healthcare design **insights**

Ultra Sustainability

Hospitals and healthcare organizations are fundamentally about human sustainability—curing disease and injury, and improving lives. Likewise, many healthcare organizations have worked hard to improve their environmental sustainability. Both goals have become the norm in healthcare design and construction, and in fact support and enhance each other. Many organizations are taking human and environmental sustainability as realized in their built environment much farther still, in ways that mix pragmatism, aggressive pursuit of mission, and a willingness to experiment. This means new challenges for project teams, who wrestle with setting up the process, managing the competing altruistic, regulatory and practical goals, and responding to quickly evolving sustainable practices and technologies.

When considering the challenges your organization faces, we encourage you to ask:

What is the most sustainable healthcare building project you can imagine?

How do you guide your project's development and design team toward your goals?

This edition of *Healthcare Design Insights* examines three projects at the leading edge of healthcare sustainability, each illustrating a very different approach for defining sustainability, setting goals, conceptualizing built solutions, and achieving significant sustainability improvements.

:: **At PeaceHealth Peace Island Medical Center (Peace Island) in Friday Harbor, Washington, the Living Building Challenge, an ambitious program that builds on "net-zero" energy usage and adds strict performance standards in a wide range of environmental and social arenas, guided the owner and design team.**

:: **The Oregon Health & Science University (OHSU) Center for Health & Healing used Leadership in Energy and Environmental Design (LEED) as a benchmark and achieved one of the nation's first LEED Platinum ratings for a healthcare project (Platinum is the highest level) with an impressive range of green features, including particularly innovative wastewater technologies.**

:: **Gunderson Lutheran Health System is on the forward edge of achieving "energy neutral" strategies, and has achieved a dramatic drop in annual energy costs partway through a highly focused energy improvement program.**

In this Issue:

Further Reading About Sustainability in Healthcare

Healthy Hospitals
Healthy People
Healthy Planet
World Health Organization, 2008

This World Health Organization report looks broadly at sustainability in healthcare, addressing energy and building design, and also transportation, food, waste and water topics. With an international flavor, lots of examples, and a detailed bibliography, the report is a good starter for the broadest investigation into and application of sustainability in healthcare.

Redefining Sustainability and Pushing the Boundaries

In the words of its authors, the Living Building Challenge (LBC) is "the most advanced measure of sustainability in the built environment possible today." Developed by the Cascadia Region Green Building Council (and the related International Living Building Institute), the "challenge" is just that: a call to the development, design, construction and maintenance industries to fundamentally change how buildings are perceived, to encourage related industries and building owners to change expectations of energy use and environmental impact, and to integrate context (site, neighborhood, and regional aspects of sustainability) into every project. The LBC is both an extremely high bar of mandatory performance standards and a call for social change. (The 50-page LBC standard can be easily read by a non-technical audience.)

The LBC builds upon the "net-zero" philosophy that a building creates as much (or more) energy as it uses and minimize natural resource use/impacts.

Using the analogy of a flowering plant, the standard defines seven "petals," each addressing a major arena of environmental or social impact:

(1) Site
(2) Water
(3) Energy
(4) Health
(5) Materials
(6) Equity
(7) Beauty

Projects achieve LBC certification only after twelve months of operation, based on actual rather than theoretical performance (the lack of operational confirmation is a frequent criticism of LEED). While almost one hundred projects have registered with the intention of achieving the LBC, only four have been certified to date.

At the 38,500-square-foot, 10-bed critical access Peace Island Medical Center now under construction, the LBC-guided design for a project with powerful sustainability drivers: a beautiful, remote and resource strained island setting in Washington State's San Juan Island archipelago, a client for whom sustainability is core-mission, an island community wanting to pioneer environmentally responsible building, and a design team committed from the start (Mahlum's advocacy for the LBC was a factor in our selection to the team). Peace Island is the first hospital and healthcare project registered for LBC.

(1) Site Petal

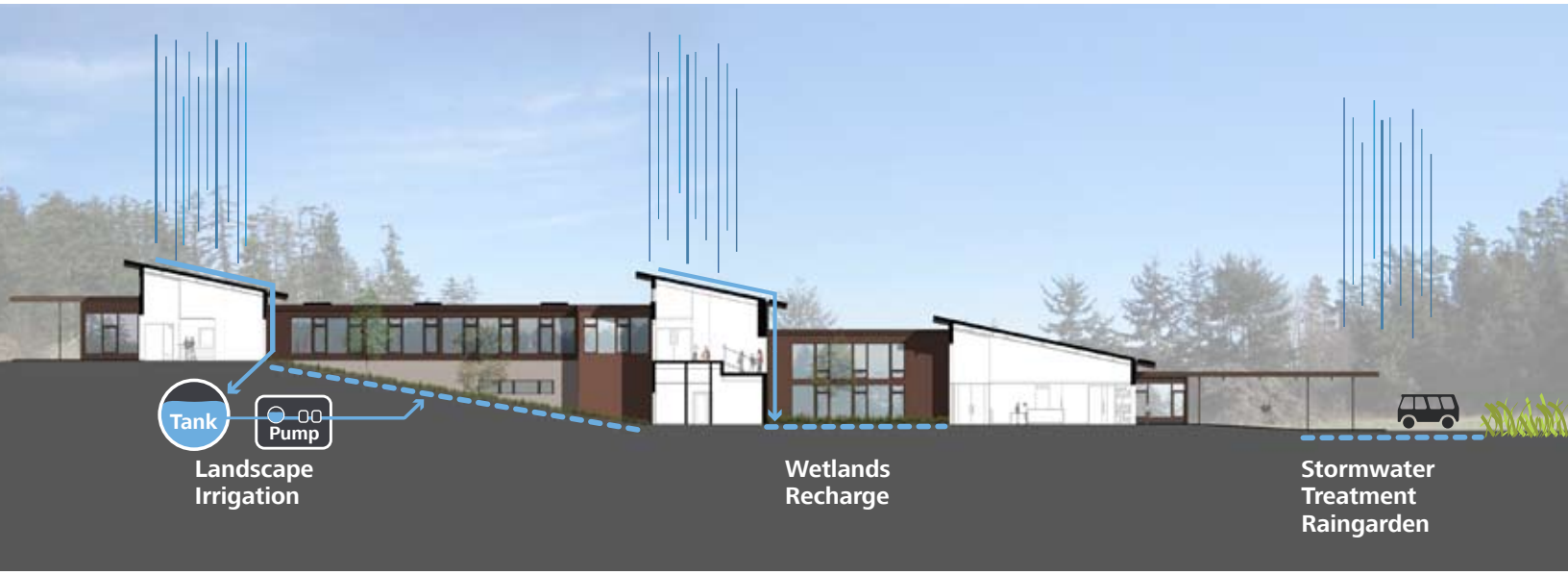
Site goals focus on reducing sprawl and encouraging walkable development. Incorporation of urban agriculture, habitat set asides equal in area to developed land, and creation of pedestrian-oriented communities are mandatory.

At Peace Island, landscape, hardscape and buildings are set back from existing critical ecological habitats of forests and wetlands, using previously-developed area. Pedestrian access and passage is encouraged with links to an existing community trail system.

(Story continues on the following pages.)

Site Petal: Land is a finite resource for San Juan Island. By minimizing development of the site, Peace Island retains a natural amenity for the medical center and the community.

Water Petal: An external system of rainwater harvesting for irrigation, wetland recharge and raingardens eliminate the need for on-site retention and infiltration.



(2) Water Petal

The LBC ideal is that 100% of building water is fed by the site, and that water leaves the site purified—without chemicals—as it would naturally, maintaining pre-development "ecological water flow."

The Water and Energy petals became the primary focus for the Peace Island team because they are the most directly relevant to environmental cost/benefit for both hospital operations and patient care. The design team developed an aggressive approach to reducing potable water use, including harvesting rainwater, using on-site wetlands for stormwater management, and using building greywater with technology from manufacturer Advantex; to treat all wastewater and supply toilet and urinal flushing, irrigation, and mechanical systems.

Illustrating how current regulatory strictures can work against sustainability goals, the greywater system became unfeasible and doubly expensive because the local sewer utility would not release the project from hookup fees, even though the design treated all wastewater on site. Yet by taking the concept through design development the technical viability of the concept was validated.

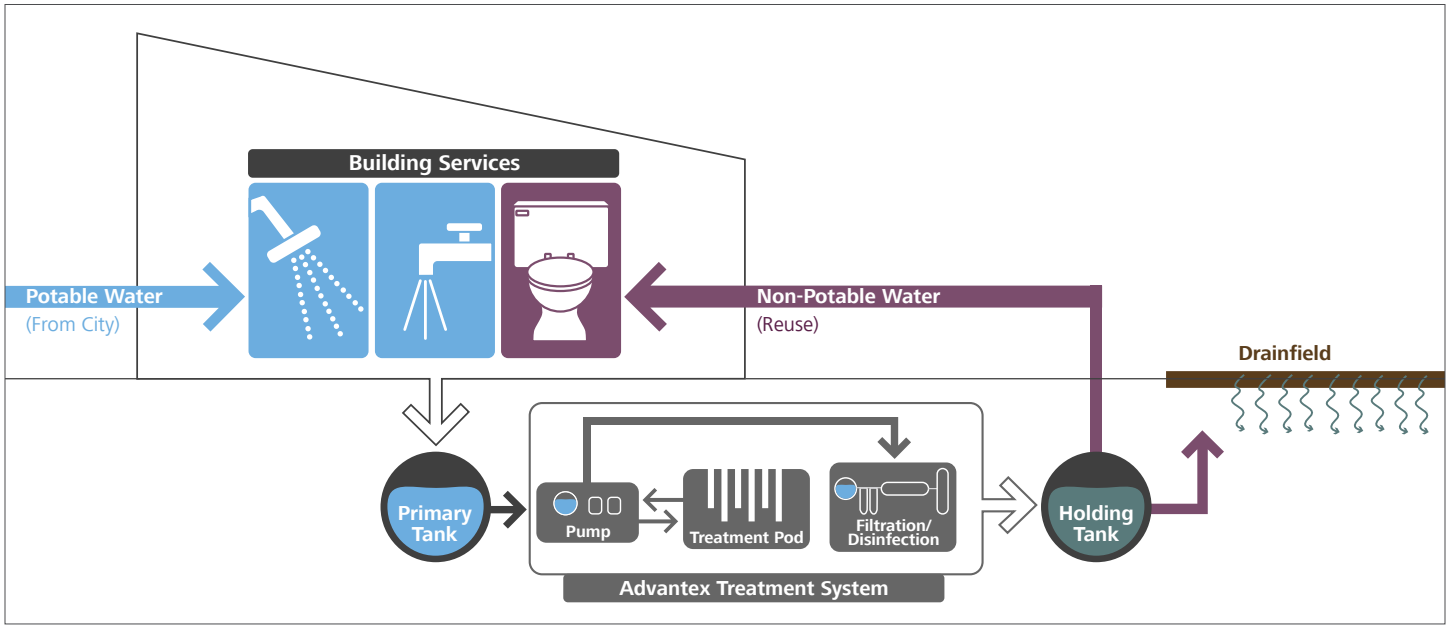
The Peace Island Medical Center design illustrates the viability of these technologies for healthcare organizations:

Collecting rainwater for non-potable uses

Recycling/re-using greywater

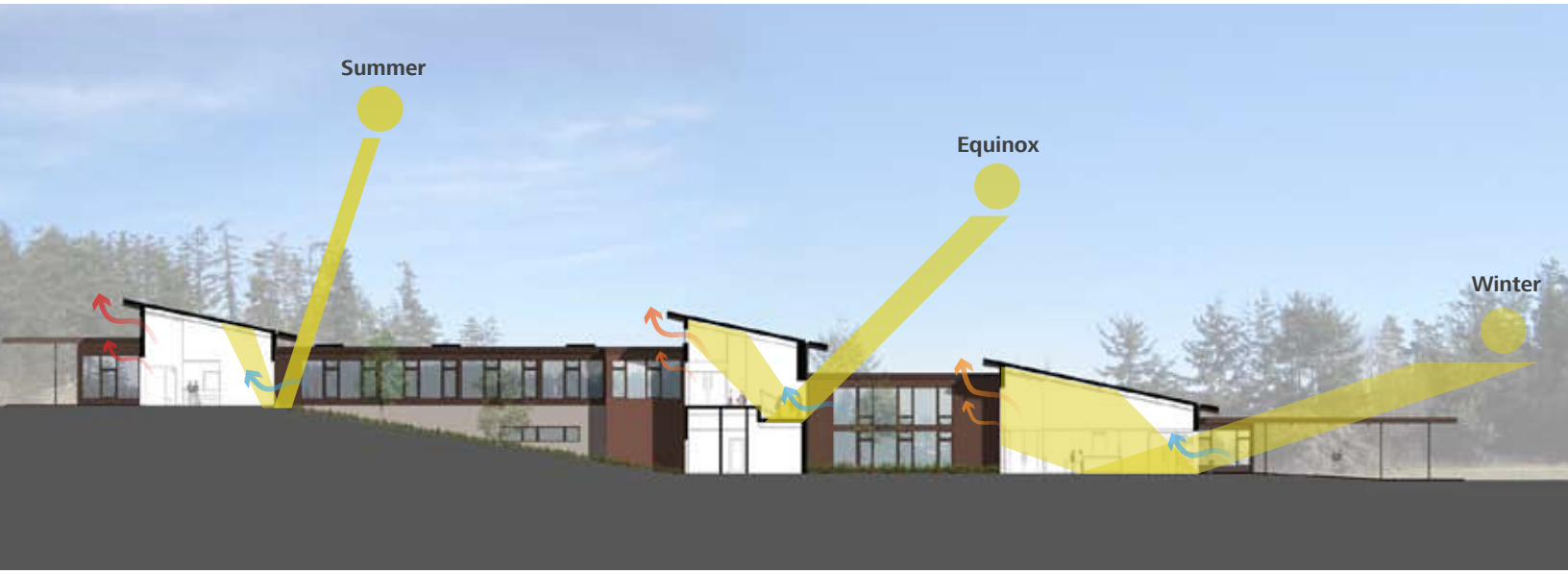
Using rain gardens for stormwater treatment

Treating wastewater onsite, through composting toilets, living machine or more traditional septic systems



Net Zero Water: Potable water use inside the building is limited to sinks and shower, with greywater treated and reused in toilets and non-contact building systems

Energy Petal: Perimeter treatment and public spaces are naturally ventilated and daylit, with deep overhangs to control summer solar heat gain.



(3) Energy Petal

The LBC mandates that 100% of energy needs are supplied by on site renewable and pollution-free energy sources.

At Peace Island, the design team is reducing projected building loads by 62% against Commercial Buildings Energy Consumption Survey (CBECS) averages and providing 93% of power through non-fossil-fuel sources with the following techniques, all models for other hospitals:

A ground source heat pump using 22 vertical wells, supplemented with an electric boiler.

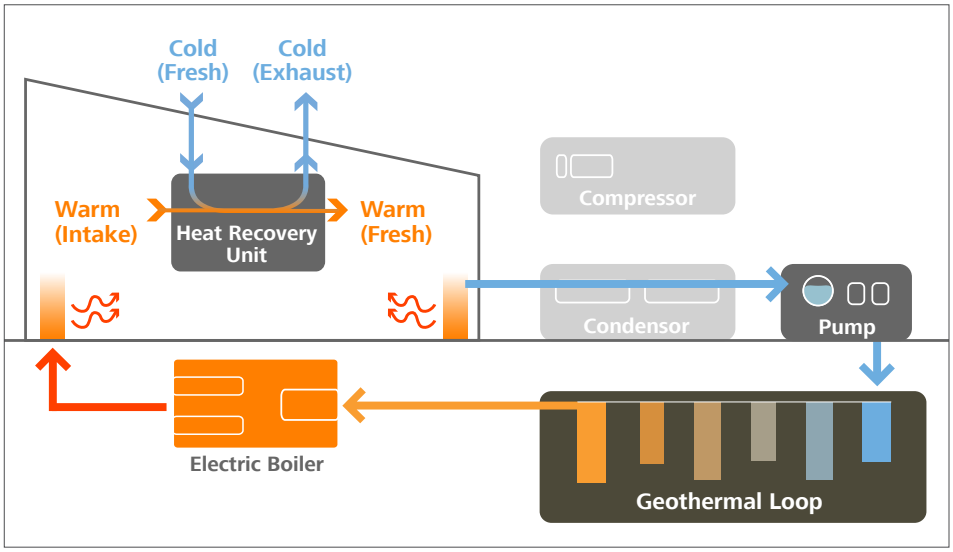
Extensive use of natural ventilation and external shading, reducing cooling and distribution needs.

A decentralized and distributed heating and cooling system that matches the specific and widely varying air quantity and heating/cooling needs of specific program areas, particularly focusing on eliminating re-heat.

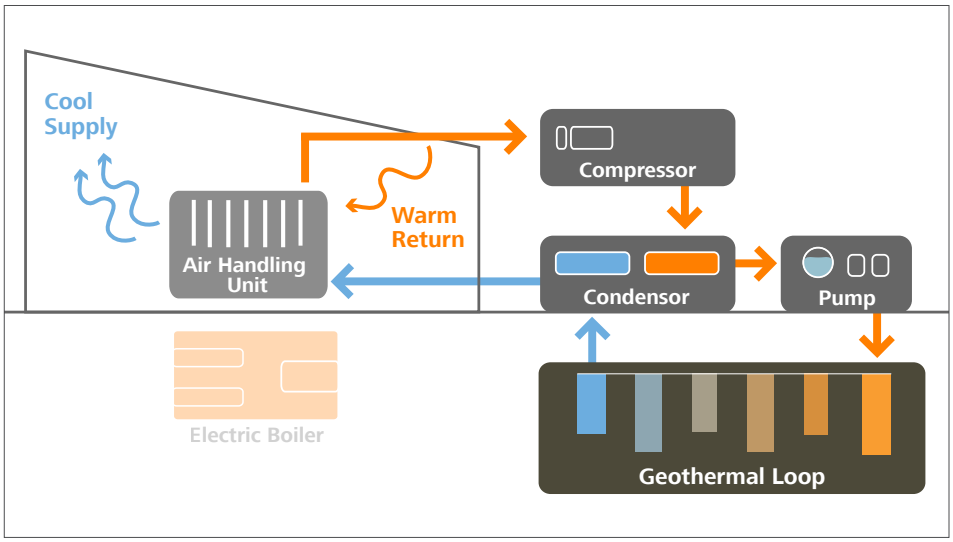
Extensive use of occupancy sensors to "throttle down" air flow and turn off accessory equipment with electrical demands.

Submetering to provide specific and real-time information on lighting and plug loads enabling more active building management.

Use of heat recovery systems to capture excess heat from medical equipment and pre-heat fresh air.



Heating Mode: In winter months a geothermal loop supports the hydronic heating system, while the heat recovery units capture and redistribute internal heat loads.



Cooling Mode: In summer months the geothermal loop pre-cools the process water serving the air handling unit, with natural ventilation reducing much of the load.

(4) Health Petal

The LBC focus on occupant health and comfort requires that all occupied spaces have operable windows, no smoking, and perhaps most impactful, the inclusion of "biophilic design elements." Biophilic design emphasizes orientation, materials and geometry to address and build on primordial human desire to affiliate with nature to increase emotional, intellectual, and physical health.

At Peace Island, 85% of occupied areas have access to daylight and 25% have natural ventilation. The building mass emphasizes and follows site topography and views.

(5) Materials Petal

This petal focuses on the component elements of building materials, mandating non-toxic, sustainable resources, and socially responsible manufacture. In addition to requiring a one-time carbon offset equal to the ecological built footprint of the project, materials must be sourced as locally as possible and promote sustainable resource extraction and manufacture (such as certified timber). The focus on "local" resources includes the design team itself, with strict limits on A/E/C team travel.

Perhaps most challenging, and ultimately not achievable for Peace Island, the materials petal mandates zero Red List components, such as asbestos, mercury, and polyvinyl chloride (PVC). The challenge is meeting maintenance and durability expectations without these materials: at Peace Island this would have cost almost $400,000.

The Pharos Project, a non-profit associated with Cascadia USGBC and ILBI, offers resources and evaluation tools for green building materials. (In a future issue of *Healthcare Design Insights,* we would like to delve deeper into the specific topic of materials, sustainability, and maintenance, and how to rid healthcare environments of toxic building materials.)

(6) Equity Petal

Addressing more broadly the realm of society and culture, the Equity petal fosters "human scaled" as opposed to "automobile-scaled" environments with requirement for paved area coverage, specific site and landscape design elements, and even signage. Goals for democracy and social justice are met through requirements for equal access to the public, considering not just physical disabilities but social and economic disadvantage. LBC projects cannot interfere with an adjacent properties' air, sunlight, or access to waterways.

Health Petal: Access to outdoor spaces and the integration of nature within healing environments is integral to achieving healthy and comforting spaces, such as Swedish Medical Center's Freestanding Emergency Department in Mill Creek, Washington.

(7) Beauty Petal

Lastly, and perhaps most broadly, projects must include design features for "human delight and the celebration of culture, spirit and place appropriate to its function," as well as education by the project and team to the larger community and furthering the challenge and its goals.

With public access to the site and natural features (and of course the building), a design focused on elevating spirit to improve therapeutic outcomes, and educational efforts about the project itself, Peace Island—as many hospitals might—meets LBC Equity and Beauty criteria.

Living Buildings:
Are AEC Firms up to the Challenge?
by Edward Keegan,
Building Design + Construction (Sept 2011)

This article examines the Living Building Challenge and the issues it poses for teams across different building types. It also provides summaries of six registered and completed LBC projects to date.

Mastering LEED and Reducing Natural Resource Use

LEED is the typical industry benchmark and most used guide for sustainable design. After Mahlum's Providence Newberg Medical Center became the first new hospital in the nation to achieve LEED Gold, the OHSU Center for Health & Healing by GBD Architects became the first medical center to receive LEED Platinum at completion of construction, and received Platinum again in the Existing Building (EB) program for sustainable operations and maintenance. This project illustrates the significant sustainable goals that can be achieved with dogged pursuance of a high LEED rating, the benefits of strong relationships with entitlement and permitting agencies who have the leeway to allow new sustainable concepts, and the need to sometimes change regulations from prescriptive to performance-based. Significant built sustainable technologies include a central utility plant, building-integrated photovoltaics, a solar air heater on the building exterior, chilled beams, rainwater capture, and extreme water efficiency. In addition to reduced capital outlay for "typical" mechanical systems, post-occupancy evaluations document energy usage approximately 33% less than the baseline model.

A notable element of this project is the use of a membrane bio-reactor (MBR) that receives 100% of the building's wastewater, processes it and makes it available as a non-potable water source. This is the first medical research facility in the country to use this technology, which uses membrane cartridges instead of gravity as a physical barrier to separate effluent from the biomass or remaining sludge material, and then with further treatment and disinfection produces gray water for select non-clinical urinals, cooling tower make-up, and on-site irrigation. The system treats 15,000 gallons of waste and sends only a minimal amount of sludge into the municipal sewer system.

A **report** by Interface Engineering details many of the project's sustainable features and design process and notes that key to success for the OHSU project was the ability to challenge building codes where traditional prescriptive requirements got in the way of real improvement. The engineers were able to make code appeals and "hash out" code exceptions. In fact, this project benefitted from significant investment by the City of Portland and other public entities, in the form of tax credits, funds for energy modeling, federal tax credits and more.

Another **report,** this from the Portland Office of Sustainable Development, details these investments, including $50,000 from the Office of Sustainable Development's Green Investment Fund grant program among a total of $1,500,000 in grants and credits, and the benefits received. The report itself is a strong exhibit for the need to involve regulatory process stakeholders and ensure that decision-makers have the flexibility and authority to approve measures that advance long-term sustainability.

The lobby at Oregon Health & Science University Center for Health & Healing (Photo from http://sustainableindustries.com/articles/2010/09/bridging-gap)

An Intense and Creative Energy Focus

Hospitals are among the most energy-intensive commercial buildings, with a baseline of more than two and a half times the energy usage and carbon dioxide emissions. Focusing on energy efficiency and changing sources can dramatically reduce a hospital's "footprint." Gundersen Lutheran Health System in La Crosse, Wisconsin, has achieved dramatic reductions in energy use, increased its use of sustainable energy sources, and achieved significant savings.

In 2008, the hospital set a goal to reduce energy consumption 20% by 2009 and to generate 100% of its power using renewable energy by 2014. The hospital moved energy use to the forefront of business and operational decisions. The initial focus was on the system's top six energy consuming buildings. The hospital used a raft of techniques, including conducting detailed energy audits to identify specific opportunities, replacing and upgrading equipment, promoting employee education and awareness, and "retro-commissioning," a process focusing on low-cost efficiency and energy reduction measures such as installing solar power, upgrading to energy efficient equipment, chiller tower reprogramming, and light fixture retrofits. In their first year the system realized a 25% reduction in energy use, and $1.25 million in savings.

Two cogeneration approaches at Gunderson are particularly creative, illustrating use of clean and renewable energy resources and, with a neighborhood and community approach. The first was partnering with a local brewery to convert what was previously 100% flared (burnt off, similar to gas fields) biogas into electricity cogeneration. A second was partnering with the local county and a turnkey engineering firm to design and build a landfill gas renewable energy project to pipe landfill off-gases two miles to a Gundersen facility, generating electricity worth $800,000 annually and realizing additional savings from heat recovery systems. A Cogeneration & Onsite Power Production online article details both projects.

Gunderson's energy initiatives have been so successful that the hospital is offering services to other healthcare organizations as a consultant, detailed on the organization's website along with internal case studies.

Entrance courtyard at Gundersen Lutheran Health System, who partnered with Ellerbe Becket to integrate sustainable design into their campus renewal project, currently under construction. Rendering from: http://www.gundluth.org/?id=5059&sid=37

High Performance Hospital Partnerships
by Heather Burpee, Joel Loveland, Michael Hatten and Stan Price, Better Bricks (March 2009)

This report dives deep into energy use in hospitals, and in particular meeting the AIA 2030 challenge. It recommends five effective focuses for energy reduction:

1. Avoid or minimize re-heat needs.
2. Identify all sources of waste heat and implement heat recovery strategies.
3. Focus attention on reducing or eliminating other systems-imposed loads.
4. Address excessive zone-level loads with architecture solutions.
5. Work with applicable state agencies to undertake a review of air flow related code requirements.

A Possible and Better Future

We hope you have enjoyed this look at what is possible, and continue to look ahead. These three projects are examples of environmental and human sustainability. They often intertwine and can mean many things: healthy environments and communities, operational savings, better staff productivity, improved patient comfort and therapeutic outcomes, and healthier lifestyles. The anticipations of even the recent past are paying off with concrete results on many fronts. Let us know your thoughts!

Healthcare Design Insights, produced by Mahlum, furthers evidence-based design, offering practical tools and ideas to healthcare administrators, facility managers, and developers. We welcome your feedback and ideas for future issues!

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