Zero Net Energy Portfolio Case Study

OVERVIEW

Portfolio Details

Location: Headquartered in La Crosse, WI

Climate Zone: 6A

Measured Energy Stats

141 - 109 = 32

BUILDING'S TOTAL EUI	RENEWABLE PRODUCTION RPI	BUILDING'S NET EUI

Site Energy Use Index (EUI) kBtu/SF/year

The Energy Equation: **the building energy use** *minus* **the renewables production** *equals* **the net energy of the building**. Buildings may be 'Getting to Zero' and have a net EUI above zero. If renewable production exceeds energy use its net EUI is below zero (negative) and it is creating surplus energy.

Photos: AECOM

GUNDERSEN HEALTH SYSTEM

Overview

Gundersen Health System is the largest portfolio of buildings striving to reach zero net energy performance on a district wide scale in North America. Made up of 45 new and existing buildings and spanning more than 2.5 million square feet of floor area, Gundersen has consistently worked towards achieving energy independence with increasing success. Hospitals account for only 2% of commercial floor space in the U.S. but use 5.5% of all commercial building energy[1]. Operating a zero net energy portfolio of health-care facilities in a challenging climate like Wisconsin makes this achievement all the more impressive.

Project Goals

Gundersen Health System first announced a goal to control rising energy costs and improve the health of the local community in 2008. To reach this goal, Gundersen has focused on two initiatives which work hand-in-hand toward achieving energy independence. First, and most important, Gundersen is reducing resource consumption through a portfolio-wide focus on energy efficiency and water conservation, including strategies for new construction, major retrofits, building tuning, and equipment replacement. This efficiency-first approach is financially responsible: energy efficiency has long been considered the "first fuel" due to its low cost and high return on investment. Second, Gundersen has invested in clean, renewable energy generated from an uncommonly diverse array of sources. These sources include the now-familiar solar photovoltaics (PV), but also include solar hot water, biomass, and biogas. A corollary goal is to be

1. University of Washington Integrated Design Lab: Targeting 100! http://128.95.168.21/t100/OVW_HEU.php

nbi new buildings institute

For more information:
newbuildings.org/zero-energy

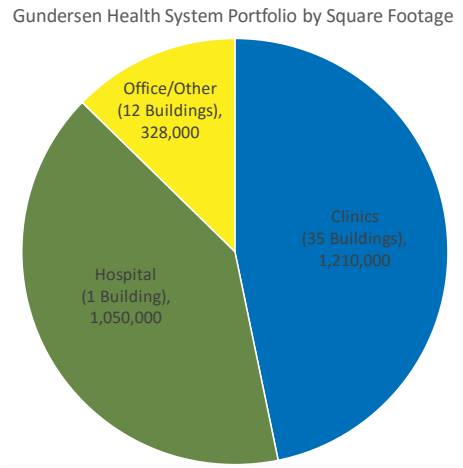


Figure 1: Gundersen Portfolio at a Glance

Photo: Don Wong

energy independent by completely offsetting all utility energy consumption with equivalent, renewable and local energy generation. To date, the longest continuous zero net energy stretch, where renewable energy generation met or exceeded consumption, across all buildings in the Health System lasted for 81 days. The ongoing improvements in both the energy conservation and generation side of the equation will lead to further energy independence.

Financing

Many of the conservation and renewable energy systems put in place within Gundersen Heath System took advantage of available incentives from multiple sources. The most notable source came from Wisconsin's energy efficiency and renewable energy incentive program called "Focus on Energy," which is funded by Wisconsin's investor-owned energy utilities. Gundersen has also taken advantage of state and local incentives.

Overall, the financial impacts of Gundersen's investments in energy conservation and renewable energy have been favorable. The savings from avoided energy costs have attractive rates of return. These savings have a major added benefit for a long-term owner like Gundersen, including dramatically reduced exposure to future risk from rising energy costs and demand charges. According to Alan Eber, Gundersen's Engineering & Energy Management Manager, the incremental cost for an ultra-high performance building is generally low, ranging from 3-5% of the project cost. The rate of return on energy efficiency spending is about double that of solar PV spending (14% for efficiency vs. 4-5% for solar PV), in part due to the fact that Wisconsin's climate is not ideally suited for photovoltaic energy generation. However, with falling PV prices, solar electric generation is likely to become a more attractive investment in the future.

Eber had this to say about the ambitious project, "When we started on our energy conservation program it was common to find projects and activities that had a three or less year payback. As the low-hanging fruit was gathered we starting looking at projects with paybacks around five to seven years. We are now to the point where we will look at projects with payback at 10 [years] or even a little more if they have significant infrastructure benefits along with the energy savings benefits." At this point, the main driver for further development is a longer investment time horizon, good return on investment, and energy independence. Even with payback periods around 10 years, investments in energy conservation have offered a higher rate of return than conventional investment methods. The energy savings lower the operational costs of the health system, which directly benefits the bottom line.

Community-Scale Zero Net Energy

Most zero net energy projects today are individual buildings. However, many buildings simply cannot reach that goal on a single building basis. A recent study completed by Grumman/Butkus found that hospitals based in the Illinois and Wisconsin region use an average of 238 kBtu/ft^2/year^2. The latest hospitals, built to 2013 code standards in the same climate zone will use approximately 130 kBtu/ft^2/year^3, while a small office building would use only 30 kBtu/sf/yr. Even

2 Grumman/Butkus Associates, G/BA 2015 Hospital Benchmarking Survey. http://grummanbutkus.com/assets/uploads/pages/GBA_2015Survey_ReportPart1.pdf

3 Pacific Northwest National Laboratory: End-Use Opportunity Analysis from Progress Indicator Results for ASHRAE Standard 90.1-2013 (December 2014)

Photo: AECOM

the highest-performing large multi-story buildings such as hospitals or high-rises cannot feasibly generate enough energy on site to cover their usage as there simply is not sufficient space to place enough PV panels.

Gundersen Health System strives to be a responsible corporate citizen and values reducing pollutant emissions to make a positive difference in the health of the local community and the world at large.

A community or portfolio-scale zero net energy model, like the Gundersen example, offers a way for corporate and institutional campuses with larger and more energy-intensive buildings to get to zero. Community-scale renewable energy presents an opportunity to take advantage of technologies beyond solar PV and small scale wind. As Gundersen has found, large wind turbines, biomass, and even biogas become feasible when working beyond the boundaries of the building site. The renewable energy generation within the Gundersen Health System includes:

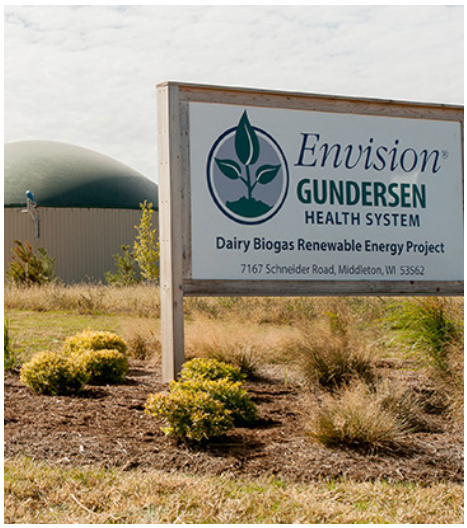
- Solar photovoltaic panels, 75 kW capacity
- Solar thermal collectors, 25 kW capacity
- Two wind turbine sites, totaling 10 MW of capacity
- Two manure digesters coupled with reciprocating engines, totaling 2.7 MW of capacity
- A combined heat and power (CHP) reciprocating engine fueled by landfill methane, 1.1 MW capacity
- A biomass boiler with a 800 hp capacity, coupled with a 400 kW turbine

Striving for Energy Independence

Throughout the past decade, the Gundersen Health System project has reduced energy consumption in a variety of ways, from small-scale upgrades to full energy auditing. Aside from the energy and cost savings, important secondary benefits help make the case for energy independence. The extensive cost savings have allowed the health system to pass along savings to the patients. According to Alan Eber, rates for the cost of care at Gundersen would typically go up by about 13% year to year. With more energy-related capital investment projects becoming fully paid back from their savings, the additional funds have helped Gundersen keep healthcare cost increases at only 4% in 2015.

Another benefit, though harder to quantify in terms of dollars or kWh, is the public health improvement attributable to emission reductions. Gundersen strives to be a responsible corporate citizen and values reducing pollutant emissions to make a positive difference in the health of the local community and the world at large.

Photo: AECOM



Since 2008, the efficiency improvements and clean energy production adopted by Gundersen have positively contributed to air quality improvements in the region.

Table 1: Emission Reductions for Various Pollutants Attributable to Gundersen Health System (Source: Gundersen Envision)

Emissions (lbs.)	2008	2015[4]	% Reduction
SO_2	241,011	15,027	94%
NO_x	161,729	31,771	80%
CO_2	80,846,997	5,751,799	93%
Mercury	2.4	0.3	87%
Particulate Matter	434,928	39,542	91%

Lastly, the conservation and generation projects pioneered by Gundersen have focused on working with the local community, thereby contributing to the local economy. Partnerships with the local landfill, nearby dairies, and biomass suppliers all help to offset natural gas consumption, which may be imported from as far as Texas.

Table 2: Summary of Conservation and Generation Projects Adopted by Gundersen Health System

Conservation Strategies	Energy Generation Projects
Retro-commissioning	Biogas from Lacrosse county landfill
Energy Auditing	Biogas from local dairy manure digesters
Lighting retrofits	Biomass boiler burning locally sourced wood products
Automated computer shutdown software	Wind turbines
Exhaust fan upgrades	Solar hot water collectors
Chiller-tower optimization	Solar photovoltaics
Automatic computer management	
Cooling system infrastructure upgrades	

Insights

New construction is the first place Gundersen looks for cost-effective investments in energy efficiency, according to Alan Eber. In the healthcare market in particular, energy efficiency is often not a primary consideration of building design and construction teams. The incremental cost of designing ultra-high performance buildings has proved to be minimal when considering avoided energy costs, not to mention the improved building performance, occupant satisfaction, public health, and other societal benefits.

4 Gundersen Health System's facility area grew by 26% from 2008 to 2015.

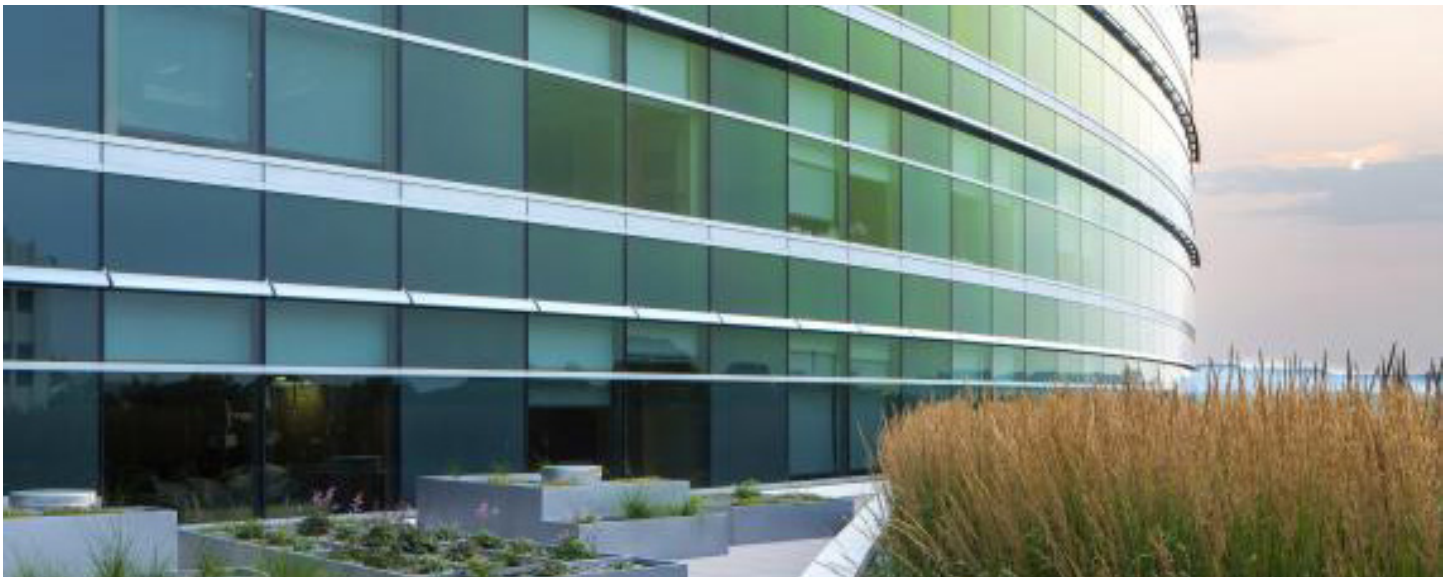


Photo: AECOM

Setting an energy consumption target is the most important step. With a target set, the design team, construction team, operators, and occupants are all on the same page. The target and the associated energy model are critical tools for the design team to make informed decisions that will help reach the target energy usage.

For Gundersen, getting to zero net energy is an ongoing process. It has required commitment at all levels – from executive leadership to health care providers – to continuously seek out avenues for energy conservation and generation. Building retro-commissioning, for example, is a valuable tool to maintain performance in buildings and identify improvements which can save energy, often for little cost. Because zero net energy is not a one-time achievement but rather an ongoing real-world performance goal, this is of great importance for zero net buildings and portfolios, as high-performance must be maintained to meet energy performance targets.

Gundersen's method for maintaining buildings is built on continuous energy monitoring. Benchmarking buildings against historical data highlights the buildings which have increased energy consumption and therefore the greatest potential for energy savings. These high priority buildings then go through an audit to identify energy conservation measures. Next, each of the energy saving measures are scoped out for paybacks and ranked by cost-effectiveness. This prioritized list of measures gets produced twice a year. The entire exercise has successfully allowed Gundersen to effectively allocate resources to achieve greater savings.

Setting an energy consumption target is the most important step. With a target set, the design team, construction team, operators, and occupants are all on the same page. The target and the associated energy model are critical tools for the design team to make informed decisions that will help reach the target energy usage. On the occupant side of the equation, having a public, progressive goal will help to engage the building staff. Eber notes, "Just hearing the results and successes are the best tool for exciting the staff to get on board and be a part of the success."

Outcomes

Gundersen has been a bold leader in the community by looking at its environmental impact beyond the day-to-day operations of the clinics, offices, and hospital. Gundersen is committed to improving the health of the community. The board of directors at Gundersen has supported this long-term goal, which has led to energy conservation and innovative energy generation to reduce harmful emissions, support the local economy, and lower the cost of care.

Photo: Gundersen

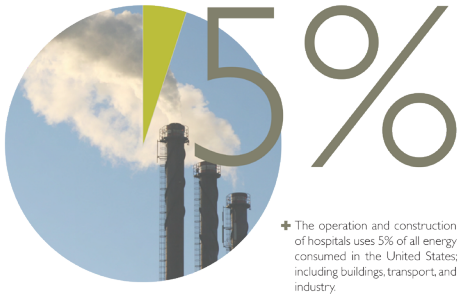


Figure 2: Courtesy, University of Washington

The operation and construction of hospitals uses 5% of all energy consumed in the United States; including buildings, transport, and industry.

For More Information

Gundersen Envision Program

Gundersen Energy Conservation

Gundersen Renewable Energy

Targeting 100!

Grumman/Butkus Associates Hospital Energy and Water Survey

Key Takeaways

Efficiency makes financial sense

A focus on load reduction and efficiency first and careful attention to the medium and long-term impacts of design choices can deliver new ZNE buildings at a low cost premium compared to conventional buildings – only 3-5% in Gundersen's case. For existing buildings, ongoing energy audits and periodic retro-commissioning can identify further low-to no-cost solutions to save energy.

Community scale allows more building types to get to Zero Net Energy

High density and energy-intensive building types (e.g., hospitals, high-rises, restaurants, or data centers) often cannot offset their annual energy consumption with on-site renewables. By expanding the scale to a community or district level, these buildings can more readily get to zero net energy as a portfolio, campus or district.

Solar PV isn't the only option

The vast majority of zero net energy projects rely on solar photovoltaics to offset energy consumption. However, there are other forms of renewable energy available (Gundersen has taken advantage of wind, biogas, and biomass), which can come into play especially when expanding zero net energy to a portfolio of buildings.

Setting goals is paramount

Setting an energy usage goal for the building as a first step will guide the design team towards a lower energy consuming building. Having this goal in the forefront of the project aligns priorities towards energy efficiency.

The leadership of a champion drives performance and leads to successful

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