&H), 8 Jul 10, subject: Sustainable Design and Development Policy Update (Environmental and Energy Performance)
- Memorandum, Office of the Under Secretary of Defense, DoD Implementation of Storm Water Requirements under Section 438 of the Energy Independence and Security Act (EISA), 19 Jan 10.
- EPA 841-B-09-001, Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act, Dec 09.



Current Requirements

- ECB 2012-13 – Energy Implementation Guidance Update, ASHRAE 189.1, LCCA Requirements
 - ▶ Modifies & clarifies ECB 2011-1
 - ▶ FY13 Projects – ASHRAE 189.1-2009 Compliance
 - ▶ 30% Energy Reduction from ASHRAE 90.1-2007 Baseline (including plug/process loads)
 - ▶ Life Cycle Cost Analysis required beyond the minimum compliance
 - If project > ASHRAE 189.1 AND 30% energy reduction, LCCA required.
 - If project > either but not both, NO LCCA required.
 - ▶ ASHRAE 189.1 baseline for LCCA.



Current Requirements

- **ECB 2012-13 - Continued**
 - ▶ Additional guidance regarding adoption of ASHRAE 90.1-2010 and ASHRAE 189.1-2011 expected w/in 90 days.
 - ▶ It has been > 280 days.
- **ECB 2012-14 – Update to LEED Certification Guidance**
 - ▶ National Defense Authorization Act 2012 Guidance regarding LEED certification
 - ▶ No use of funding to achieve LEED Gold or Platinum.
 - Do NOT require in contract
 - Do NOT consider offeror's statement of intent to achieve higher certification level.
 - If beyond LEED Gold or Platinum, document that rating achieved w/in available funds and reduces total cost of ownership (LCCA).



Current Requirements

- **ECB 2012-15 Exterior Lighting Performance Standard**
 - ▶ Applies to FY14 and beyond on Army MILCON and SRM projects.
 - ▶ Exterior lighting systems/fixture adhere to quality standards recognized by
 - DesignLights Consortium
 - EPA Energy Star
 - DoE FEMP
 - OR Appropriate 3rd party.
 - ▶ 5 year Luminaire Warranty
 - ▶ 40 yr Life cycle cost evaluation of on-site renewable power for lighting.



Current Requirements

■ Change Summary

- ▶ No use of funds for LEED Gold or Platinum
- ▶ Partial ASHRAE 189.1 Compliance
- ▶ 30% energy reduction w/ plug & process loads
 - Vs 40% energy reduction w/out plug & process loads
- ▶ Energy conservation LCCA clarification
- ▶ Exterior Lighting Performance meeting 3rd party standards if more stringent & 5 year warranty



Trend

- EISA 2007 - Reduce fossil fuel energy use in Federal buildings from 2003 baseline:
 - ▶ **2015 – 65%**
 - ▶ 2020 – 80%
 - ▶ 2025 – 90%
 - ▶ 2030 – 100% - **NET-ZERO!!!**



Trend

- 2011 EISA Study (USACE, NREL, PNNL)
 - ▶ 25-35% Reduction – Maximum energy savings for lowest cost
 - ▶ 35-60% Reduction – Each increment saved comes at increasingly higher cost
 - ▶ > 60% - Cost prohibitive w/o looking beyond bldg – central plants, utility scale renewables, etc.
 - ▶ Some facilities will never reach 65% through energy efficiency alone
 - ▶ The most effective EEMs included items we already employ most of the time except:
 - Radiant Heating and Cooling in Barracks and HQ
 - Ground Source Heat Pumps in HQ
 - Passive house insulation levels in DFAC



Trend

- 30% w/o plug/process loads – EPAAct 2005
- 40% w/o plug/process loads – ECB 2010-14
- 40% w/ plug & process loads (energy cost) – ECB 2011-1 (15 LEED EAc1 points)
- 30% w/ plug & process loads – ECB 2012-13
 - ▶ Tough to control plug & process loads
 - ▶ Consider
 - 15% of baseline is plug load -> 35% w/o plug loads
 - ▷ (Vehicle Maint, MO; Vehicle Maint, KY)
 - 25% of baseline is plug load -> 40% w/o plug loads
 - ▷ (Lodging Facility, OH; Administrative, KY; LEED default)
 - 40% of baseline is plug load -> 59.5% w/o plug loads
 - ▷ (Army Reserve Training, MO)
 - 55% of baseline is plug load -> 67% w/o plug loads
 - ▷ (Consolidated BN/BQ HQ, KY)



Trend

■ Energy Requirement

- ▶ Requirement to justify investments with life cycle cost beyond 30% energy reduction.
- ▶ Note that 2011 EISA Study indicates that between 35-60% Reduction, each increment saved comes at increasingly higher cost.
- ▶ Future
 - Group buildings to share resources to take advantage of larger, more efficient technology:
 - ▷ Cogeneration
 - ▷ Utility scale renewables
 - Group functions into single building:
 - ▷ Combine barracks and DFAC (like in a dorm) – Example: Both have high domestic hot water demands but peak at different times.
 - Emphasis on Occupant Behavior – Turn off lights/TVs. Turn off computers. Do not block vents. Do not locate coffee pot by the thermostat. Limit thermostat range.
 - Reducing plug/process loads gets into mission/quality of life issues.



Trend

■ Energy Requirement

- ▶ Buildings are programmed to reach the MINIMUM requirements.
- ▶ Due to existing processes for appropriating funding for projects:
 - No mechanism for incorporating higher levels of performance into 1391
 - Difficult to plan multiple building projects sharing central plants, cogeneration, etc.
 - Planning central systems may require upgrade of existing buildings. Different funding sources
 - ▷ Example: Central heating/cooling plant using ground source heat pumps programmed. Coil sizes for existing facilities planned to use new plant are inadequate due to difference in water temperatures. Upgrade to all existing buildings on plant required.



Enterprise Design Approach

- Consistently deliver:

“a life cycle cost effective high performance sustainable building of design and constructed quality to perform and function as expected, verified and tested before we leave the project site.”

Through the insertion of standard processes.



Enterprise Design Approach

- Insert processes from planning through occupancy
 - ▶ Planning
 - Design team present at 1391 charrettes
 - Eco-charrettes
 - Evaluate district energy/utility application w/ adjacent or future buildings.
 - ▶ Design
 - Standards for energy models & LCCA
 - Passive design features
 - Develop property report card – expected utility meter readings, energy & water savings.
 - ▶ Construction/Occupancy
 - Advanced commissioning
 - Monthly meter data collection
 - Comparison to predicted performance



Energy & Sustainability Record Card at a glance

BUILDING: Building 12345 **SF:** 100,000 **PA:** 8,000,000 USD
PROJECT: 1234567 - Stargate Research Complex **100% Complete**
LOCATION: USAG Humphreys, Korea **Climate Zone:** ... **as of 19-Oct-2012**

ENERGY & SUSTAINABILITY RECORD CARD **FOUO/Draft**

Green - data input cells Blue - Data calculated from tabs

District Ofc: **Project Type:** New Construction **Acquisition Strategy:** **Program Year:** **BoD Date:**
PM/POC: **Phone:** **Description of Building/Project:**

Energy Intensity (kBtu/SF)
Target (40%): 106
As Designed: 77
Actual: 47

MODELED Savings
Energy Savings vs. Baseline: 9,959,418 kBtu/yr
56% Savings from 90.1-2004
Water Savings vs. Baseline: 21,000 gal/yr
21% Savings from IPC 2006

ACTUAL Savings
Energy Savings vs. Baseline: 13,040,485 kBtu/yr
74% Savings from 90.1-2004
Water Savings vs. Baseline: 21,000 gal/yr
21% Savings from IPC 2006

Annual Energy Usage
Grid Electricity (kBtu)
Facility: 7,301,98
Plug Loads: 3,582,749
Natural Gas (kBtu)
Facility: 1,099,14
Propane (kBtu)
Facility: **Cooking:** **Other Fossil Fuels (kBtu)**
Fuel Oil: **Cooking:**

On-Site Alternative Energy
Type(s): Total System Rating, kW: Annual Production, kBtu: 4,241,292
ASHRAE 189.1 Renewable Requirements
7.3.2 Min RATING in kW: 7.4.1.1 Min kBtu/yr:

Energy Use to Baseline Comparison
Use Reduction Net Utilities Renewables

Energy & Sustainability Features
include narrative, drawings, and/or photos describing highlights in energy, sustainability, and LID:

Compliance Ratings: (Overall) 45%
EPAct 2005: ASHRAE 189.1: EO 13423: EO 13514: UFC 1-200-02: HPSR MOU: LEED Impact: **Target Level: Silver** Projected Level: Silver Yes' Points: No' Points:

LEED Points in Required Categories: 45% of Minimum Points for Silver from Energy and Water Conservation

- SS 6.1 Stormwater Design, Quantity Control
- SS 6.2 Stormwater Design, Quality Control
- WE 1 Water Efficient Landscaping
- WE 3 Water Use Reduction (2 minimum)
- EA 1 Optimize Energy
- EA 3 Enhance Commissioning
- EA 5 Measurement and Verification
- MR 2 Construction Waste Management
- MR 4 Recycled Content
- IEQ 3.1 Construction IAQ Management Plans
- IEQ 3.2 Construction IAQ Management Plans
- IEQ 7.1 Thermal Comfort Design

Water Use to Baseline
Use Reduction Harvested On-Site Net Utility

Project/Facility Information

Description of Unique E&S Features

Energy and Water Metrics:

- Energy Intensity (BTU/SF)
- Overall Design Model Savings
- Overall Actual Savings as Measured
- Energy Model by Source and Type

Compliance & Performance Dashboard

Renewable Energy Info Breakout

LEED Dashboard

Energy Summary Infographic

Water Summary Infographic



Enterprise Design Approach

- What does it mean to you?
 - ▶ Planning
 - Sustainable design and energy conservation appropriately programmed.
 - ▷ Do we need higher cost mechanical, lighting, envelope systems?
 - ▷ What would a ground source well field cost? Do we need one?
 - ▷ Do we put photovoltaics on the roof or on parking shading? Cost?
 - ▷ Can we share renewables, heating/cooling plants, etc. among planned facilities?
 - ▷ What do we have to do to meet the low impact design requirements? Cost?
 - ▷ How would we mass/orient the building? Is this even an appropriate site?
 - Increased effort and cost during 1391 development
 - ▷ Concept level energy analysis & LCCA
 - ▷ Site assessment/analysis
 - ▷ Civil, architect, mechanical, electrical, and cost (possibly structural) additional time (1-2 days each)
 - ▷ DPW additional time (1 day)



Enterprise Design Approach

- What does it mean to you?
 - ▶ Design
 - Consistency across projects in energy modeling and LCCA.
 - Additional energy model predicting utility costs.
 - Concentration on passive features such as thermal mass, solar shading, solar walls, air tightness, prevent thermal bridging, etc.
 - Increased cost/time
 - ▷ Additional/adjusted energy models
 - ▷ Influence honest, more accurate energy models & LCCA
 - ▷ More information necessary from users, DPW, etc. to facilitate accurate modeling.
 - ▷ Passive features can have higher initial costs w/ lower energy savings than mechanical/electrical systems but result in lower maintenance costs and can last as long as the buildings stand.



Enterprise Design Approach

- What does it mean to you?
 - ▶ Construction/Occupancy
 - Higher level of quality assurance. Changes in existing business practices.
 - Evaluation of utility consumption of facility during occupancy can further shake-out construction deficiencies and design problems or identify operational issues.
 - Determine accuracy of energy models. Check actual % energy reductions.
 - Potential for accountability to design team or contractor (unless the design team & contractors are smart).
 - Increased Cost/Time
 - ▷ Advanced commissioning = advanced cost.
 - ▷ Cost for monthly meter data collection depends on capability to interface w/ systems.
 - ▷ Calibration of energy models.
 - ▷ Increased cost for additional controls points, trends, etc. installation.
 - ▷ Increased cost for investigation of identified problems and resolutions.



Regional Centers of Expertise

- Sustainability, Energy, and LCCA Centers
- Regional Support
- Develop and transfer knowledge among Divisions/Districts
- Each Center responsible for developing knowledge in specific technology or process
- Website: <https://mrsi.usace.army.mil/sustain/SitePages/Home.aspx>
 - ▶ Website also includes training information, policies, technical information and reports, and news.



Regional Centers of Expertise

NAD - Commissioning, Low impact design, *Solar thermal*

SAD - District energy, Water, Waste water, Purple pipe

LRD - Charrettes, Conceptual modeling, *Ground source heat pump*

SWD - OMA / SRM/ existing buildings, *Waste to energy*

NWD - Building envelope, Air tightness, Passive house , waste

SPD - Life cycle cost analysis, *Solar PV, Wind*

POD - Energy modeling, Lighting (day lighting and electrical)

HNC - Energy audits, Metering, Acquisitions (ECIP. ESPC etc.)

TAD - Operational energy, Contingency design

ERDC/CERL - Liaison/Advisor assigned to each competency

HQ USACE - Proponent assigned to each center



Regional Centers of Expertise

- Eco-Charrettes (Sustainability/Energy Charrettes)
 - ▶ Sample products:
 - ▶ Ft. Sheridan USARC Energy Charrette
 - ▶ Kansas City USARCE Energy and Design Charrette
 - ▶ One reference under References to NREL Handbook for Planning and Conducting Charrettes for High-Performance Projects (2009)
 - ▶ Websites not fully developed yet
 - ▶ <https://mrsi.usace.army.mil/sustain/SitePages/CX/Charrettes.aspx>
- Geothermal
 - ▶ Better developed
 - ▶ Case studies and articles
 - ▶ Tools, standards, manual lists
 - ▶ Related training
 - ▶ <https://mrsi.usace.army.mil/sustain/SitePages/CX/HeatPumps.aspx#>



Available Now

- MILCON Energy Efficiency and Sustainability Study of Five Types of Army Buildings
 - ▶ (Standard Designs)
 - Barracks
 - TEMF (Vehicle Maintenance)
 - COF (Warehouse & Administrative)
 - Brigade HQ (Administrative)
 - Dining Facility
 - ▶ Studied various energy efficiency/sustainability packages to attempt to meet all applicable design policies/requirements.
 - ▶ http://mrsi.usace.army.mil/sustain/Documents/2011_EISA_Study.pdf
 - ▶ ECB 2012-7



Coming Soon

- Comparisons of ASHRAE Energy Standards for the Design of High-Performance Army Buildings
 - ▶ Study of 2 building types across 6 climate zones
 - TEMF
 - Brigade HQ
 - ▶ Cost and performance comparisons between standards
 - ASHRAE 90.1-2007
 - ASHRAE 189.1-2009
 - ASHRAE 189.1-2011
 - ▶ Includes differences in other sustainability feature costs.



Coming Soon

- LEED Enhanced Commissioning requirement for MCA projects **MAY** be rescinded.
 - ▶ Push back due to
 - Cost for independent Commissioning Authority (CxA)
 - ▷ \$200-\$300 k per project
 - ▷ LRL - \$50-\$150 k per project
 - LEED rules preclude USACE staff from acting as CxA (indirectly)
 - Limited additional benefit to Government – Existing QA practices duplicated.
- More emphasis on Measurement & Verification
 - ▶ See Enterprise Design Approach
 - ▶ LEED M&V required for MCA currently; not regularly enforced
 - ▶ Implementation combined w/ current metrics =
 - Independent contract OR
 - Expanding in-house tools (software, hardware, data loggers, etc.)



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