4. Methods to Achieve the Goals

This section summarizes strategies that can help teams meet the Federal mandates and LEED certification where pursued. These strategies have been determined to have particular application to VA facilities and fall into two sections:

- Integrated Strategies: those that require early team consideration and have the potential to have multiple benefits across sustainable requirements, and
- Energy Efficiency Strategies: strategies that will help meet the mandates for energy reduction.

4.1 INTEGRATED 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.

In addition to the integrated strategies outlined in the Energy Efficiency section, 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.*

The following strategies pertain to siting of the facility:

- Orientation
- Massing
- Storm Water

4.1.1 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.

Building orientation can typically be accomplished with no appreciable construction cost impact. On some sites, however, it is impractical to achieve optimum orientation. This is typically due to other site constraints, such as site slope, adjacent roads or buildings, etc. In these cases, it is usually cost prohibitive to improve the building orientation.

4.1.2 MASSING

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.

Context: 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. For acute care facilities, a common exterior skin ratio is in the range of 0.4 to 0.5 SF of wall area per square foot of gross floor area. Good massing would increase that ratio typically to around 0.7 to 0.8, an increase of roughly 60 percent. However, this would translate into a cost increase to the total building of around 10 percent for the increased skin costs.

Balancing the increased skin cost is 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 offsetting reduction in systems costs will amount to roughly 2 percent, leaving a net increase in cost of around 8 percent. The long term cost savings in energy demand will provide a payback for this premium over time, usually in the range of seven to ten years. Including the benefits of improved staff retention in the analysis will further reduce the length of the payback period.

Operating Costs: In addition to reducing the first costs of the mechanical and electrical systems, improved massing can reduce the operating cost of the facility through reduced energy demand and reduced system maintenance. Studies have demonstrated improvements in both staff and patient well-being resulting from improved access to views and daylight. Benefits include improved patient outcomes, reduced stays in acute care facilities, reduced medical error and staff injuries, better staff retention, etc.

4.1.3 STORM WATER

Development often disrupts natural hydrological cycles by reducing surface permeability and increasing stormwater run-off. Paved areas also increase the velocity of run-off and can cause significant erosion problems. The stormwater 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 stormwater run-off include pervious paving, vegetated roof surfaces, diversion channels to on-site infiltration basins, and stormwater collection cisterns. Pervious paving and vegetated roof surfaces can retain between 20 and 50 percent of stormwater, depending on the materials. Collecting stormwater 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 stormwater 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.

Stormwater 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.

Stormwater 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 typical cost of rainwater harvesting is in the range of $3 to $5/gallon, or $2,000 to $4,000/ hundred cubic feet. This would translate into roughly $2 to $4/GSF if the project were to collect the entire roof runoff. In many areas the current cost of potable domestic water is too low to provide a meaningful payback for rainwater harvesting alone.

The primary benefit of integrating stormwater 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 stormwater flow through swales and rain gardens. This allows for a certain amount of stormwater 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 stormwater 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, they can be very valuable in providing views and roof gardens on lower roofs. The green roofs cost from two to three times the cost of a conventional roof, but since the roof is a relatively small contributor to overall cost of a healthcare facility, the overall cost impact is less than 1 percent. The long term cost benefits however, while appreciable, are rarely sufficient to justify the added cost through a payback analysis.

4.2 ENERGY EFFICIENCY STRATEGIES

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.

4.2.1 BUILDING LOAD REDUCTION STRATEGIES

4.2.1.1 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 skylights and other appropriate locations, insulated translucent composite panels.

While each strategy on its own may have a first cost impact, it can also deliver significant operational cost savings in reduced energy. In addition, these strategies can improve the interior environment through better access to daylight, views, and outdoor ventilation.

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 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 can reduce requirements for forced air ventilation, and in many climates, cooling. They also improve the sense of connection to the outdoors, which enhances the occupant 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 is 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, 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, they must be used judiciously in order to not compromise the air pressure balancing necessary for infection control.

Operable windows are well suited to long term care facilities and to medical office buildings, and in certain climates can provide a reduced first cost, as well as reduced operating expenses.

4.2.1.2 WALLS, ROOF AND SLAB

It is vitally important in any strategy trying to reduce energy use to maximize the thermal performance of envelope construction by minimizing heat transfer according to climate needs. 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.

4.2.1.3 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. Increasing wall thicknesses to accommodate additional insulation can also have a significant cost impact. In most cases the cost of the insulation itself is relatively small.

4.2.1.4 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.

4.2.1.5 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.

The following table identifies the minimum standard for the areas having reduced ventilation rates:

Space Type	Occupancy Control	Occupied ACH	Unoccupied ACH
Office	Time Clock	4	2
Education	Time Clock	6	2
Library	Time Clock	6	2
Emergency	Time Clock	8	4
Dermatology	Time Clock	8	4
Endocrinology	Time Clock	8	4
Neurology	Time Clock	8	4
Woman's Clinic	Time Clock	8	4
Cardiology	Time Clock	8	4
Mental Health	Occ Sens	6	2
Rehab	Occ Sens	6	2
Eye Clinic	Occ Sens	6	2
Geriatric	Occ Sens	6	2
Speech	Occ Sens	6	2
Dialysis	Occ Sens	6	4

Space Type	Occupancy Control	Occupied ACH	Unoccupied ACH
Digestive Disease	Occ Sens	8	4
Patient Film Records (archive)	Occ Sens	4	2
Gantry Room	Occ Sens	12	6
Dental Admin Offices	Occ Sens	6	2
Patient Areas	Occ Sens	6	2
Vent. Test Rm / Spirometry	Occ Sens	6	4
Blood Gas Analysis	Occ Sens	6	4
Sp. Procedures / Bronchoscopy	Occ Sens	8	4
Sleep Labs	Occ Sens	6	2
Exercise Room	Occ Sens	10	6
MAS Spaces	Time Clock	6	4
Laboratory	Occ Sens	12	12
Medical Research	Occ Sens	12	12
Cardiology Lab	Occ Sens	12	12
Medical R&D	Occ Sens	12	12
Surgery	Occ Sens	20	10
Ambulatory Surgery	Occ Sens	15	8
Hyperbaric Surgery	Occ Sens	15	8
Kitchen, Dietetics	Time Clock	10	4
Canteen	CO2	10	4
Outpatient Pharmacy	Occ Sens	6	2
Exempt repackage/compound	Occ Sens	6	2

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.

4.2.1.6 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. As per ASHRAE 90.1 2004 the occupancy sensors are assumed to reduce the space lighting load by 15 percent, which can translate into an overall energy cost reduction of 2 – 3 percent.

Typically the cost increase for incorporating occupancy sensors in all enclosed offices and other similar regularly occupied spaces (excepting patient rooms and some other specialty spaces) includes the cost of the control system, and is in the range of 2 to 3 percent of the overall lighting budget.

4.2.7 Warmest Supply Temperature Reset

Control systems can 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 by 1 to 2 percent. The energy reductions, however, can be very substantial.

4.2.2 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.

4.2.2.1 High Efficiency Chiller Systems

Using a highly efficient chiller, or using chillers with an efficiency of 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.

4.2.2.2 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. The cost increase would typically be less than 1 percent of the overall cost of the HVAC system.

4.2.2.3 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.

4.2.2.4 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.

4.2.2.5 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.

4.2.2.6 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.

4.2.3 Renewable Systems

The use of renewable energy sources should be considered by VA project teams, as one half of VA's renewable energy requirements must come from new sources (available after January 1, 1999) or if feasible, generated on site. By using renewable energy either off site or on site, VA will be contributing to reducing greenhouse emissions by reducing non-renewable energy demand.

There are several advantages to generating energy on site, such as increasing electrical reliability and providing an emergency backup system. In addition, 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.

In addition, if the renewable energy is generated on site, VA will receive credit for double the energy actually generated for use in reporting on the Federal Energy Report Card.

The following are examples of renewable systems:

4.2.3.1 Off Site

Purchasing green power (power derived from solar, wind, geothermal, biomass or low-impact hydro sources), by selecting a Green-e certified power provider for a portion of electric purchases, purchasing a portion of electric power through a Green-e accredited utility program, or by purchasing Green-e accredited Tradable Renewable Certificates (RECs).

4.2.3.2 On Site

Photovoltaics (PV): PVs can be placed on the exterior of a building and generate electricity through collection of solar energy. Light shining on a PV cell, which is a solid-state semiconductor device, liberates electrons that are collected by a wire grid to produce direct current electricity which is then converted to alternating current for use by the facility.

There are two types of PV cells: crystalline and amorphous. Crystalline cells are more expensive at around $60 to $80/SF. Amorphous cells are usually in the range of $40 to $60/SF. The crystalline are generally provide a higher electrical output per square foot than amorphous at peak generation at 8 to 10 W/SF, compared to 4 to 6W/SF for amorphous. 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 which can increase the cost further. 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 Energy: Wind energy can be harnessed by wind turbines, located either on the building or at an adjacent site. Wind rotates the turbine which converts the mechanical movement into electric power. 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 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.

The use of biomass to generate biodiesel would be very limited in most healthcare settings, but may be practical in small scale applications.

4.3 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 sufficient to pay for the project over the term of the contract, and that savings will exceed costs (i.e., agency payments) in each contract year. After the contract ends, all additional cost savings accrue to the agency.
- **UESC:** Contract arrangement with a local utility in which the utility provides financing and expertise to implement energy and water efficiency 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. These incentives where available 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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