April 2010

SUSTAINABLE DESIGN & ENERGY REDUCTION MANUAL

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INTRODUCTION

The Federal Mandates for sustainability and energy reduction require all construction projects to comply with sustainability and energy reduction requirements. The Mandates apply to VA new buildings, renovations, build to suit leased facilities, and cemeteries.[1] They include laws[2], regulations[3], the Memorandum of Understanding (MOU) signed by 18 Federal Government Agencies[4], and Presidential Orders[5]. In general, they fall into five areas, called the Guiding Principles:

1. Employ Integrated Design Principles
2. Optimize Energy Performance
3. Protect and Conserve Water
4. Enhance Indoor Environmental Quality
5. Reduce Environmental Impact of Materials

APPLICATION

VA requires compliance with the VA Directive 0055 sets forth Department-wide energy and water management program policy for efficient use of those resources at VA facilities, and directs that the Federal Mandates apply to **all activities in all VA facilities**.

This manual has been written specifically to cover VA major projects (over $10 million); however, this guidance should be adapted for projects below $10 million as appropriate. The Veterans Benefits Administration (VBA) and the National Cemetery Administration (NCA) have issued their own specific instructions for those programs.

This manual is intended for the Architect/Engineer (AE) and others engaged in the design and renovation of VA facilities and VA Medical Centers, and is required for Major, Non-Recurring Maintenance (NRM), and Minor Construction Projects.

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[1] VA Green Buildings Action Plan Implementing the Memorandum of Understanding on Federal Leadership in High Performance and Sustainable Buildings, signed by Robert J. Henke, VA Assistant Secretary for Management, March 30, 2007

[2] Energy Policy Act - 2005 (EPAct), Energy Independence and Security Act – 2007 (EISA)

[3] Department of Energy Final Rules

[4] Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding (MOU)

[5] Presidential Order 13423 – Strengthening Federal Environmental, Energy, and Transportation Management; Presidential Order 13514 – Federal Leadership in Environmental, Energy, and Economic Performance

Deviations from this manual may be proposed to promote new concepts and design enhancements. Deviations shall not conflict with any Federal Regulations, Public Laws, Executive Orders, or medical requirements. Any deviations are subject to review and ***written*** approval by the VA Project Manager in consultation with the VA Facilities Quality Service. For projects designed and contracted by the Office of Construction & Facilities Management, the VA Project Manager is the VA authority, henceforth referred to as the VA.

THIRD PARTY RATING SYSTEMS

To take advantage of existing sustainable work in the private sector that is well accepted by the construction industry, VA has determined that using a third-party rating system is the most efficient methodology for achieving the Federal Mandates. The Project Team may propose using either the LEED[6] or the Green Globes rating system. VA requires that projects obtain a minimum of either LEED Silver or Two Green Globes certification by their respective rating organizations. The work to achieve certification shall be included in the AEC[7] fee negotiation(s).

The primary use of Third-party verification systems is to achieve the Federal Mandates. VA has included charts in this manual for both LEED and Green Globes identifying which credits meet the Federal Mandates, and these credits are mandatory. The additional credits needed to achieve these ratings beyond those identified by VA to meet the Federal Mandates are at the collective discretion of the Project Team, the VA Medical Center, and VA Project Management.

Applications to the Third-party rating systems that require VA signatures shall be co-signed by the VA Medical Director and the VA Project Manager.

[6]Leadership in Energy and Environmental Design (LEED)

[7] Architect, Engineer, Contractor (AEC)

CHAPTER I

GUIDING PRINCIPLES & PROJECT DELIVERABLES

GUIDING PRINCIPLE

1

EMPLOY INTEGRATED DESIGN PRINCIPLES

1.1 Integrated Design

Use a collaborative, integrated planning and design process that:

- *Initiates and maintains an integrated project team in all stages of a project's planning and delivery*
- *Establishes performance goals for siting, energy, water, materials, and indoor environmental quality along with other comprehensive design goals; and, ensures incorporation of these goals throughout the design and lifecycle of the building*
- *Considers all stages of the building's lifecycle, including deconstruction*
- *Establishes performance goals for siting, energy, water, materials, and indoor environmental quality along with other comprehensive design goals; and, ensures incorporation of these goals throughout the design and lifecycle of the building*
- *Considers all stages of the building's lifecycle, including deconstruction*

1.2 Commissioning

- *Employ total building commissioning practices tailored to the size and complexity of the building and its system components in order to verify performance of the building components and systems and help ensure that design requirements are met. This should include a designated commissioning authority, inclusion of commissioning requirements in construction documents, a commissioning plan, verification of the installation and performance of systems to be commissioned, and a commissioning report. Commissioning initiates and maintains an integrated project team in all stages of a project's planning and delivery*

GUIDANCE

COMMISSIONING

The commissioning process must comply with the VA Commissioning Manual and Specifications.

TEAM INTERACTION

Using an integrated design process is foundational to success in achieving sustainable, energy efficient, high performing buildings. An *integrated design* process is different from the typical linear project delivery methodology where technical decisions by the design team are made independently, such as when the architect determines the building floorplate and exterior skin of the building and then hands it to the mechanical engineer to place the mechanical systems within it.

An integrated design process requires a true collaborative effort between all the technical disciplines and the client, one where from the beginning of the project there is interactive dialogue and interaction to find the most appropriate design solution. The ability to identify synergies across systems when the design solution is still flexible, to bring in divergent viewpoints to solve problems, and to seek inter-relationships between technical disciplines in formulating solutions, is key to lower cost, high-quality sustainable designs that provide long-term value to the facility and occupants.

At the beginning of Schematics 1, the entire project team should be in attendance at a Sustainability Kick-off Meeting to participate in an integrated, collaborative work-session to identify a preliminary set of sustainable strategies that they will pursue towards meeting the Federal Mandates. Each discipline should be present in order to share expertise and explore strategies that seek synergies across requirements and goals.

ESTIMATING PROCESS

The cost estimator must be involved in the design process from the start of the project and, as part of an integrated design process, provide dynamic cost modeling and control as opposed to static end of phase modeling only. The estimator must also be familiar with sustainable design strategies, and their cost implications.

Dynamic Cost Modeling versus Static End of Phase Estimating

The design team is responsible for managing the total scope within the project budget. The budget should not be viewed as one amount for the building and a separate amount for sustainability, but rather as a total to be achieved through integrated design.

In the schematic phases of the project, it is essential to develop a high quality project analysis model that provide a sufficient level of detail to allow the project team to make informed decisions regarding the overall scope relative to the established project budget. The model will be required as a part of the submittals.

Life-Cycle Cost Analysis

VA policy requires that projects use the current Building Life-cycle Cost program (BLCC 5.3) developed by the National Institute of Standards and Technology (NIST).

The Energy Independence and Security Act of 2007 increased the time period to 40 years for the purpose of conducting lifecycle cost calculations for energy. Building the alternative models within the program requires careful attention to a wide range of parameters and costs. Project teams should include sufficient time within the design schedule and consultant fee structure to allow for comprehensive life-cycle cost analysis.

SURVIVABILITY

VA medical facilities must remain operational and survive a four day power supply disruption and an uninterrupted water supply in the event of a natural disaster, pandemic, or bio-chemical attack (see the VA Physical Security Design Manuals). VA encourages design teams to consider survivability and sustainability as mutually supporting objectives and to explore possible ways to use sustainable practices to accomplish the survivability goals. Possible options may be the use of rain water harvesting, potable water storage, well water, photovoltaics, fuel cells, natural lighting, natural ventilation, co-generation, geothermal, wind sources, etc. If survivability goals are merged with sustainable goals at the outset of a project and carried forward using an integrated design process the result can be the ability to accomplish both with little or no cost premium.

Federal Mandates Kick-Off Meeting

On large complicated buildings, a formal facilitator should be engaged to lead the team to identify strategies to discuss design and construction approaches to meet the Federal Mandates. Solutions that work across systems to achieve multiple benefits in terms of energy savings, resource use reduction, survivability, occupant health and productivity, and so forth should be reviewed and discussed. Additional information should be identified for further development during alternative concept development.

The design team should research and test out targeted sustainable strategies as alternative design solutions are being developed, always seeking those solutions that will give the greatest benefit through integrated system strategies.

Alternative solutions to reach the 30 percent energy consumption reduction requirement should be tested through energy modeling and life-cycle costing to determine the best solution.

Team Members Engaged in Sustainability & Energy Reduction

Participation to achieve the Federal Mandates must include all disciplines who will be working on the project together. A representative list is below:

- VA Project Manager
- VA Contracting Officer
- Architectural team, especially the facility planners
- Consulting Mechanical Engineer
- Consulting Plumbing Engineer
- Consulting Electrical Engineer
- Consulting Energy Engineer
- Consulting Civil Engineer
- Consulting Landscape Architect
- VA and consulting Interior Designers
- Consulting Structural Engineer
- Consulting Cost Estimator
- Key VA medical client decision maker(s)
- VA facilities management (VA Energy Engineer, Resident Engineer, Chief Engineer, VA Environmental Manager)
- Commissioning Agent (CxA)
- Contractor and major sub-contractors (if a part of DB or IPD[8] delivery process)
- Facilitator

[8] DB: Design Build

IPD: Integrated Project Delivery

Background Research Analysis

In order to make informed decisions, the following preliminary data collection at a minimum MUST be undertaken and evaluated by the AE consultants prior to the Sustainability Kick-off Meeting. The data shall be gathered about the proposed site if known, or the general area if not, and used as a basis to begin discussion of energy reduction and sustainability in the Kick-off meeting.

Site Conditions Analysis:

- **Sun conditions**: : Identify sun path, sun angle for façade – building interior shading conditions, average number of sunny days, latitude, and technical potential for solar harvesting. Note optimal building orientation on potential site(s)
- **Wind conditions**: Evaluate general potential for wind harvesting
- **Geo-thermal energy**: Identify if geo-thermal is reasonable for this location
- **Ground-source heat pump**: Identify general soil types, site geology, and evaluate potential
- **Climate**: Collect high/low temperatures, humidity, unusual conditions, and weather hazards
- **Site hydrology**: Determine amount of rainfall, natural topography flow, and groundwater locations
- **Environment**: Note significant trees and natural conditions, including any important general natural animal habitat, hazardous conditions, soil contamination
- **Cultural context**: Note any significant issues
- **NEPA/SECTION 106**: Begin processes
- **Other:** Identify any other significant issues that are or may be important to achieving the Federal Mandates on this project

Base Case Energy Analysis:

- Begin core project programming, including identification of basic areas, functions and adjacency requirements
- Evaluate energy requirements including building base, receptacle and process loads
- Evaluate major building equipment
- Evaluate water requirements for building and site use
- Define program areas suitable for daylighting
- Develop and test a simple base case massing model to understand optimal site orientation/massing, daylighting, and wind opportunities for energy load reductions

Financial Assessment/Incentives Analysis:

- Identify local utility companies' rates, including peak load rates and load shedding arrangement opportunities
- Utility Energy Service Contract (UESC) opportunities
- Energy Savings Performance Contract (ESPC) opportunities
- Enhanced use leasing opportunities
- Ratepayer incentive opportunities
- Investigate co-generation partnership opportunities
- Research utility rebate/ potential partnerships/sell back rates
- Research incentives potential for renewables and energy efficiency (see DSIRE website - www.dsireusa.org)

Commissioning

The commissioning process activities shall be completed by the Commissioning Agent (CxA) in accordance with the VA Commissioning Guide. The Commissioning Agent should be hired at the same time as the architect/engineer and participate in the sustainability discussions from the beginning of the project.

DELIVERABLES

1.0 Current Report of the Dynamic Cost Model

- Up-to-date costs of the project including various sustainable & energy options and refinements. Cost information should match the status of the submittal stage.

1.1 Report of Federal Mandates Kick-Off Meeting & Background Research Analysis Results

- Date, list of participants by name and discipline for the Federal Mandates Kick-off and Coordination Meetings
- Copy of meeting minutes outlining progress towards sustainability & energy goals status and next assignments
- Report on the site research analysis results

1.2 Commissioning Plan

- Name of Commissioning agent (CxA)
- Commissioning Plan (at appropriate level of development)

GUIDING PRINCIPLE

2 OPTIMIZE ENERGY PERFORMANCE

2.1 Energy Efficency

Establish a whole building consumption performance target that takes into account the intended use, occupancy, operations, other energy demands, and design to earn the Energy Star® targets for new construction and major renovation where applicable. ASHRAE/ IESNA Standard 90.1 – 2007 Energy Standard, Appendix G[9] shall be used to create the baseline building performance ratings:

***New construction**: Reduce the energy consumption by 30 percent if lifecycle cost effective compared to the baseline building performance rating.*

***Major Renovations:** Reduce the energy consumption by 20 percent below pre-renovations 2003 baseline if lifecycle cost effective compared to the baseline, providing building functions remain similar.*

***Laboratory spaces:** May use the Labs21 Laboratory Modeling Guidelines.*

***Non-compliance:** If the 30 percent energy reduction is not life-cycle cost effective (using OMB Circular Number A – 94 Guidelines and Discount Rates for Benefit – Cost Analysis of Federal Programs"), evaluate the cost-effectiveness of alternative designs at successive decrements below 30 percent (e.g., 25 percent, 20 percent, etc) in order to identify the most energy-efficient design that is life-cycle cost effective for that building.*

2.2 Renewable Energy & Distributed Generation Systems

Where life-cycle cost effective, each agency shall implement distributed generation systems in new construction or retrofit projects, including renewable systems on site such as solar electric, solar lighting, geo (or ground coupled) thermal, small wind turbines, as well as other generation systems such as fuel cell, bio-energy, co-generation, or highly efficient alternatives. Projects are encouraged to use distributed generation systems when a substantial contribution is made towards enhancing energy reliability or security.

VA will implement on-site renewable energy technologies whenever determined to be technically feasible and practical, and include funding in the project application process where appropriate and in accordance with Federal Statues. Due to the rising cost of traditional energy and constant

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[9] The DOE Final Rule (Federal Register, Vol. 72, No. 245, 12-21-2007) eliminates plug loads from the calculations. However, because this guidance is at odds with achieving Third-party rating credits, VA will include plug and process loads in the ASHRAE/IESNA 90.1 calculations.

improvements in renewable energy technologies, each energy assessment of a facility or project will as a rule include renewable technologies.

2.3 Energy Star Products

Utilize products that have the Energy Star® rating and/or FEMP-designated energy-efficient products where available.

2.4 Solar Hot Water

Meet at least 30% of the hot water demand through the installation of solar hot water heaters, when life cycle cost effective.

2.5 Measurement and Verification

Install building level utility meters in new major construction and renovation projects to track and continuously optimize performance to measure consumption of potable water, gas, steam, electricity, and thermal energy in Federal buildings and other facilities and grounds. Metering systems should be coordinated with the VA facility and the VA national metering reporting system.

> ***Metering:*** *Metering requirements should be included in all Enhanced Savings Performance Contracts (ESPC) and Utility Energy Service Contracts (UESC), as appropriate.*

GUIDANCE

VA Definition of Energy Efficiency: The Federal Mandates defining methodology for energy metrics have not been standardized. However, VA has defined the primary energy goal as:

> *To improve energy efficiency and reduce greenhouse gas emissions of the agency through* ***reduction of energy consumption*** *(BTUs/GSF/YR) wherever possible given the project scope and budget.*

In some cases to create energy efficiency, such as having a co-generation plant on site, or by using other energy efficient options, the actual on-site BTUs for the project will increase. VA does not intend to discourage these options if they make sense and are life-cycle cost effective. Although in general, consumption should control design, it is important to balance consumption, efficiency, sensitive/mission critical needs, and energy costs when design decisions are being made to assure the best overall solution.

Achievement of the energy reduction Federal Mandates can be very dependent on regional factors and strategies will vary greatly by building type and climate.

Life-cycle Cost Effectiveness: The Federal Mandate energy requirements state that the energy efficiency measures that are required to meet the 30 percent energy reduction goal for new buildings and 20 percent for major renovations must be life-cycle cost effective. In order to demonstrate this, the analysis should take into account energy, operations and maintenance, and periodic replacement cost impacts, and should include sensitivity analysis reflecting uncertainty in escalation and energy performance. Where 30 percent or 20 percent energy reductions are not life-cycle cost effective, analysis should be undertaken at decreasing increments of 5 percent down to the achievable range. **VA directs that 40 years shall be the time period for the purpose of conducting lifecycle cost calculations, as required by EISA.**

Renewable Energy: VA wishes to use onsite renewable energy wherever technically feasible and lifecycle cost effective. A preliminary technical feasibility review/study shall conducted for the following strategies and for others (geographically specific or unlisted here) in early conceptual/schematic design to determine those appropriate for the project:

- Solar electric
- Solar hot water
- Solar heating, cooling, and lighting
- Hybrid solar systems
- Wind
- Geothermal
- Ground source heat pump
- Co-generation
- Biomass

Energy Reduction Design Features: Project teams shall design energy efficient roofing and envelope systems, such as high solar reflectance roofs, enhanced insulation and air barriers, and consider the use of vegatative roof systems as appropriate.

Energy Modeling: Energy modeling is required from the beginning of early concept design on all buildings 5,000 GSF and over to evaluate which design alternative provides the best energy performance and to refine the selected design solution during the project delivery process. The complexity of the energy model should be in keeping with the design stage, progressing from simple[10] during schematic design to a complete analysis in DOE2 or similar approved tool for the final design development design. The energy modeling can be provided by specialty consultants or within the scope of the MEP consultant.

> **The energy models and calculations for each of the proposed concepts shall be submitted to VA for review as a part of determining the best solution.**

The use of analytical computer software tools to evaluate preliminary energy performance is essential and MANDATORY in determining from the beginning of the design which concept solutions hold the most promise for energy reduction. Updated energy modeling is a required submittal at each phase of the project.

Using ASHRAE/IESNA Standard 90.1 – 2007, including Appendix G and including plug and process loads, create the baseline building performance, determine the appropriate mandated reduction and track the building design progress against the baseline of BTUs/GSF/YR and percentage reduction. Provide backup calculations and information on proposed energy reduction strategies/options (if requested) modeled for each of the conceptual design alternatives, and for alternative energy strategies pursued during design development.

VA Metering Requirements: Building level advanced electrical, natural gas, chilled water, hot water, steam, as well as potable and reclaimed water meters shall be installed for buildings

[10] For BIM projects, the use of energy analysis software that interfaces with the BIM model will be acceptable for early concept energy modeling.

above 5,000 GSF and energy intensive buildings (such as laundry buildings and data centers). Advanced sub-meters should also be installed for the make-up water to cooling towers and boilers. Further information regarding specific meter requirements are in VA specifications.

DELIVERABLES IN ADDITION TO PG 18-15

2.1 Project Energy Models

Provide energy engineering calculations (as requested) to support energy targets and current analysis of best solutions. Provide calculations as per instructions above if energy targets cannot be met.

2.2 Define Distributed Generation Systems and Renewable Energy Goals

Outline project strategies to incorporate distrubuted generation systems, if feasible. Project teams shall perform a feasibility study of on-site renewable energy options and provide a preliminary technical and lifecycle cost-effective analysis before design begins to identify appropriateness for the project. During design, report progress as the technical information matures.

2.3 Report on Use of Energy Star Products

Include Energy Star rating as a part of the purchase evaluation criteria in the construction specifications for the selection of building equipment. After purchase, identify which Energy Star or FEMP designated efficient products were obtained.

2.4 Plans for Solar Hot Water Use

Provide explanation and technical backup information as to how the project will meet this goal. Report on progress during project delivery.

2.5 Metering

Provide information regarding each required meter to meet this goal.

GUIDING PRINCIPLE

3 PROTECT AND CONSERVE WATER

3.1 Indoor Water

Reduce potable water consumption by a minimum of 20 percent less than the indoor water use baseline calculated for the building, after meeting the EPAct – 1992, Uniform Plumbing Codes 2006, and the International Plumbing Codes 2006 fixture performance requirements.

3.2 Outdoor Water

Reduce outdoor potable water consumption by a minimum of 50 percent over that consumed by conventional means (plant species and plant densities). Use water efficient landscape and irrigation strategies, including water reuse and recycling. The installation of water meters for locations with significant outdoor water use is encouraged.

Employ design and construction strategies that reduce storm water runoff and polluted site water runoff. To the maximum extent feasible, maintain or restore the predevelopment hydrology of the site with regard to temperature, rate, volume, and duration of flow using site planning, design, construction, and maintenance strategies.

3.3 Process Water

When potable water is used to improve a building's energy efficiency, deploy life-cycle cost effective water conservation measures as per EPAct -2005 Section 109.

3.4 Water Efficient Products

Use EPA's WaterSense Program labeled products or other water conserving products. Irrigation contractors must be certified through a WaterSense labeled program.

GUIDANCE

Medical Care Buildings: Expected levels of achievement vary to some degree by building type or function. Every effort should be made to increase water efficiency in acute care and long-term care facilities as far as possible without compromising infection control.

Medical Office and Residential-type Buildings: There should be greater opportunities in these buildings for water efficiency, particularly in the area of water reclamation and reuse.

Low-flow lavatories and toilets or other water saving strategies such as dual flush toilets, should be used in all locations except where infection control would be compromised.

Landscaping: Plant materials chosen for landscaping should be appropriate for the institutional mission of the facility, the climate, and for low water requirements and ongoing maintenance. Where irrigation may be required (in climates where natural rainfall is minimal, in healing gardens, or to assure shade in strategic locations) low irrigation strategies shall be used, such as drip irrigation, using moisture sensors to determine watering times, etc.

Reduction of site water runoff: Strategies should be employed to minimize additional site water runoff due to construction. Rain gardens, percolation fields, bio-retention swales, and infiltration areas, etc. should be employed to minimize water runoff and to return water to the aquifer.

Use of Water Efficient Products: Contract specifications shall include using water efficient products, including the requirement to use WaterSense rated products as a differentiator for selection after required performance requirements are met.

DELIVERABLES

3.1 Report on Reducing Indoor Water Use

- Provide the potable water baseline with the back up calculations, and the required reduction target.
- Define stategies to achieve the reduction goals, with the calculations to support the strategies.

3.2 Report on Reducing Outdoor Water Use

- Provide outdoor water consumption calculations for exterior water usage and recycling. Show plans to reduce water usage for landscaping by choosing plant materials that do not require on-going irrigation; where irrigation is required by specifiying low irrigation strategies and recycling where appropriate.

3.3 Water for Reduction of Energy

- If potable water is being used to reduce energy, provide information regarding the use of life-cycle cost effective water conservation measures to achieve the energy reduction.

3.4 Water Efficient Products

- Report on types and number of products that are water efficient, including those which meet the WaterSense rating.

GUIDING PRINCIPLE

4 ENHANCE INDOOR ENVIRONMENTAL QUALITY

4.1 Ventilation and Thermal Comfort

Meet the current ASHRAE Standard 55-2004, Thermal Environmental Conditions for Human Occupancy, and ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality.

4.2 Moisture Control

Establish and implement a moisture control strategy for controlling moisture flows and condensation through the building skin to prevent building damage and mold contamination.

4.3 Daylighting

Achieve a minimum of daylight factor of 2 percent (excluding all direct sunlight penetration) in 75 percent of all space occupied for critical visual tasks. Provide automatic dimming controls or accessible manual lighting controls, and appropriate glare control.

4.4 Low-Emitting Materials

Specify materials and products with low pollutant emissions, including adhesives, sealants, paints, carpet systems, and furnishings.

4.5 Protect Indoor Air Quality During Construction

Follow the recommended approach of the Sheet Metal and Air Conditioning Contractor National Association Indoor Air Quality Guidelines for Occupied Buildings under Construction, 1995. After construction and prior to occupancy, conduct a minimum 72-hour flush-out with maximum outdoor air consistent with achieving relative humidity no greater than 60 percent. After occupancy, continue flush-out as necessary to minimize exposure to contaminants from new building materials.

GUIDANCE

Daylighting: VA directs the AE to achieve the mandated daylighting goals.

Air Quality: AEs shall provide adequate construction specifications to assure that indoor air quality is protected during construction.

DELIVERABLES

4.3 Daylighting

- Provide calculations and colored floor plans designating which areas receive the required daylight to show compliance with this metric.

GUIDING PRINCIPLE

5 REDUCE ENVIRONMENTAL IMPACT OF MATERIALS

5.1 Recycled Content

For EPA-designated products, use products meeting or exceeding EPA's recycled content recommendations. For other products, use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of the total value of the materials in the project.

5.2 Bio-based Content

For USDA-designated products, use products meeting or exceeding USDA biobased content recommendations. For other products, use biobased products made from rapidly renewable resources and certified sustainable wood products.

5.3 Waste and Materials Management

During a project planning stage, identify local recycling and salvage operations that could process site related waste. Program the design to recycle or salvage at least 50 percent construction, demolition and land clearing waste, excluding soil, where markets or on-site recycling opportunities exist.

5.4 Ozone Depleting Compounds

Eliminate the use of ozone depleting compounds during and after construction where alternative environmentally preferable products are available, consistent with EPA Title VI of the Clean Air Act Amendments of 1990, or equivalent overall air quality benefits that take into account life cycle impacts.

GUIDANCE

Ozone Depleting Compounds: By following the current VA specifications and other VA guidance, this goal should be easily achieved.

Recycled Content and Bio-based Content: Follow the requirements based in the Guiding Principle for this requirement unless VA standards for functionality, cleanability, and longevity are compromised.

Construction Waste: All construction waste that can be recycled or salvaged, preferably on site if possible, should be done if lifecycle cost effective. Identify early in the project which materials will be recycled.

Construction Waste Revenue: According to Public Law 103-329, Sec 608, revenue generated through recycling and waste prevention program activities can be retained for VA use by VHA Facility Directors. Construction materials that can be recycled are covered under this law. The Project Team will have to identify those construction items to be recycled, and the VA Project Manager will have to appropriately negotiate with the General Contractor to assure that the appropriate value of the material is accounted for and available to the government.

DELIVERABLES

5.1 & 5.2 Report on amount of recycled and Bio-based content used

- Determine compliance as per instructions and provide summary calculations and backup material. If unable to meet goal, provide explanation as to why.

5.3 Report on Construction Waste Recycling

- Identify possible waste recycling options early in the project. Create recycling plan and report by type and amount throughout project delivery. Provide final summary at project completion.

REQUIRED LEED CREDITS (IN GREEN)

VA Required LEED Credits to meet FEDERAL MANDATES

LEED-NC v 3.0

Credits highlighted in green indicate Federal Mandates

0	0	0	Total Project Score		Possible Points	78

Certified 40-49 points **Silver** 50-59 points **Gold** 60-79 points **Platinum** 80+ points

0	0	0	Sustainable Sites (SS)	Possible Points	Design/Constr.	4
Y	?	N				
			Prereq 1	Construction Activity Pollution Prevention	Construction	REQ
			Credit 1	Site Selection	Design	1
			Credit 2	Development Density and Community Connectivity	Design	
			Credit 3	Brownfield Redevelopment	Design	
			Credit 4.1	Alternative Transportation, Public Transportation Access	Design	
			Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Ro	Design	
			Credit 4.3	Alternative Transportation, Low Emitting & Fuel Efficient Ve	Design	
			Credit 4.4	Alternative Transportation, Parking Capacity	Design	
			Credit 5.1	Reduced Site Disturbance, Protect or Restore Habitat	Construction	
			Credit 5.2	Reduced Site Disturbance, Maximize Open Space	Design	
			Credit 6.1	Stormwater Design, Quantity Control	Design	1
			Credit 6.2	Stormwater Design, Quality Control	Design	1
			Credit 7.1	Heat Island Effect, Non-Roof	Construction	
			Credit 7.2	Heat Island Effect, Roof	Design	1
			Credit 8	Light Pollution Reduction	Design	

0	0	0	Water Efficiency (WE)	Possible Points	Design/Constr.	10
Y	?	N				
			Prereq 1	Water Use Reduction - 20%	Design	REQ
			Credit 1.	Water Efficient Landscaping (50% Reduction)	Design	2
			Credit 2	Innovative Wastewater Technologies	Design	
			Credit 3.1	Water Use Reduction	Design	
			Credit 3.2	Water Use Reduction, 30% Reduction	Design	

0	0	0	Energy & Atmosphere (EA)	Possible Points	Design/Constr.	35
Y	?	N				
			Prereq 1	Fundamental Commissioning of Bldg Energy Syste	Design/Construction	REQ
			Prereq 2	Minimum Energy Performance (OPTION 1)	Design	REQ
			Prereq 3	Fundamental Refrigerant Management	Design	REQ
			Credit 1	Optimize Energy Performance	Design	10-19
			Credit 2	On-site Renewable Energy (7.5% goal)	Design	4-7
			Credit 3	Enhanced Commissioning	Design/Construction	2
			Credit 4	Enhanced Refrigerant Management	Design	2
			Credit 5	Measurement & Verification	Construction	
			Credit 6	Green Power	Construction	

0	0	0	Materials & Resources (MR)	Possible Points	Design/Constr.	14
Y	?	N				
			Prereq 1	Storage and Collection of Recyclables	Design	REQ
			Credit 1.1	Building Reuse, Maintain Existing Walls, Floors and Roof	Construction	
			Credit 1.2	Building Reuse, Maintain Existing Interior Nonstructural Elements	Construction	
			Credit 2	Construction Waste Management - 50%	Construction	1
			Credit 3	Materials Reuse	Construction	
			Credit 4	Recycled Content	Construction	1
			Credit 5	Regional Materials	Construction	
			Credit 6	Rapidly Renewable Materials	Construction	1
			Credit 7	Certified Wood	Construction	1

0	0	0	Indoor Environmental Quality (IEQ)	Possible Points		9
Y	?	N				
			Prereq 1	Minimum IAQ Performance	Design	REQ
			Prereq 2	Environmental Tobacco Smoke (ETS) Control	Design	REQ
			Credit 1	Outdoor Air Delivery Monitoring	Design	
			Credit 2	Increase Ventilation Effectiveness	Design	
			Credit 3.1	Construction IAQ Management Plan - During Construction	Construction	1
			Credit 3.2	Construction IAQ Management Plan - Before Occupancy	Construction	1
			Credit 4.1	Low-Emitting Materials - Adhesives and Sealants	Construction	1
			Credit 4.2	Low-Emitting Materials - Paints and Coatings	Construction	1
			Credit 4.3	Low-Emitting Materials - Flooring Systems	Construction	1
			Credit 4.4	Low-Emitting Materials - Composite Wood & Agrifiber Products	Construction	1
			Credit 5	Indoor Chemical & Pollutant Source Control	Design	
			Credit 6.1	Controllability of Systems - Lighting	Design	1
			Credit 6.2	Controllability of Systems - Thermal Comfort	Design	
			Credit 7.1	Thermal Comfort - Design	Design	1
			Credit 7.2	Thermal Comfort - Verification	Design	
			Credit 8.1	Daylight and Views - Daylight	Design	1
			Credit 8.2	Daylight and Views - Views	Design	

0	0	0	Innovation & Design Process (ID)	Possible Points		6
Y	?	N				
			Credit 1.1	Innovation in Design (Employ Integrated Design Princ	TBD	1-5
			Credit 2	LEED™ Accredited Professional	Design	

0	0	0	Regional Priority (RP)	Possible Points		4
Y	?	N				
			Credit 1	Regional Priority		1-4

Example of REQUIRED GREEN GLOBE CREDITS (IN GREEN – required credits are currently being determined. Please contact Renée Tietjen at 202-461-8294 for questions)

Total Project Score — Possible Points: 1000

One Globes = 35% of applicable points, Two Globes = 55% of applicable points, Three Globes = 70% of applicable points, Four Globes = 85%+ of applicable points

Section 6 = must get 50% of applicable points, Section 7 = must get 24 % of applicable points for NC or 0% for renovations, Section 8 = must get 50% of applicable points Path A

Yes	?	No			Points
0	0	0	6. PROJECT MANAGEMENT		
0	0	0	6.1 Coordination and Benchmarking		28 Points
			6.1.1	GDDC Pre-Design Green Design Meetings	4
			6.1.2	GDDC Performance Goals	10
			6.1.3	GDDC Progress Meetings for Design	6
			6.1.4	GDDC Progress Meetings for Construction	8
			6.1.5	Suggested Documentation	N/A
0	0	0	6.2 Environmental Management during Construction		16 Points
			6.2.1	Environmental Management	4
			6.2.2	Clean Diesel Practices	1
			6.2.3	Building Materials and Building Envelope	2
			6.2.4	Indoor Air Quality	9
			6.2.5	Suggested Documentation	N/A
0	0	0	6.3 Whole Building Commissioning		42 Points
			6.3.1	Pre-Commissioning	3
			6.3.2	Whole Building Commissioning	39
			6.3.3	Suggested Documentation	N/A
0	0	0	6.4 Environmental Management - Post Construction		14 Points
			6.4.1	Operations and Maintenance Manuals	14
			6.4.2	Suggested Documentation	N/A
Yes	?	No			
0	0	0	7. SITE		
0	0	0	7.1 Site Development Area		32 Points
			7.1.1	Urban Infill, Urban Sprawl and Public Transportation	12
			7.1.2	Greenfields, Brownfields, and Floodplains	20
			7.1.3	Suggested Documentation	N/A
0	0	0	7.2 Ecological Impacts		25 Points
			7.2.1	Site Disturbance and Erosion	9
			7.2.2	Heat Island Effect	14
			7.2.3	Bird Collisions	2
			7.2.4	Suggested Documentation	N/A
0	0	0	7.3 Watershed Features		27 Points

Yes	?	No		
0	0	0	8. ENERGY	
			PERFORMANCE - PATH A	
0	0	0	8.1 Building Carbon Dioxide Equivalent (C	
			8.1.1	Percent Reduction in Carbon Dio:
			8.1.2	Suggested Documentation
0	0	0	8.2 Demand -PATH A	
			8.2.1	Passive Demand Reduction
			8.2.2	Thermal Energy Storage System
			8.2.3	Power Demand Reduction
			8.2.4	Demand Capable Energy Manage
			8.2.5	Suggested Documentation
0	0	0	8.3 Measurement and Verification -PATH	
			8.3.1	Measurement and Verification P
			8.3.2	Suggested Documentation
			* Path A is recommended for federal agencies	
			PRESCRIPTIVE - PATH B	
0	0	0	8.4 Building Opaque Envelope -PATH B	
			8.4.1	Thermal Resistance and Transm
			8.4.2	Orientation
			8.4.3	Fenestration Systems
			8.4.4	Suggested Documentation
0	0	0	8.5 Daylighting - PATH B	
			8.5.1	Daylighting
			8.5.2	Suggested Documentation
0	0	0	8.6 HVAC Systems and Controls - PATH	
			8.6.1	Cooling Equipment
			8.6.2	Cooling Towers
			8.6.3	Heat Pumps
			8.6.4	Heating Equipment
			8.6.5	Condensate Recovery
			8.6.6	Steam Traps
			8.6.7	Domestic Hot Water Heaters
			8.6.8	Variable Speed Control Pumps
			8.6.9	Minimizing Reheat and Re-cool

CHAPTER TWO

SUGGESTED STRATEGIES FOR COMPLIANCE

Integrated Design Strategies

Integration takes advantage of synergies in design and of specific design solutions meeting more than one sustainability or energy requirement. It views the building and site as a series of interdependent systems rather than a collection of separate components. Integrated strategies can only be maximized through a comprehensive integrated design process.

This section examines opportunities for additional cost effective implementation of sustainable design and energy efficient elements through early integration of strategies. ***It is intended as an overview of selected common integrated strategies, and is not an exhaustive list of all possible opportunities for integration.***

BUILDING ORIENTATION

Building orientation is one of the most important first steps in determining key sustainable design elements of the project. Building orientation related to the sun and prevailing winds will have a significant impact on the required heating and cooling systems and thus the overall energy efficiency of the project. In general, it is recommended to orient the elongated dimensions of the building along the east-west axis so that a majority of the wall surface area faces north or south. This will minimize heat gain through east and west facing glazing and maximize suitable day lighting. Orientation should also be considered in relation to prevailing winds to optimize natural ventilation or shield the project from unwanted winds.

Proper building massing should be determined in conjunction with building orientation. Building massing refers to the way in which building elements are put together in terms of volume and can be used to optimize passive heating and cooling strategies, optimize resource efficiency, and maximize open space. For passive heating and cooling, building massing can be designed to slowly absorb heat during the day so that the volume does not reach outside temperatures until those higher temperatures begin to drop in the evening. Then, as the outside temperatures drop, the mass slowly releases the heat into the space. Massing can also be used to deflect prevailing winds or to optimize natural ventilation.

In terms of resource efficiency, massing can refer to program and equipment. Massing similar building programs together can provide for a more efficient use of space and allowing increased productivity. Also, stacking and massing mechanical equipment can minimize the use of space and in some cases minimize the exterior envelope, providing it is efficiently designed.

BUILDING MASSING

Massing also often refers to the relation of the building mass to the open space on the site and should be considered in relation to optimizing the amount of natural light in the building, providing views and visual access to the exterior as well as the surrounding site context.

Building massing can have a significant impact on construction cost, particularly for acute care facilities which have traditionally been developed with very large, deep floor plates. Medical office buildings also often have relatively deep floor plates. Long-term care facilities, in contrast, are more often fairly shallow; therefore, improving the massing will represent less of a change to current practice for this facility type.

BUILDING SKIN

Selecting narrow floor plate increases the exterior cladding quantity for a given floor area. Since the skin cost is a major contributor to the overall cost of construction for healthcare facilities, increasing the skin ratio increases the overall cost of construction. Balancing the increased skin cost enables a reduction in the cost of other systems: with greater daylight penetration, lighting loads can be reduced significantly, leading to lower power demands and lower cooling demands. The long term cost savings in energy demand will provide a payback for this premium over time. Including the benefits of improved staff retention in the analysis will further reduce the length of the payback period.

SURVIVABILITY

VA medical facilities must remain operational and survive a four day power supply disruption and an uninterrupted water supply in the event of a natural disaster, pandemic, or bio-chemical attack (see the VA Physical Security Design Manual). VA encourages design teams to consider survivability and sustainability as mutually supporting goals and to explore possible ways to use sustainable practices to accomplish the survivability goals. Possible options may be the use of rain water harvesting, potable water storage, well water, photovoltaics, fuel cells, natural lighting, natural ventilation, co-generation, geothermal, wind sources, etc. If survivability goals are merged with sustainable goals at the outset of a project and carried forward using an integrated design process the result can be the ability to accomplish both with little or no cost premium.

STORM WATER

Development often disrupts natural hydrological cycles by reducing surface permeability and increasing storm water run-off. Paved areas also increase the velocity of run-off and can cause significant erosion problems. The storm water run-off collects contaminants from roofs and paved surfaces and carries them to either existing water bodies or municipal sewer systems where treatment is required. All of these impacts can be mitigated and at times neutralized by conscious design decisions. Means by which a project can reduce the quantity of storm water run-off include pervious paving, vegetated roof surfaces, diversion channels to on-site infiltration basins, and storm water collection cisterns. Pervious paving and vegetated roof surfaces can retain between 20 and 50 percent of storm water, depending on the materials. Collecting storm water for use as irrigation or gray water creates a valuable synergy of environmental measures by reducing the project's demand of municipally provided potable water.

TREATING STORMWATER

Treatment of contaminated storm water can be accomplished on-site in a variety of ways including contaminant source reduction, using landscape features, and structural Best Management Practices (BMPs). Reducing the source of contaminants such as phosphorous on site can easily be accomplished by prohibiting the use of phosphate-based cleaners for exterior building maintenance and specifying submergible time-release phosphate fertilizers for landscaping if necessary. Landscape features such as bioswales or vegetated filter strips are also effective at removing both phosphorous and other solids from run-off. There are also several types of structural BMPs that are effective and available as both off-the-shelf sand filters and built-to-spec guidelines available from the EPA.

Storm water detention or retention ponds can also be incorporated into bioswale systems, but these can add significantly to the cost and required site area. Retention ponds are not suitable for rainwater harvesting in all locations, although they have proven successful for cemetery use.

Storm water retention tanks are the most expensive integrated solution, but they do provide the added benefit of rainwater harvesting, allowing the reuse of the collected rainwater for irrigation or other purposes. In areas with sufficient year round rainfall, this can result in a significant long term reduction in water usage.

The primary benefit of integrating storm water management strategies is to minimize first costs by combining systems. The most common and lowest cost integrated strategy is simply to use the landscaping to dissipate the storm water flow through swales and rain gardens. This allows for a certain amount of storm water infiltration into the ground in most conditions, and will reduce peak flow offsite. It also serves to reduce the suspended solids and silt in the rainwater, and, through the use of appropriate plant material, even eliminate some pollutants. This strategy often results in overall first cost savings, by reducing the extent of below grade piped storm water systems.

GREEN ROOFS

Vegetated roofs can play a similar role to bioswale systems where site area is insufficient to provide for adequate swales. Green roofs dissipate rainwater flows, leading to reduced peak runoff, and also treat the rainwater by reducing suspended solids and other pollutants. Other advantages of green roofs are that they improve the insulation of the roof and reduce the heat island effect, thus lowering the energy demand within the building. They can also increase the longevity of the roof by eliminating UV and chemical degradation of the roof membrane.

In addition to providing storm water benefits, green roofs can also be made into accessible healing gardens, if designed correctly. The mental and physical health benefits of having access to or view of nature directly from patient and public areas has been well documented. Healing gardens should be integrated into green roofing wherever possible.

2

Energy Efficency Strategies

These suggested energy efficiency measures are organized into three groups: 1) strategies which reduce the overall energy load within the building; 2) strategies which improve the efficiency of the systems; and 3) strategies incorporating on-site generation of electricity through the use of renewable resources.

Many of the energy reduction strategies discussed in this section can provide other benefits to the project, and will improve the overall sustainable performance of the facility. Examples include improved access to daylight and views, improved indoor air quality, and improved occupant comfort. For this reason many of these strategies should be considered as part of the overall integrated design strategy, rather than as individual, stand-alone strategies.

The cost effectiveness of individual energy efficiency measures varies greatly by region and climate, and there is no one combination of measures that will always provide the optimal energy efficiency. Project teams must carefully evaluate all possible and appropriate actions to ensure that the most cost-effective solutions are attained.

BUILDING ENERGY LOAD REDUCTION

WALLS, ROOF, AND SLAB

Before any other strategy is employed, the building must be designed and constructed to reduce the requirement for cooling.

Heat gain in a building is a passive activity. It accumulates through solar energy, through the activity of building mechanical systems, and through human activity. The cost of providing appropriate temperatures for physical comfort is in reducing that heat through air conditioning. Since the primary source of the heat accumulation in a building is from solar energy, it is vitally important to maximize the thermal performance of envelope construction by minimizing the solar heat transfer according to the climate zone in which the building is located.More insulation is usually beneficial but there is a point at which additional insulation is not justified. Energy modeling is used to determine the optimal U-value of the walls, roof and slab construction. The effective U-value, which is calculated by factoring in the negative effect of thermal bridges, can then be used in energy modeling to more accurately simulate thermal performance. Thermal lag benefits of heavy mass construction versus light weight, highly insulated construction should be considered.

AIR BARRIERS

Heat loss/gain results from air infiltration caused by temperature differential, wind and stack effect. By placing air barriers correctly within the opaque wall assembly, or, in appropriate climatic areas, a combined air and vapor barrier, substantial energy can be saved that would normally escape through the building enclosure. Attention to the wall assembly, lighting fixtures, stairwells, shafts, chutes, elevator lobbies, spaces under negative pressure, and air ducts during design and construction is necessary to assure that a continuous air barrier “system” is place to control air leakage into, or out of, the conditioned space. ASHRAE 90.1 Addendum Z is a source of information on standards for air barriers.

The most significant costs associated with improving the thermal performance of the envelope come from eliminating thermal bridging and reducing the degree of air infiltration through the façade. Elimination of thermal bridging can be quite challenging, and requires significant attention to architectural detailing. It can, however, provide additional benefits in the reduction of internal condensation and improved occupant comfort.

FENESTRATION

Suggested strategies for fenestration include the use of high performance glazing products, sun shading/light shelves, operable windows (in areas that do not impact infection control and patient safety), fritted glass, and for roofs and other appropriate locations, skylights and insulated translucent composite panels.

High performance glass includes both high insulation and low emissivity (low-e) glazing. Insulation reduces conductive heat gain/loss, while low-e reduces radiant heat gain/loss. Performance requirements will vary greatly by location and exposure. Typically high performance glass can add 5 to 10 percent to the glazing cost. The added gazing cost is, however, usually more than offset by reductions in energy load, and is economically desirable in most climates. Using windows with an Energy Star® designation is recommended.

SUN SHADING

Sun shading and light shelves increase daylight penetration into a building while reducing the energy load on windows from direct sunlight, which can also reduce glare for building occupants. There is a wide range of premium cost, but the normal range runs from 20 to 40 percent of the glazing cost. Not all glazing will require sun shading, and so the total cost can be reduced by selective application of sunshades and light shelves. Sun shading and light shelves can form a critical part of an integrated energy design, and can significantly reduce the energy demand from solar gain on the windows and from artificial lighting. The payback for sun shading and light shelves is usually positive, but depends greatly on the design.

OPERABLE WINDOWS

Operable windows can reduce requirements for forced air ventilation, and in some climates, cooling. They also improve the sense of connection to the outdoors, which has proven to enhance the occupant’s sense of wellbeing in most cases. There are two main contributors to the costs for operable glazing: the direct cost of the glazing units, and the cost of any added controls to the HVAC system to eliminate running the air conditioning systems while windows are open. The premium cost for the glazing can run in the range of 10 to 20 percent of the glazing cost for institutional quality windows. The control costs can vary greatly, but can be significant, since operable windows can lead to much smaller and much more frequent control zones. Many times the control cost is markedly higher than the cost of the windows. For long term care facilities and to medical office buildings, however, usually the controls zones are already such that operable windows impose no significant added cost.

For acute care facilities, operable windows should be considered in non-critical areas such as public circulation spaces, places of respite, offices, etc.; however, the ability to lock them when required must be possible in order to not compromise the air pressure balancing necessary for patients when infection control is an issue.

DAYLIGHT DIMMING CONTROLS FOR PERIMETER AREAS

Daylight dimming lighting controls rely on photocells to maintain the necessary lighting levels (foot candles) in the space by reducing the lighting output from electric lighting based on the quantity of daylight in the space. The photocell is generally placed such that it reads the lighting level of the space at three feet above the floor and ten to 15 feet from the exterior wall. The photocell monitors the lighting level in the space and dims the electronic lights accordingly to maintain the required foot candles, based on the natural daylight available at any given time in the space.

In large open perimeter spaces, only lighting that is within 15 feet off the perimeter is assumed to need daylight controls.

The cost for incorporating daylight dimming controls at perimeter areas includes both the cost of the control system and the additional cost associated with dimmable fixtures. Typically the cost increase is in the range of 1 to 2 percent of the overall lighting budget. However by limiting artificial light, the heat load is also reduced, which reduces both the initial system size and long term energy costs. A rule of thumb is that for every watt of artificial light, there is an increase of 1/3 watt air conditioning load.

VARIABLE ACH VENTILATION RATES

The ventilation rates, in areas determined acceptable by VA, are reduced based on occupancy and or time clock. For the occupancy sensor based controls, a space occupancy sensor identifies if the space is unoccupied, similar to lighting controls but with a longer time delay to prevent HVAC cycling. When the space is determined unoccupied for 30 minutes (either by sensor or time clock) the ventilation rates to the space are reduced by 50 percent, and the fan VFDs throttled down. This in effect forces VAV operation for these spaces, thereby saving significant fan, cooling and reheat energy.

Cost premiums associated with variable ventilation rates are very small, essentially comprising additional control systems and occupancy sensors. The potential energy reductions are substantial with reductions in fan energy, heating, and cooling loads. See the VA HVAC Design Manuals for additional requirements and guidance.

LIGHTING AND OCCUPANCY SENSOR LIGHTING CONTROLS

As artificial lighting is a large contributor to energy use, it is important to choose the type of lighting wisely. Energy efficient fixtures and lamp types, including compact florescent lighting (CFL) and other highly efficient types, should be selected for their energy efficiency in addition to their appropriateness in color rendition, functional use, cost, longevity, etc.

Occupancy sensors turn off the space lights when no movement is detected (therefore the space is assumed unoccupied) for a period of time. See the VA Electrical Design Manual for additional requirements and guidance.

WARMEST SUPPLY TEMPERATURE RESET

Control systems should be designed to reset air delivery temperatures as required by the zone with the highest cooling load, rather than delivering a constant 55°F supply temperature when cooling is required by some zone. With this measure the control system monitors the position of each supply box and raises the supply air temperature when no boxes are fully opened. When one of the boxes is fully opened the supply air temperature is set at that temperature until either the box closes or one of the zone thermostats requires more cooling. This measure can significantly reduce reheat loads.

The primary cost impact of this measure is the cost related to the controls system hardware. If sophisticated controls hardware is installed that allows monitoring of VAV box airflow or damper position, then the additional controls costs related to supply air temperature reset have very little cost. However, if the extensive controls hardware is not part of the initial system, the hardware upgrade can increase the overall cost of the air-conditioning system. The energy reductions, however, can be very substantial. See the HVAC Design Manual for additional requirements and guidance.

INTERIOR FINISHES

Although it might not be obvious at first, the color of the interior finishes in a facility will have an impact on reducing energy use. Given two spaces with exactly the same amount of light (footcandles) but one has light finishes and the other dark finishes, the space that has dark finishes will appear less bright. This is because the human eye only sees *reflected* light, and dark surfaces absorb more light than light ones. Therefore, **additional lighting will be required in locations where there are dark flooring, walls, and furnishings to appear as bright as a similar space with light finishes.** The domino effect of darker finishes is that the additional lighting will generate additional heat, which then requires a larger mechanical system to remove it, which then requires more energy to operate.

It is important that the Interior Designer be aware of the impact of dark finishes on energy usage, so s/he can be an integral partner in helping reduce the energy requirements of the building. Dark materials, if used at all, should be limited to accents or small areas.

HIGH EFFICIENCY SYSTEMS

Most high efficiency systems have a higher first cost, but deliver improved long-term operating costs. Most of the improved long-term operating costs come in the form of reduced energy demand, but some can come from reduced maintenance or improved equipment life. More efficient systems can also lead to downsizing of equipment or systems, which will provide some offsetting initial cost savings.

HIGH EFFICIENCY CHILLER SYSTEMS

Using a highly efficient chiller, or using chillers with an efficiency of approximately 0.50 kW/Ton for the central plant saves energy by using less electricity to produce the same quantity of chilled water. In areas where cooling loads are a significant contributor to the energy usage, high efficiency chillers can provide significant energy savings, and are very cost effective. See the VA HVAC Design Manuals for additional requirements and guidance.

INCREASED CHILLED WATER DELTA-T

Increasing the temperature rise (delta T) on the chilled water system to 16°F can produce modest energy savings, particularly in areas where cooling loads are significant contributors to the energy cost. The delta T increase has a very slight effect on the construction costs as it requires slightly larger cooling coils on the Air Handling equipment. See the VA HVAC Design Manuals for additional requirements and guidance. See the VA HVAC Design Manuals for additional requirements and guidance.

COGENERATION – COMBINED HEAT AND POWER (CHP)

Incorporating cogeneration with combined heat and power for some or the entire electrical load of the facility provides several energy efficiencies, some of which extend beyond the simple reduction in energy demand at the facility. Cogeneration plants are usually more efficient generators of electricity than many commercial power plants, and there is none of the transmission loss associated with electricity received from the grid. As a result, cogeneration plants consume significantly less source energy to deliver the same level of power.

The use of combined heat and power systems allows a facility to extract additional energy from the cogeneration plant through capturing reject heat from the electricity generation for use in heating, steam generation, dehumidification, etc.

Cogeneration systems can also provide much higher levels of energy security, and can in some cases reduce the extent of emergency generation capacity required on-site.

Cogeneration systems typically have a very high first cost, and their cost effectiveness depends greatly on the electricity rate structure and the local utility's policies related to zero net metering or electricity resale. The cost effectiveness can be greatly enhanced where the cogeneration can be fueled in whole or in part through the use of reject or non-commercial fuels, such as medical waste, biomass, methane, etc. See VA Directive 0055 for additional information.

ENERGY RECOVERY

The most effective energy recovery approach is a Total Energy Recovery Wheel, although heat pipes and run around coils can also be utilized.

The Total Energy Recovery Wheel requires an increase in space for the air handling units, since the wheels are often large diameter. These systems also require that the exhaust and supply air ducts run close together which may lead to increased quantities of ductwork. Heat pipes and run around coils have less design impact, but are also significantly less effective.

Total Energy Recovery Wheels are particularly effective in humid climates since both sensible (heat) and latent (humidity) energy are exchanged, which in effect pre-heats the outside air during the heating season and pre-cools the outside air during the cooling season.

It should be noted that the use of Total Energy Recovery Wheels is not allowed for heat recovery from labs and surgery suites due to the possibility of cross contamination of the air streams. See the VA HVAC Design Manual for additional requirements and guidance.

CONDENSING BOILERS

Condensing boilers are widely available and widely used, and are very economical. They can provide very good energy cost efficiency. The most significant limitation is that they are typically limited in size range, and not available at the size required by very large facilities, particularly those with high heating loads. This limitation can be addressed through installation of multiple smaller boilers, or through installation of condensing heat recovery on a conventional boiler stack.

GROUND SOURCE HEAT PUMPS

Ground source heat pumps use the ground or ground water as a sink for heat rejection. Ground temperatures are usually very favorable for heat rejection, being generally consistently cooler than the design temperature of spaces. Ground source can also be used for heating, but with less energy efficiency. Another advantage is that ground temperatures are usually very stable, and so heat pumps can be designed more efficiently.

The primary challenge is getting a sufficient area of contact with the ground or ground water, since the ground does not conduct heat well, while protecting the ground from contamination by coolant liquids. The systems can use vertical drilled shafts, or horizontal pipe fields. Horizontal pipe fields are generally the less expensive option, but they require large open site areas.

The choice of system and its size will depend greatly on ground conditions, but because of the extent of the piping in either system, ground source heat pumps are usually more suited to buildings up to 50,000 SF. VA cemetery buildings would be ideal candidates for ground source heat pumps, since they are typically quite small, and have large site areas, allowing for the use of horizontal pipe fields.

Another potential strategy that can be examined is the use of cool incoming domestic water or sewage lines to partially pre-cool the condenser water loops. One possible application would be to have the incoming domestic hot water line and the condenser water return line running to a plate and frame heat exchanger, where the domestic hot water line is pre-heated by the condenser water loop and the condenser water loop is pre-cooled by the domestic hot water loop. The heat from the condenser water (where it is not needed) is passed to the domestic hot water (where it is needed), with the only energy ramification being the additional pump power needed to push the water streams through the heat exchanger. Water loop locations and space constraints may restrict some applications of this measure. See the VA HVAC Design Manual for additional requirements and guidance.

RENEWABLE ENERGY SOURCES

The use of renewable energy sources should be vigorously considered by VA project teams, as by law, one half of VA's renewable energy requirements must come from new sources (available after January 1, 1999) or if feasible, generated on site (which will allow VA to receive credit for double the energy actually generated for use in reporting on the Federal Energy Report Card). In addition, it should be noted that there are several advantages to generating energy on site. First, VA will help lower America's dependence on foreign oil; second, VA will reduce diverting VA resources away from patient care to pay for building operations; third, VA will increase electrical reliability and provide an emergency backup system for survivability requirements. For these reasons it is important to pursue the possibility of having some portion of a facilities' energy requirement generated on-site.

There are also some added benefits: every kWh provides a renewable energy credit (REC) which may be exchanged with the local utility for credits, or used as a part of an Energy Savings Performance Contract (ESPC) arrangement. The energy may also be useful if the VA facility participates in the local utility company's peak demand response program. During the peak demand time, the renewable kWh can be "sold" back to the utility at the peak rate, and the value recovered as a credit by the VA facility during regular billing. Of course, this type of arrangement must be worked out with the local utility.

The following are examples of renewable systems that can be employed on site:

SOLAR HOT WATER: The use of this strategy is *required* under EISA 2007 for 30% of the hot water demand if cost effective.

PHOTOVOLTAICS (PV): PVs can be placed on the exterior of a building and generate electricity through collection of solar energy.

There are two types of PV cells: crystalline and amorphous. The crystalline cells generally provide a higher electrical output per square foot than amorphous at peak power generation. Amorphous will typically provide good energy output over a wider range of solar conditions, however. Crystalline cells are panelized, with frames and glass covers, and so must be mounted on structures or frames. Amorphous cells are more flexible, and can be applied to a variety of substrates, including roofing membranes, cladding panels, window glazing and similar. Photovoltaic window or glazing modules can be integrated into a building as non-view windows, skylights, greenhouse windows, curtain walls, facades, etc.

WIND

Wind energy can be harnessed by wind turbines, located either on the building or at an adjacent site. Locating wind turbines physically on the building can be a cause for concern, since dealing with vibration being passed to the building from the turbines and from the quality of the wind flow hitting the turbine (wind is often distorted by the building structure). As a result, if the option of wind turbines is considered, a turbine site close to building areas may be more appropriate. New "micro-turbine" solutions which minimize vibration and are not dependent on wind direction are also possibilities.

GEOTHERMAL

Geothermal systems take advantage of local underground reservoirs of hot water or steam which can be drilled into for use in generating electricity and heating buildings. Geothermal energy is usually capital intensive, and is unlikely to be a significant contributor to the production of renewable energy except in optimal cases, such as large facilities located in geothermal zones.

BIOMASS

Biomass systems can be fed from a variety of sources, and can directly use gasses emitted from the decomposition of biomass, or can use the biomass in high temperature reformers to generate hydrogen, which is then fed into fuel cells. Some biomass can also be converted to biodiesel for use in diesel generators.

In the first case, biomass is composted to produce the methane. The biomass can be sewage, garbage, or other organic material. In most VA settings, it is unlikely that it would be desirable to collect biomass for methane generation, but if methane were available from existing sources, such as sewage treatment plants or landfill, it could be used. On site sewage treatment could also be a potential source of biomass methane.

Reformation of organic waste to generate hydrogen can be used both as an energy source and a means of reducing waste from the facility. One start up company, Medergy, has developed a process for using medical waste as a feedstock for reformers. This consumes significant portions of the medical waste, and sterilizes the residue. In the process, it produces hydrogen for use in a fuel cell, which in turn generates electricity and heat.

3 FUNDING OPTIONS

The Energy Policy Act of 2005 (EPAct 2005) reauthorized through 2016 the use of private sector financing to assist Federal agencies in achieving energy and water efficiency goals. Energy savings performance contracts (ESPCs), utility energy service contracts (UESCs), and enhanced use leasing (EUL) are instruments available to VA to finance project costs so scope can be optimized and reductions in energy intensity and water consumption realized. Ratepayer incentives and retention of funds are additional tools that can help offset the initial capital costs of efficiency projects. Renewable energy technologies can play an important role in reducing traditional energy consumption and costs, and should be considered along with other measures.

ESPC

A legislatively authorized contracting vehicle that allows the private sector to assume the capital costs of energy improvements in Federal facilities. An ESPC project is a partnership between a customer (VA) and an energy services company (ESCO) in which the ESCO finances, designs, constructs, and potentially operates and maintains a project that meets the agency's requirements. The ESCO guarantees that the improvements will generate dollar savings in utility bills sufficient to pay for the project over the term of the contract (up to 25 years), and that savings will exceed utility costs in each contract year. After the contract ends, future cost savings accrue to the agency.

UESC

A contract arrangement with a local utility in which the utility provides financing and expertise to implement energy and water reduction projects. Projects using UESCs can include services such as energy audits, project design and installation, construction management, commissioning, measurement and verification, as well as operations and maintenance. The Federal agency repays the utility over the contract term from the cost savings generated by the efficiency measures. Typically repayments are made via the utility bill. Many utilities have programs to defray energy infrastructure costs, and will sometimes provide grants or share in the cost to build energy reduction improvements. New construction projects, particularly mid-to-large in size, should contact the local electric and water companies to determine what services may be available.

ENHANCED USE LEASING

A legislated authority unique to VA that allows VA to execute long term out-leases of VA property through cooperative arrangements with public or private partners. In return, VA receives consideration in the form of revenue and/or in-kind consideration (e.g., provision of energy services such as electricity, steam and hot water). The lessee owns the property/facilities for the term of the lease. This arrangement provides financing, private sector ownership and operation of a physical asset for a period of time. EUL is appropriate consideration for large or long-term projects such as renewable and cogeneration plants and roof replacements with integral or roof-mounted photovoltaic cells.

RATEPAYER INCENTIVES

Ratepayer-supported rebates from public benefit funds or utilities for the purpose of offsetting energy efficiency project costs. Where available these incentives should be utilized to reduce initial capital costs.

RETENTION OF FUNDS

Allows retention of unused appropriated funds directly related to energy and water cost savings to be reinvested in energy reduction, water conservation, and sustainable building enhancements.

VA’s guidance for energy investments is contained in Directive and Handbook 0055, published in July 2003. VA has considerable experience in negotiating energy savings performance contracts and using other financing vehicles for private sector financing of energy improvements. If considering these funding options to improve energy and water efficiency, please contact CJ Cordova in VA’s Office of Asset Enterprise Management for assistance (cynthia.cordova@va.gov).

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