

Power & Foresight

CELEBRATING 15 YEARS OF SUSTAINABLE ENERGY



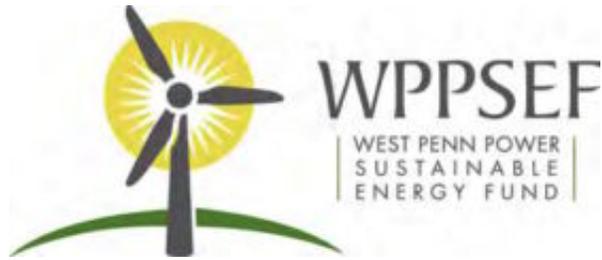
Geisinger Behind the Scenes

Bending the energy curve

Geisinger is a leader.

The Geisinger Healthcare System demonstrates Power & Foresight in the way it produces and manages its energy. For its commitment to environmental stewardship and sustainability. For its advocacy on why clean energy is important to our health.

Meet the Host Sponsor



Power & Foresight Attendees – Geisinger Medical Center

On behalf of the West Penn Power Sustainable Energy Fund (WPPSEF), it is my pleasure to welcome you to Power & Foresight's inaugural workshop and open house. WPPSEF developed its Power & Foresight program to spotlight the leaders who are making a difference in Pennsylvania. We believe these leaders will light the way for the next generation.

We chose to showcase the Geisinger Medical Center for our inaugural workshop because of Geisinger's steadfast commitment to improving the way they produce and use energy while linking their energy choices to improving community health. While their energy savings are significant, WPPSEF applauds the Geisinger Health System corporate commitment having the foresight to deploy clean energy throughout their healthcare system and for allowing our group today for a behind the scenes energy tour at their Danville campus.

We hope that you will enjoy your time spent with us today.

Sincerely,
Joel L. Morrison
Director, WPPSEF

**Power & Foresight
Geisinger Medical Center Workshop & Tour**

June 2, 2015

9:30 a.m. - 10:00 a.m.	Registration/ Light AM Refreshments
10:00 a.m. - 11:15 a.m.	Presentations
10:00 - 10:05	Welcome Remarks: Joel Morrison, West Penn Power Sustainable Energy Fund
10:05 - 11:00	Geisinger Medical Center Presentation: Alan Neuner
11:00 - 11:10	Q&A: Alan Neuner/ Joel Morrison
11:15 a.m. - 12:45 p.m.	Tour(s)
11:20 - 12:05	GREEN Group - Geisinger Medical Center Energy Tour (Alan Neuner) BLUE Group (Pine Barn Inn) - Geisinger Centennial (Bob Davies)/ Power & Foresight (Joel Morrison)
12:10 - 1:00	BLUE Group - Geisinger Medical Center Energy Tour (Alan Neuner) GREEN Group (Pine Barn Inn) - Geisinger Centennial (Bob Davies)/ Power & Foresight (Joel Morrison)
1:05 p.m. - 2:00 p.m.	Working Lunch/ Meeting Wrap-up



Who is WPPSEF?



Who are we?

The West Penn Power Sustainable Energy Fund (WPPSEF) is a 501(c)(3) nonprofit organization that invests in the deployment of sustainable energy technologies that benefit West Penn Power ratepayers in Pennsylvania.

How can we help you?

Elk herds are an unforgettable sight for the more than 350,000 guests that visit the Elk Country Visitors Center each year in Benezette, PA. When it came time for this non-profit to expand, they began a capital campaign to raise funding. But pledges happen over time and that's where the WPPSEF can be at the right place at the right time. We stepped in with a grant and bridge financing to kick start the campaign. We can be more flexible than a traditional bank and we can tolerate a bit more risk.

We are reinvesting in our communities, helping to reduce energy useage through technology and stimulating clean energy generation. If you have a project, let's have a conversation.

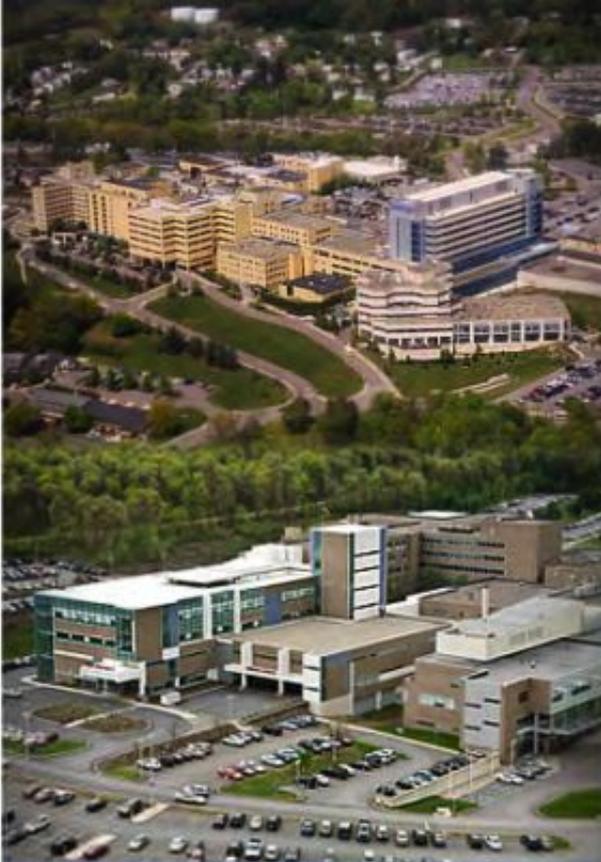


[Take an online tour](#)

Our investments are making a difference

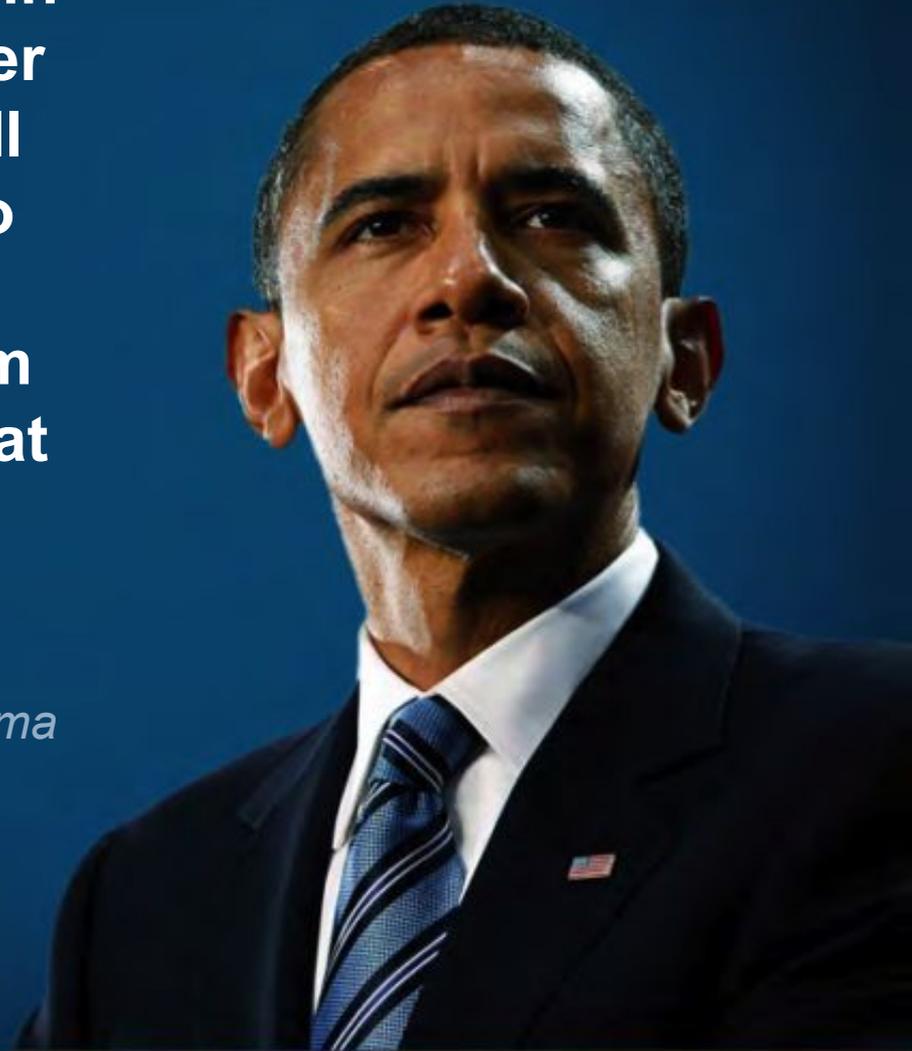
Energy Management in Healthcare

The Geisinger Success Story



“We have to ask why places like the Geisinger Health System in rural Pennsylvania ... can offer high quality care at costs well below average We need to identify the best practices across the country, learn from the success, and replicate that success elsewhere.”

– President Barack Obama



Geisinger Innovations in the Media

A Healthier Way to Pay Doctors

Physicians' bills are inflating medical costs and diverting the profession. One hospital is trying to fix the system.

It's hard to see any other way to pay doctors. But at Geisinger, we're trying to change the way we pay them. We're trying to make sure that the money we pay them goes to the people who are taking care of our patients. We're trying to make sure that the money we pay them goes to the people who are taking care of our patients. We're trying to make sure that the money we pay them goes to the people who are taking care of our patients.

TIME

A Healthier Way to Pay Doctors

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GEISINGER

The New York Times

Business Day

Paying to Cut Health Costs

Extra Nurses Help Doctors Keep Patients Out of the Hospital

It's a bit of a puzzle, but it's one that's been solved. The puzzle is how to pay doctors. The solution is to pay them based on the quality of care they provide. This is a new way to pay doctors. It's a way to make sure that the money we pay them goes to the people who are taking care of our patients. It's a way to make sure that the money we pay them goes to the people who are taking care of our patients.

The Washington Post

NATIONAL

Health System, Less Is More

How Doing Things Right the First Time, for Flat Fee, Pays Off



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FAST COMPANY

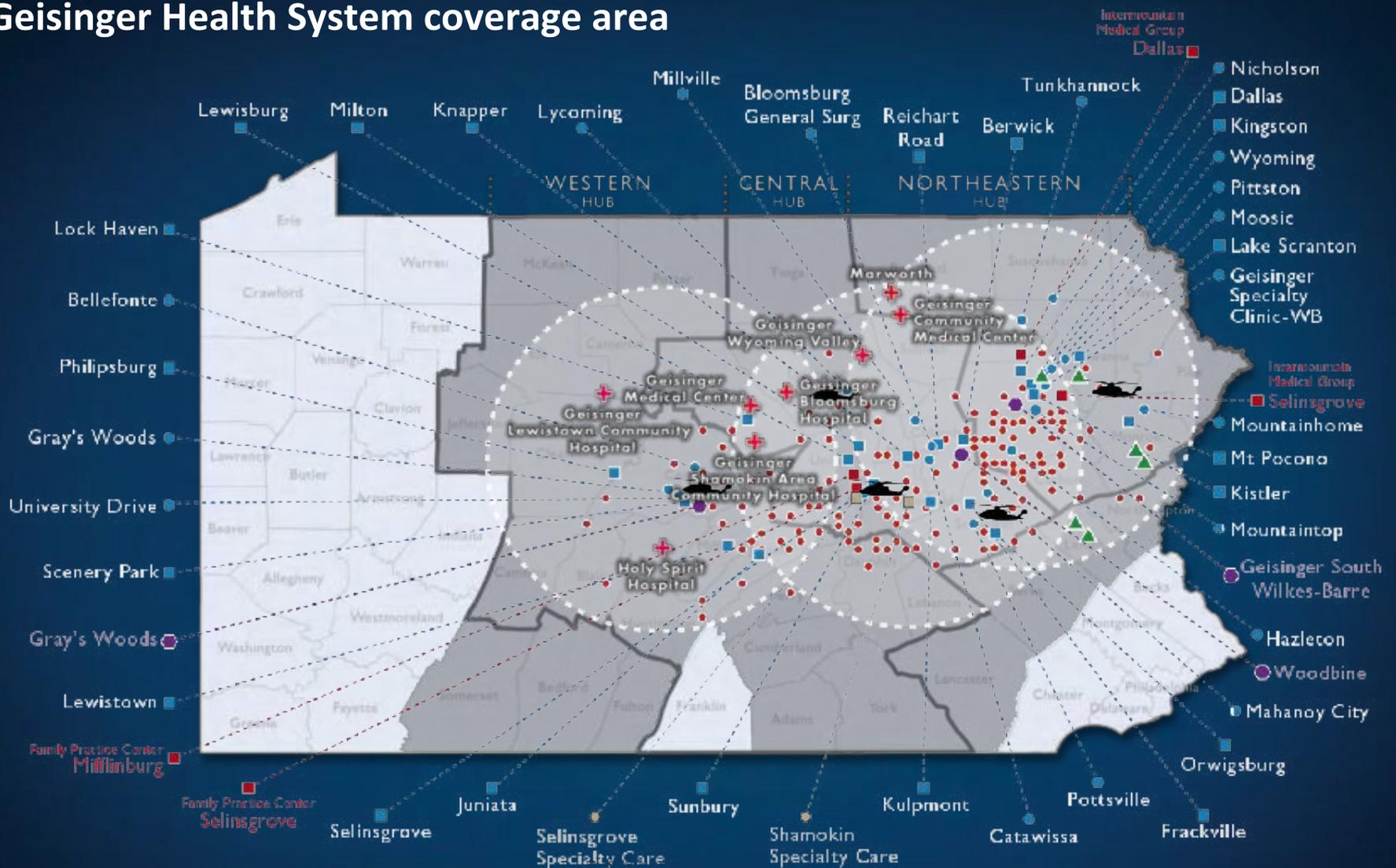


THE CURE

How a small network of hospitals in Pennsylvania is derailing cost-cutting efforts, and improving health care.

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Geisinger Health System coverage area



Revised 12-2-13. Geisinger PR & Marketing Department

- Geisinger Inpatient Facilities
- Contracted ProvenHealth Navigator Sites
- Non-Geisinger Physicians with EHR
- Geisinger Medical Groups
- Ambulatory Care Facility
- Geisinger Health Plan Coverage Area
- Geisinger Health System Hub and Spoke Market Area
- Careworks Convenient Healthcare
- LifeFlight Bases
- Geisinger ProvenHealth Navigator Sites

Geisinger Health System Coverage Area

Executive Summary

Geisinger Facilities Operations has been able to “bend the curve” to consistently lower utility expenditures, thereby increasing profitability.

This process has included implementation of conservation technologies and leveraging the commodity market to lower not only costs, but provide reductions in air pollution and the chronic health issues it creates.

These practices have resulted in Geisinger Medical Center being awarded EPA’s EnergyStar, scoring a perfect 100.

The value of these strategies have lowered operational costs over \$10,000,000 annually, and costs are forecast to decline even further in the foreseeable future.

Mission

- The mission of healthcare is to improve the health of the people we serve.
- Reducing energy consumption reduces pollution and emissions from power plants
- Reduced pollution improves health

Triple Bottom Line – People, Planet, Profit



Accomplishments

- Main site in Danville was 1.2 million square feet in 1988 (now 3 million SQFT)
- Building was expanded by 150% since that time
- Utility expense and electrical demand the same today as 1988
- Annualized utility savings = \$10 million
- 2000 Business for the Bay Award (Chesapeake Bay Foundation)
- 2002 FAME Award of Excellence – Association of Facilities Engineers (AFE)

Historical Comparison

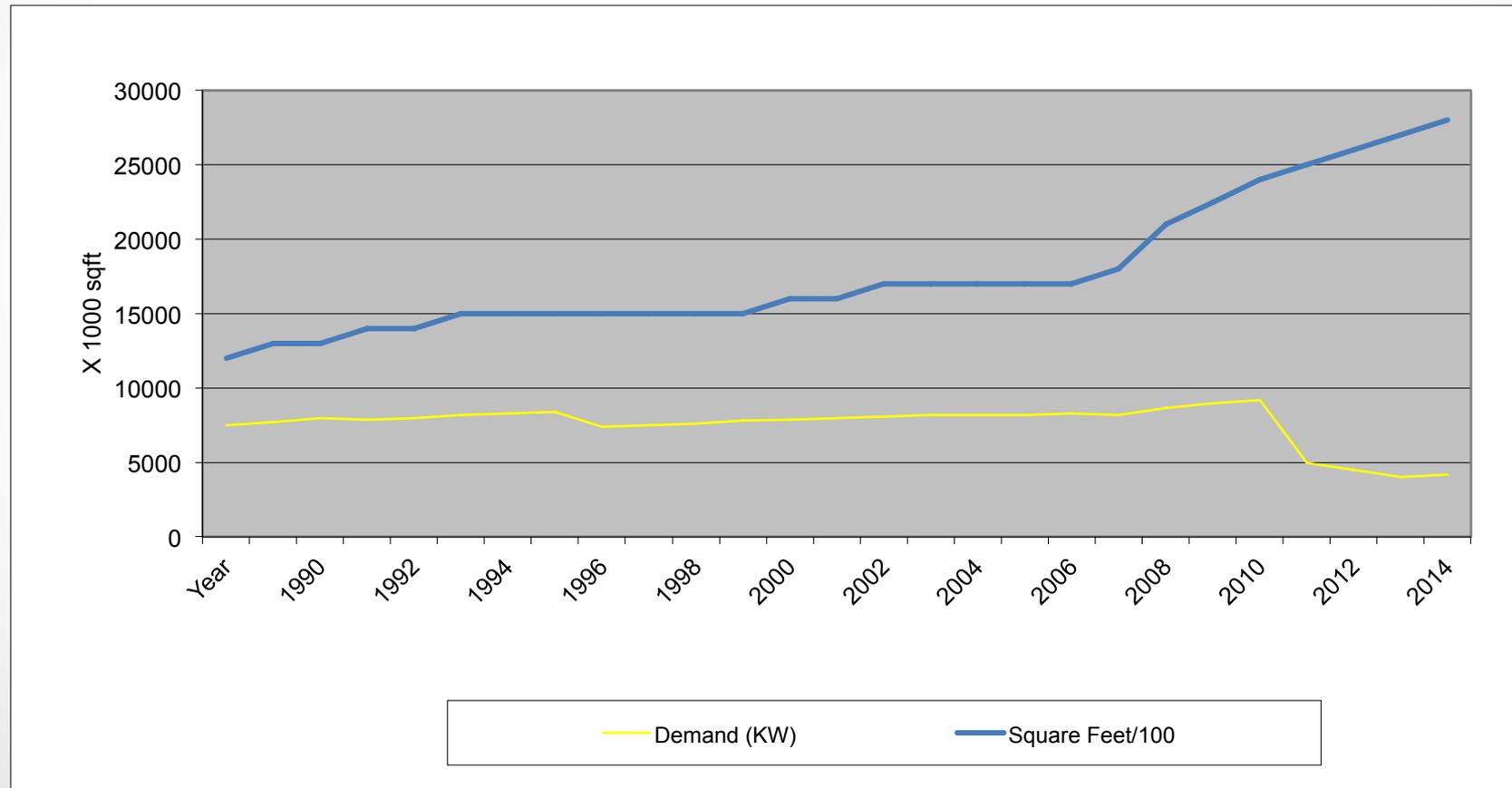
1992

- 1,200,000 SQFT
- 600 PC's
- 2,000 Tons absorption cooling, 1350 Tons electric

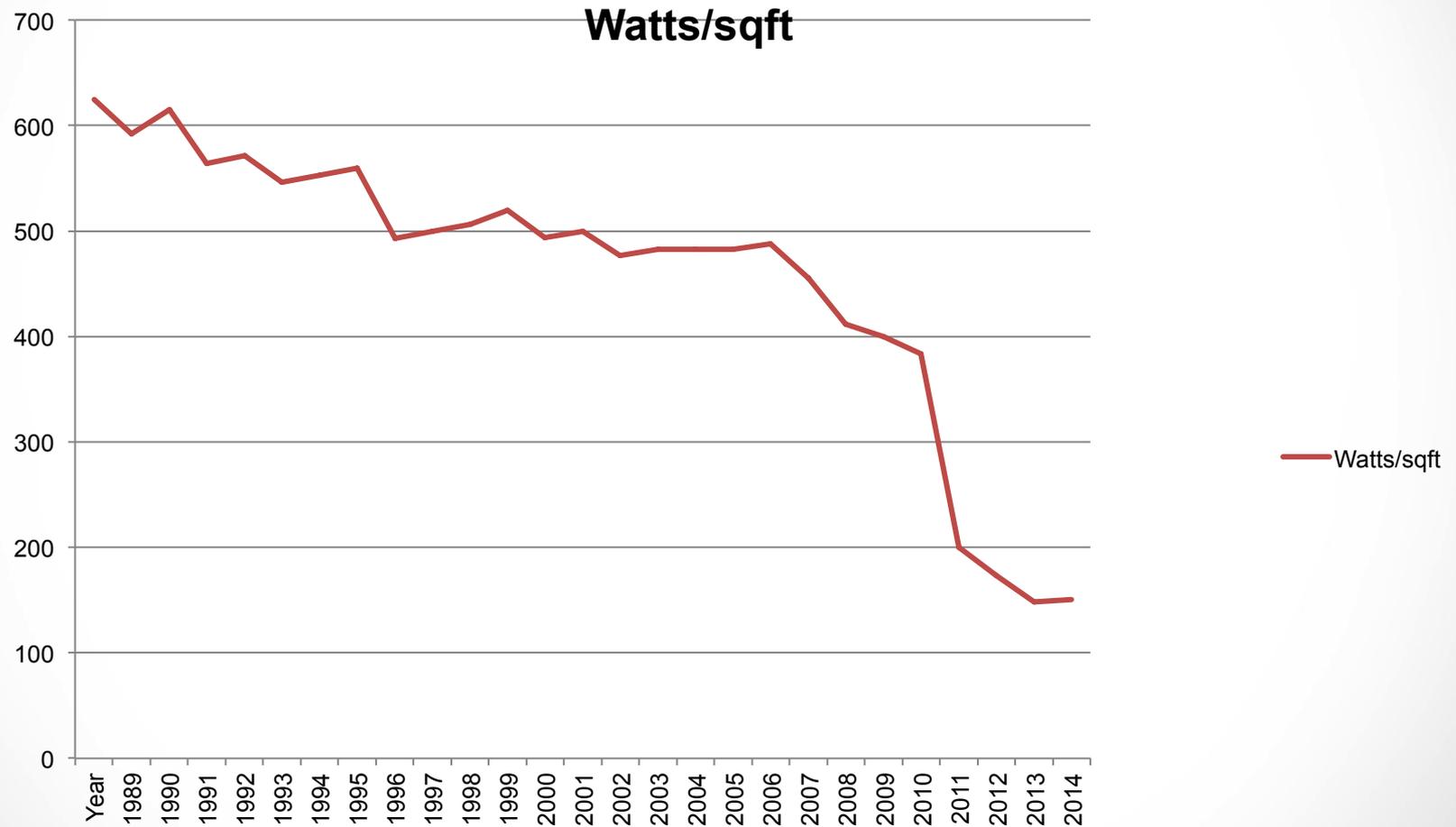
2015

- 3,000,000 SQFT
- 12,000 PC's
- 1500 Tons steam turbine chiller, 0 absorption, 5800 Ton electric, 8000 ton-hour chilled water storage

Historical Electrical Demand vs. Square Feet

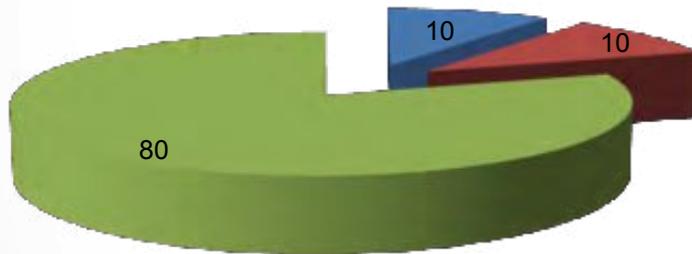


Results of Efficiency Improvements



Achieving Energy Savings

Energy Cost Reduction Drivers



■ Adjustments ■ Purchasing ■ Capital Investment

Energy Costs can be decreased in three ways:

1. Adjusting set points to lower usage (generally, no cost)
2. Lower commodity costs (natural gas and electricity)
3. More efficient energy conversion processes (almost always requires capital investment)

Technologies Deployed

- T-8 and LED lighting
- Variable Frequency Drives
- Variable Air Volume
- Off-Peak cooling and thermal storage
- Reset schedules
- Occupancy sensors (for light and VAV systems – OR)
- CHP – Combined Heat and Power
- Solar Photovoltaics
- Low approach variable counter-flow cooling towers
- Centralized rotary Uninterruptable Power Supplies
- VFD Chillers

Janet Weis Children's Hospital PV Array





Steam Plant Configuration Water Tube Boilers

(2) 1,000 bhp

Quick Start Boiler

300 bhp

Electric Boiler

6 MW / 600 bhp

Heat Recovery

800 bhp

Chiller Plant Configuration



- 1500 Ton Condensing Steam Turbine Chiller
- Four 900 ton VFD Chillers
- 8000 ton-hour chilled water storage
- Nine variable counter-flow towers
- 1.5 mW Genset

Design Approach

Thermal Storage

Sizing

Design

Benefits

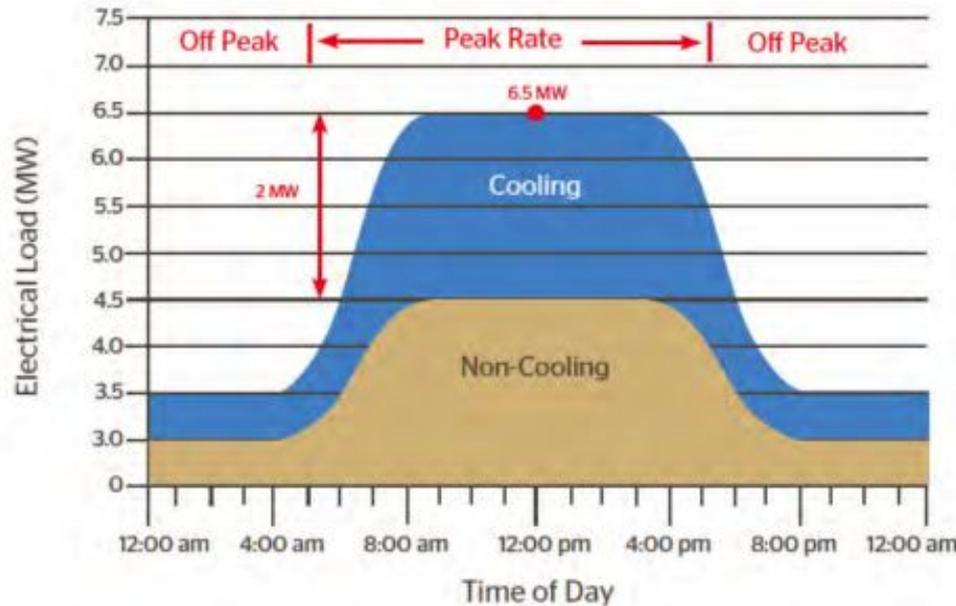
Shift Load to Off-Peak

Cheaper Electric Rates

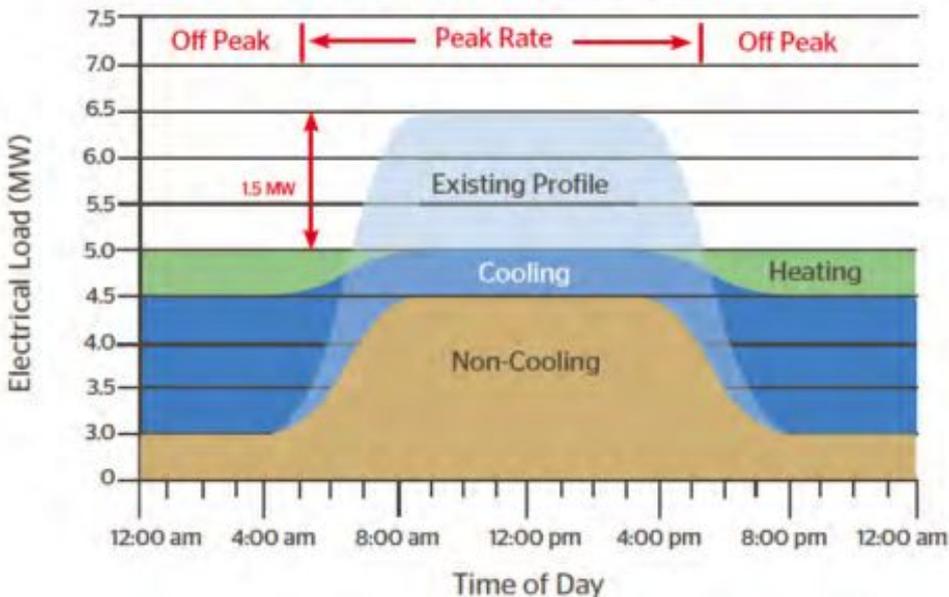
Reduce Demand

More Efficient Operation

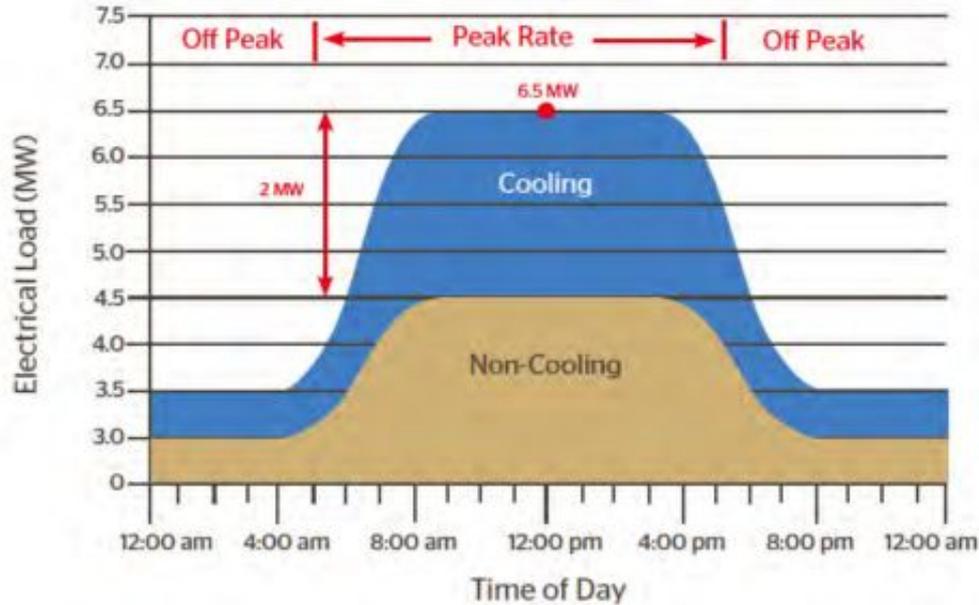
TRADITIONAL DAILY LOAD PROFILE



DAILY LOAD PROFILE WITH THERMAL STORAGE & ELECTRIC BOILER



TRADITIONAL DAILY LOAD PROFILE



Economics

Peak Load Shaving

Shifting Load to Off Peak

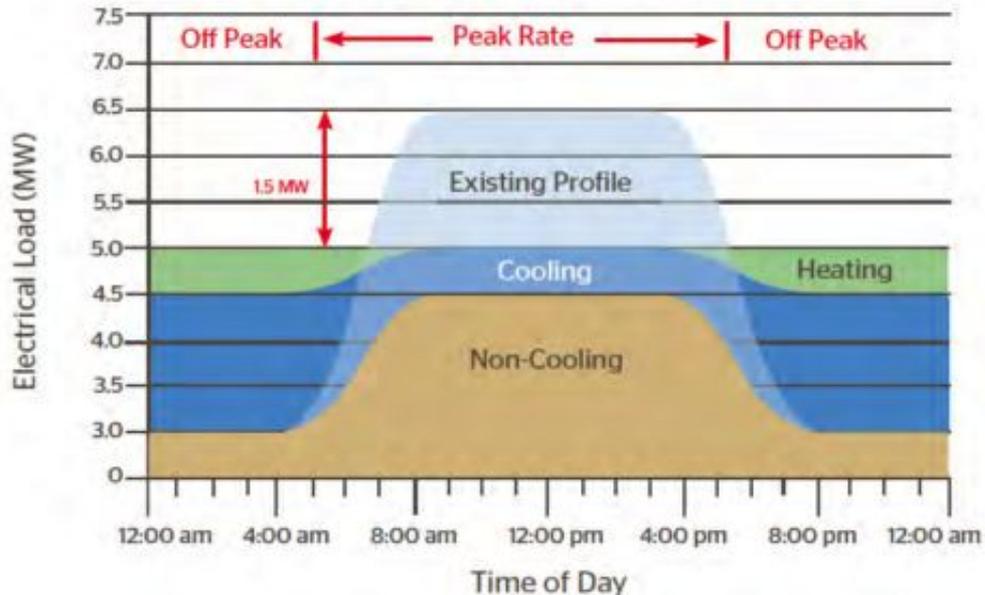
Non-Electric Cooling

\$350,000/Year

Total Savings

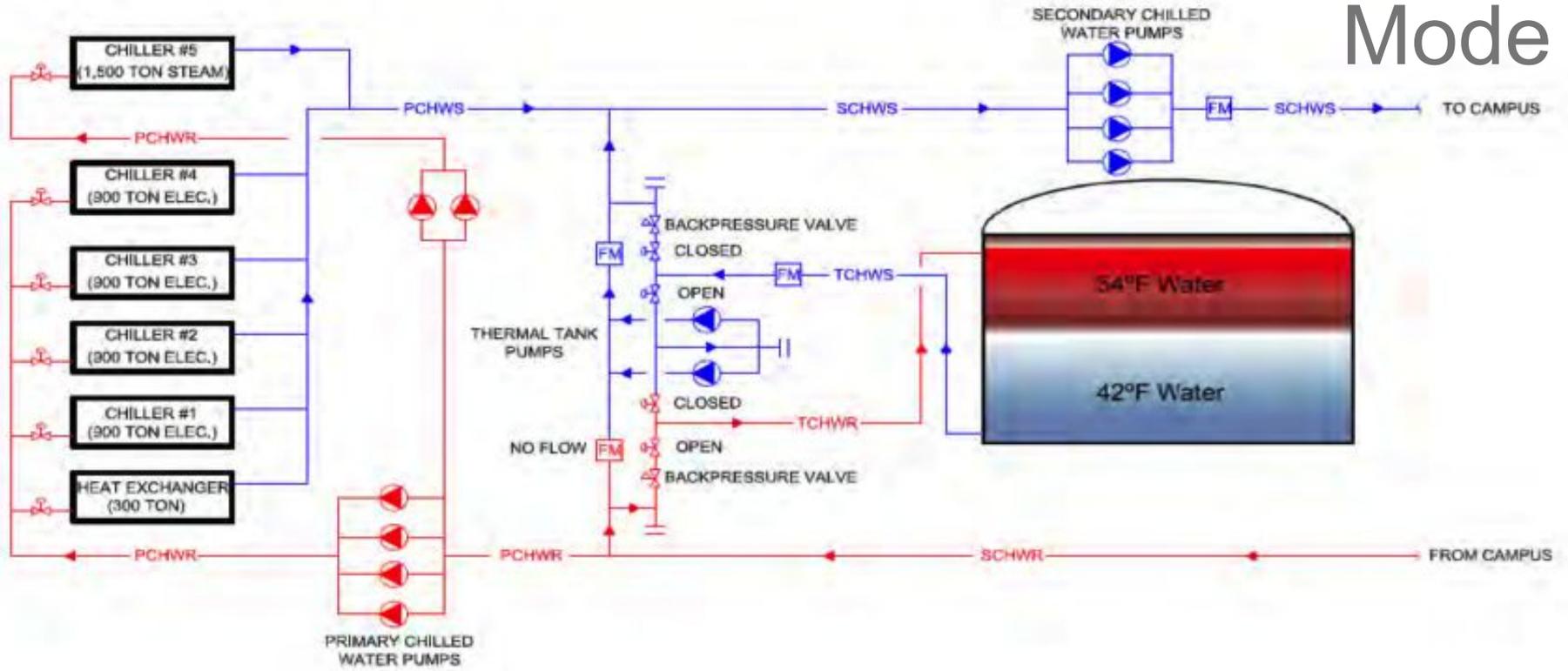
\$480,000/Year

DAILY LOAD PROFILE WITH THERMAL STORAGE & ELECTRIC BOILER



Design Approach

Thermal Storage – Discharge Mode



Design Approach

Trigeneration

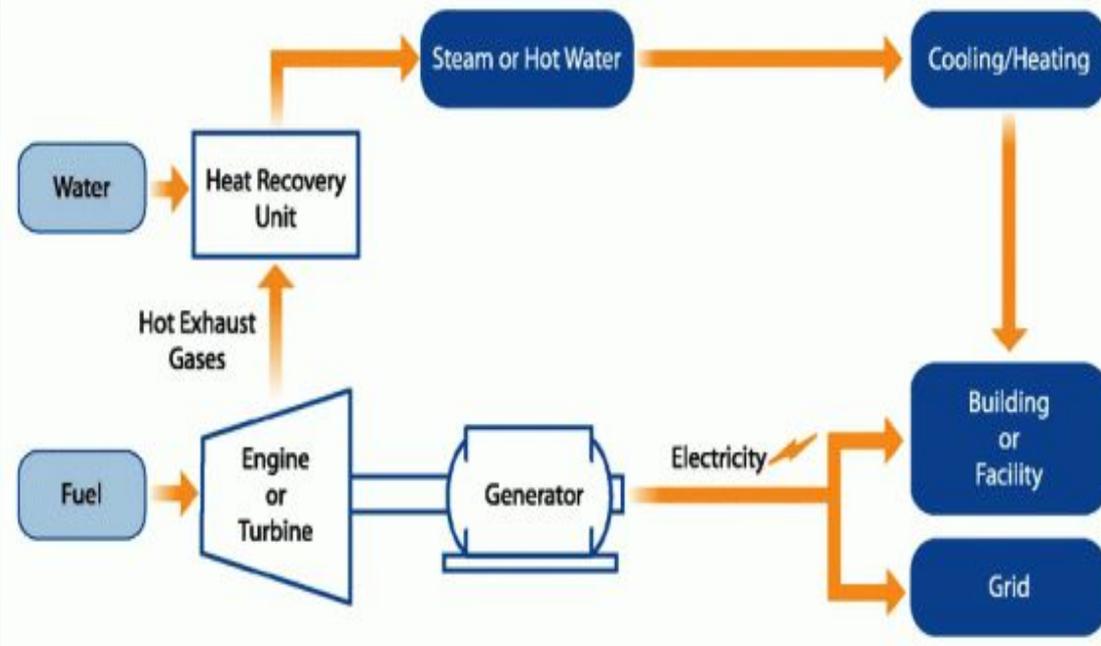
Heat (800 bhp)

Power (5 MW)

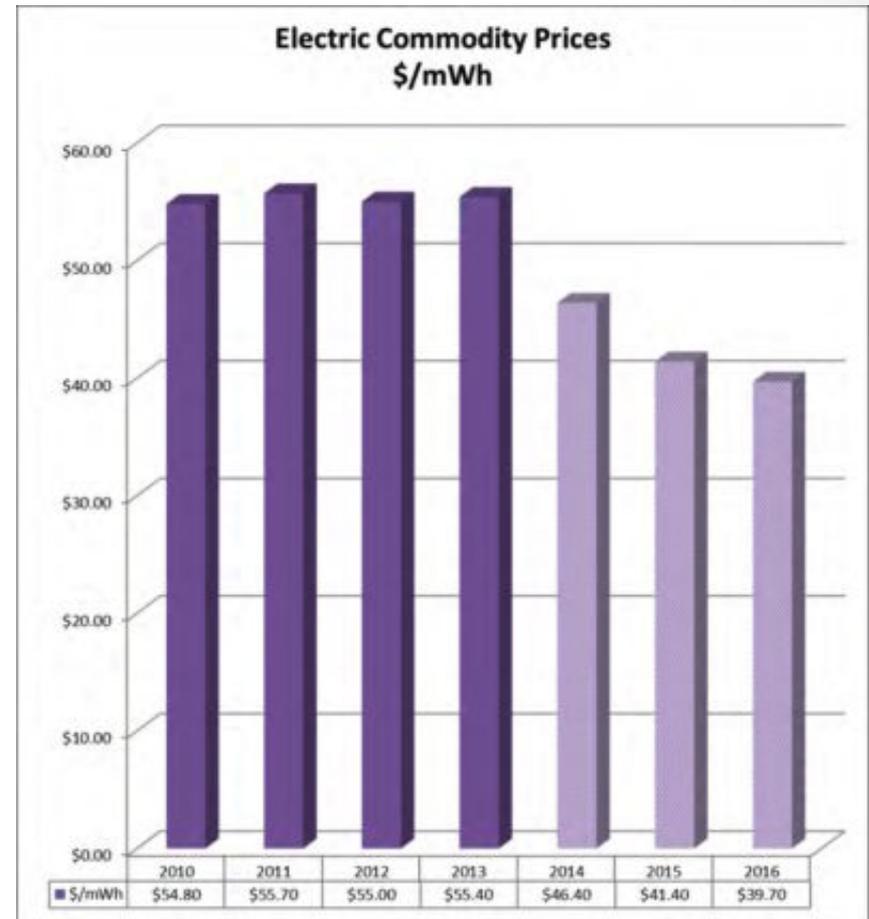
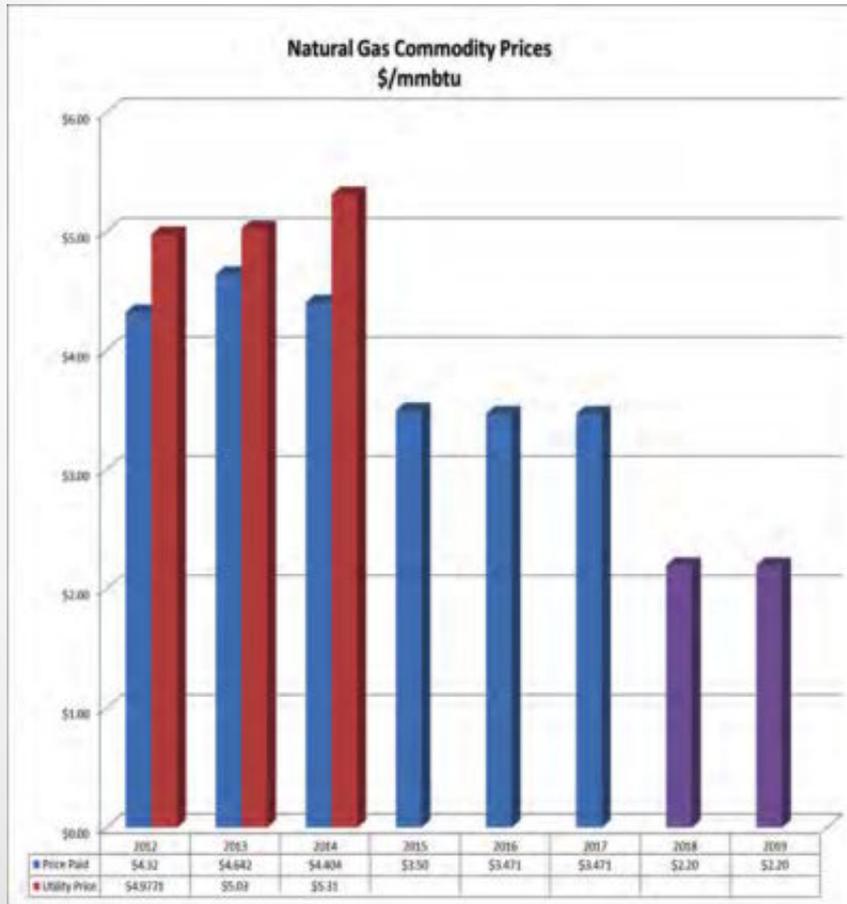
Cooling (1,500 tons)

Reliability

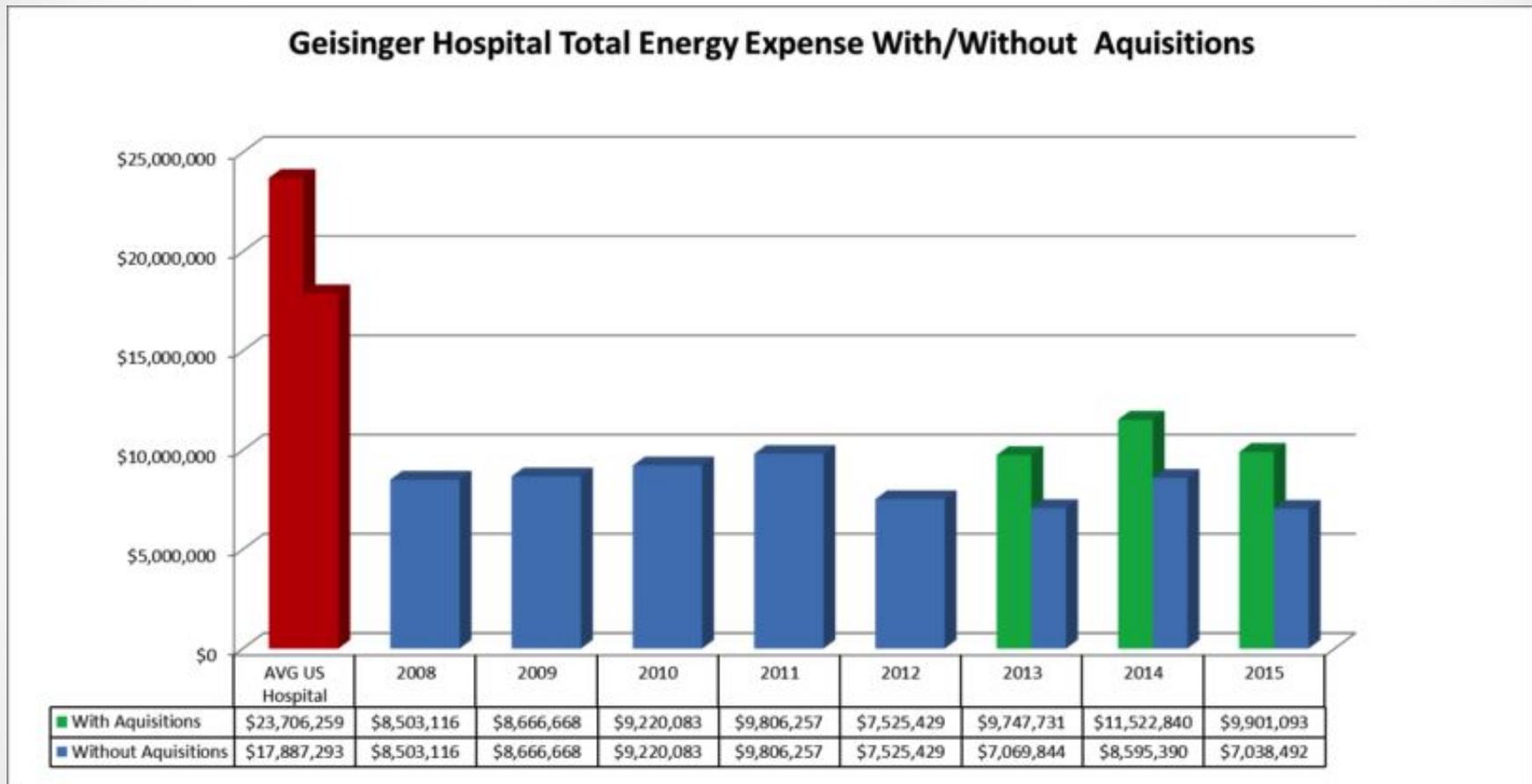
Future Island Mode



Pertinent Background



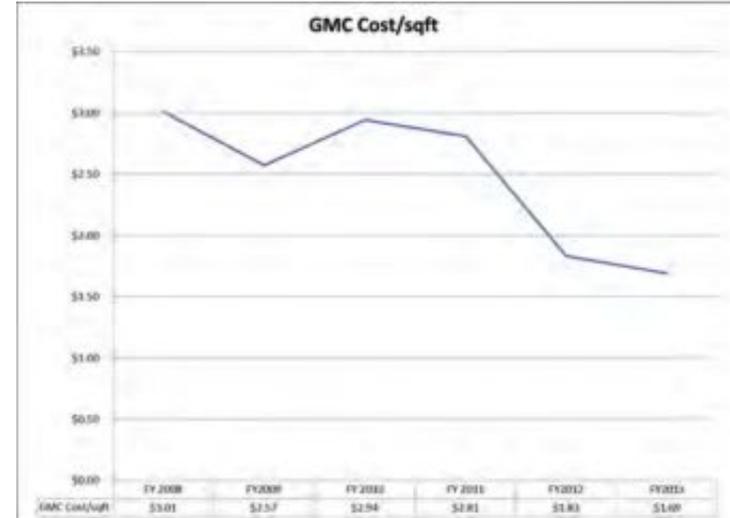
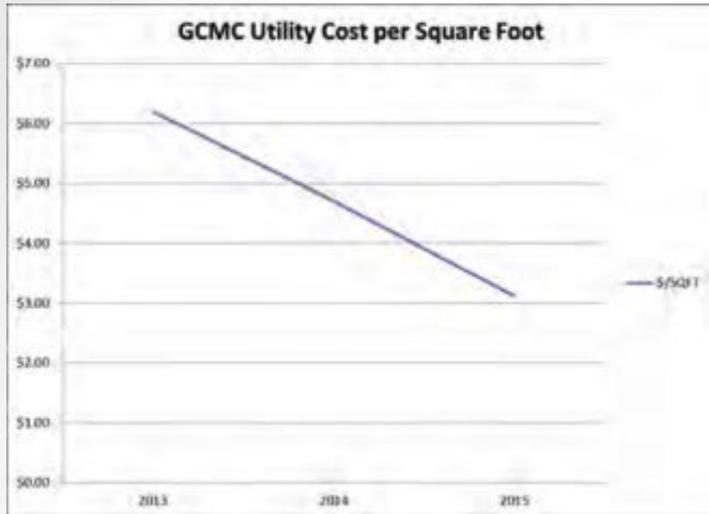
Total Energy Spend - Hospitals



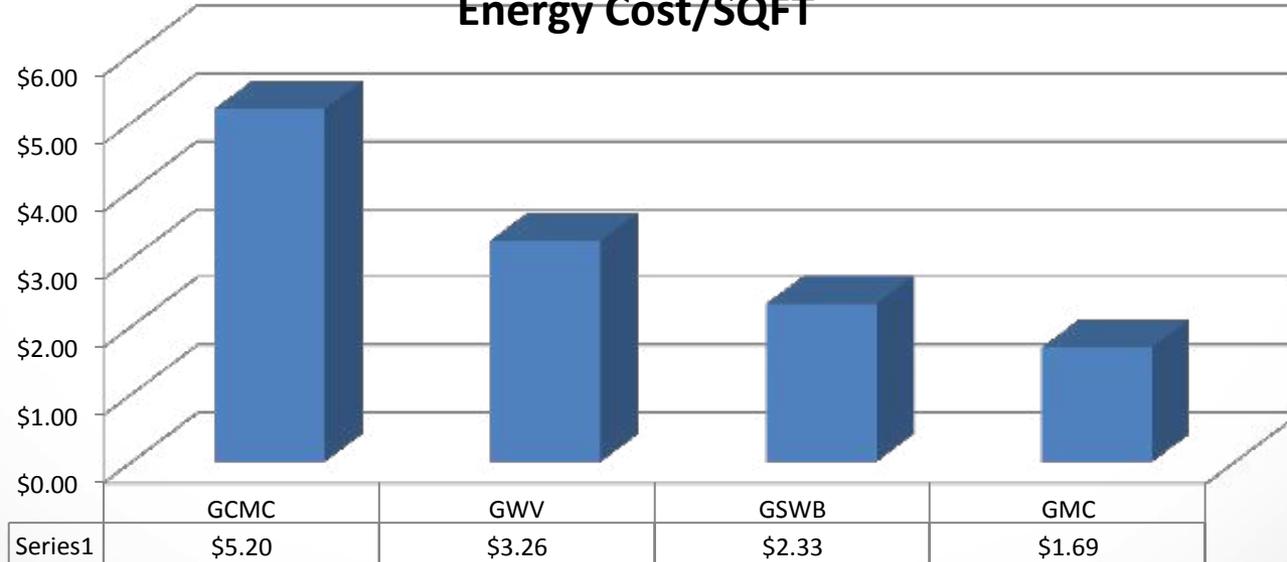
GSACH (2013), GCMC (2013), GBH (2014)

GMC, GWV, GSWB, Marworth

2013 Cost per Square Foot - Hospitals

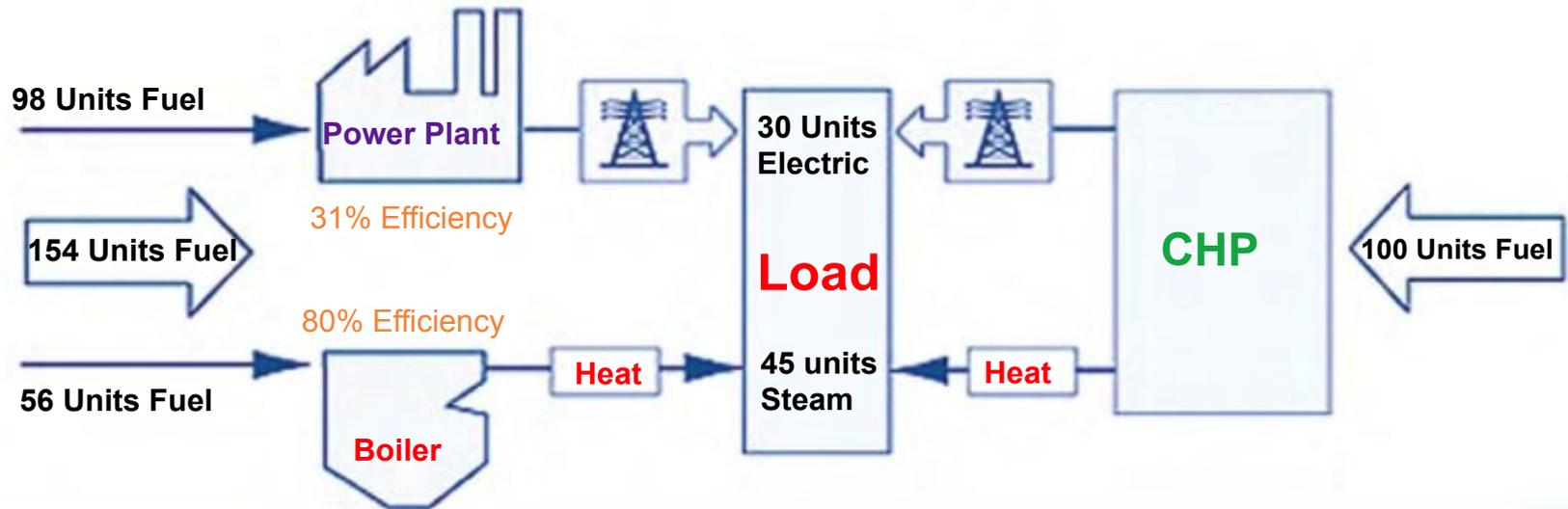


Energy Cost/SQFT



Traditional Model

Cogeneration



49% Efficiency

75% Efficiency

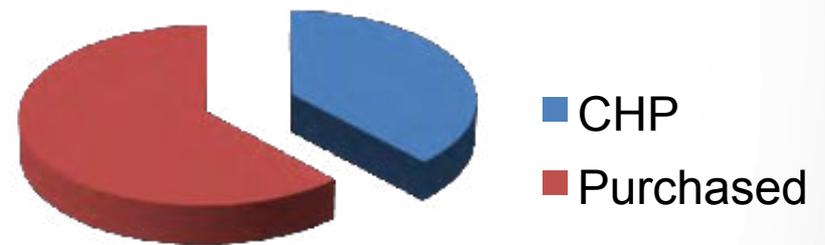
Operations

Cogeneration

Steam Production



Electricity



Operations

Operation Decisions

Based on Real Time Pricing
Switch Fuel Mix to React

Boilers

Gas vs. Electric Cost

Negative Real Time Costs

Cogeneration

Gas vs. Electric Cost



PJM PPL Zone vs NYMEX Natural Gas, Calendar 2013

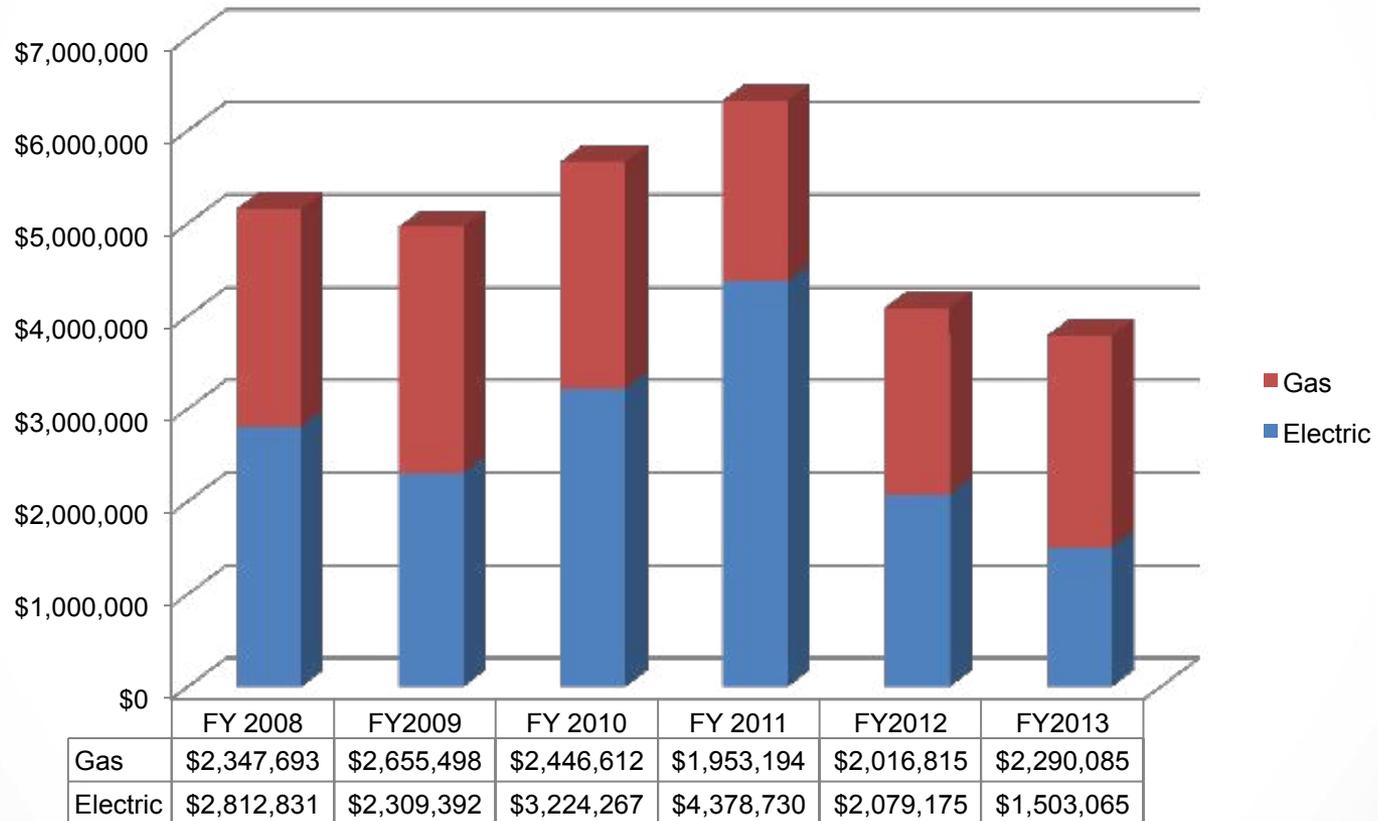


Economics

GMC Cogeneration

Cost of Cogeneration Project	\$5,300,000
DEP Green Energy Works Grant	\$2,250,000
PPL Act 129 Grant	\$500,000
Net Cost	\$2,550,000
Annual Savings	\$2,200,000
Project Payback (86.2% ROI, 84% IRR, \$9,367,822 NPV)	14 Months

GMC Utility Costs



System Quantitative Impacts

	<u>Pre</u>	<u>Post</u>	<u>Savings</u>
Electricity (kWh)	138,908,830	22,400,000	116,508,830
Cost (\$.08/kWh)	\$11,084,924	\$1,792,000	\$9,292,924
Pollutants Generated			
<i>SO₂ (Tons)</i>	539.87	87.94	451.93
<i>NO_x (Tons)</i>	114.60	18.67	95.93
<i>CO₂ (Tons)</i>	74,220.33	12,089.43	62,130.90
<i>Mercury (Tons)</i>	6.25	1.02	5.23
Heath Incidents per Million			
<i>Premature Death</i>	1.67	.27	1.4
<i>Chronic Bronchitis</i>	1.06	.17	.89
<i>Hospital Visits</i>	1.51	.25	1.26
<i>Asthma attacks</i>	34.27	5.58	28.69
<i>Respiratory Symptoms</i>	1,635.37	266.38	1,368.99
<i>Work Loss Days</i>	301.64	49.13	252.51
Societal Value	\$12,727,058	\$2,073,055	\$10,654,003
Direct Medical Costs	\$1,561,194	\$234,296	\$1,326,898

CO₂ Reduction
62,131 Tons/Year

NO_x Reduction
95.93 Tons/Year

SO₂ Reduction
451.93 Tons/Year

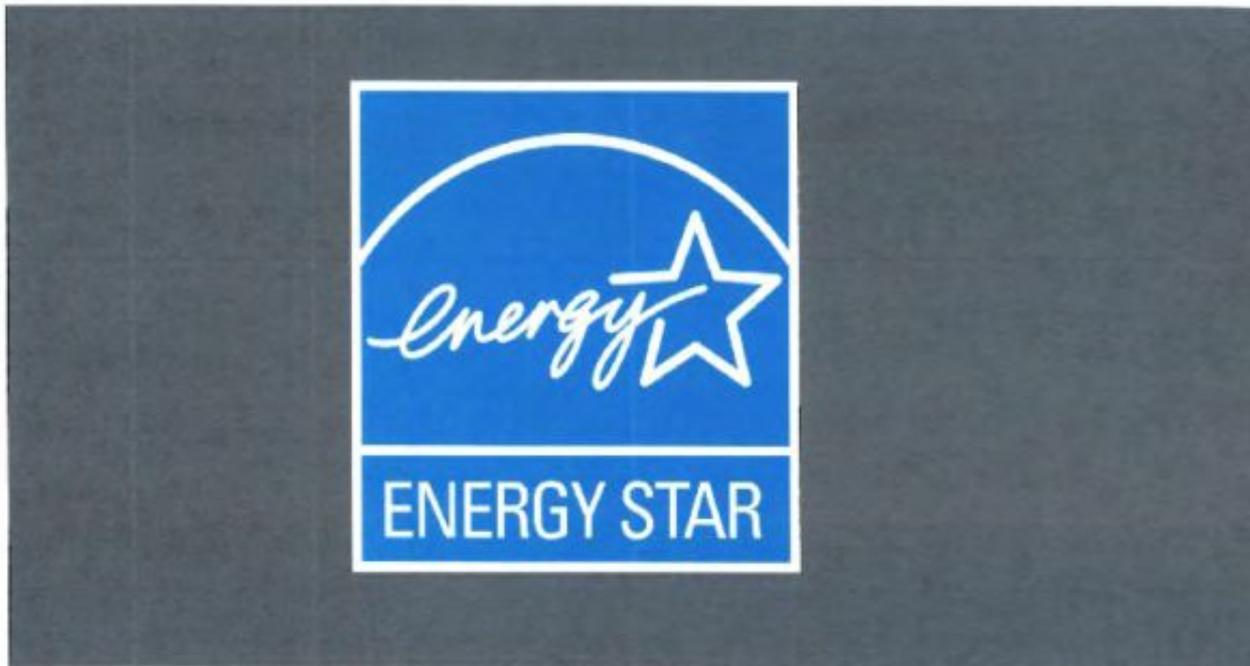
Hg Reduction
5.23 Tons/Year

System Benefits for Our Service Territory Population Impact

2.6 Million People

Premature Death	3.64
Chronic Bronchitis	2.34
Hospital Visits	9.29
Asthma Attacks	74.59
Respiratory Symptoms	3,559.37
Work Loss Days	656.53
Societal Value	\$27,700,407
Direct Medical Costs	\$3,447,608

Recognition

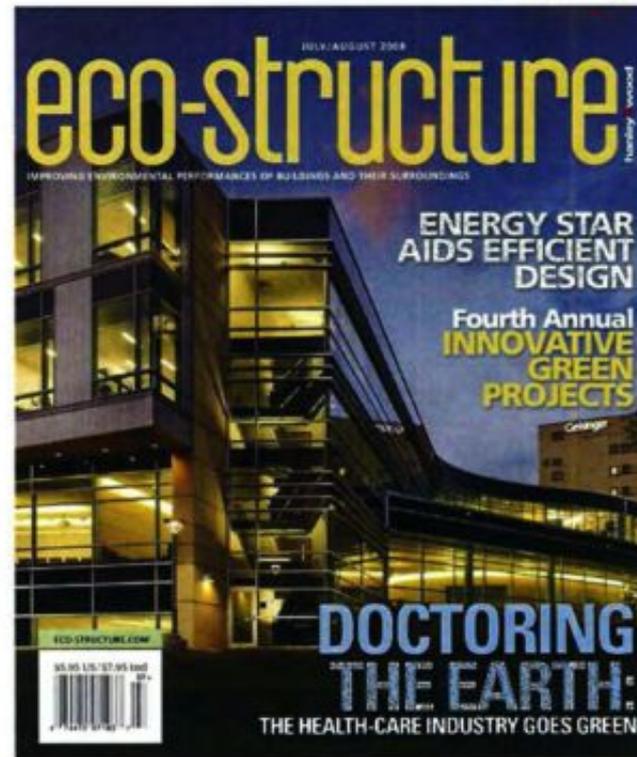
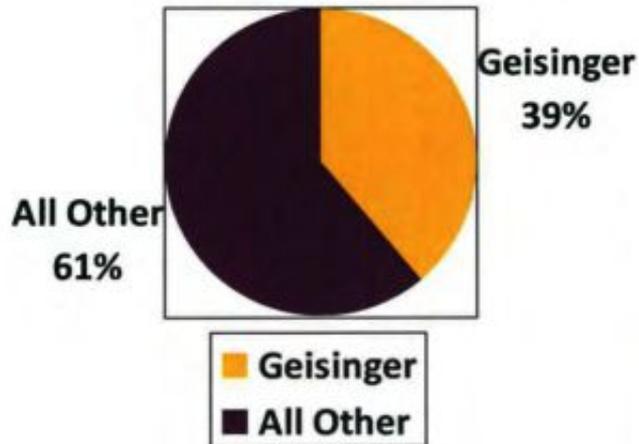


GMC Campus was awarded an Energy Star rating by EPA in August 2013, scoring 100

Geisinger Health System



Healthcare Projects
currently Registered or
Certified for LEED in
Pennsylvania



Source: www.geisinger.com Image: Geisinger Health System

How to Talk CFO –it is a foreign language

- Average age of plant and how new construction distorts reality
- Book value of facility
- Annual depreciation expense
- Building value far exceeds that of radiology, surgery, etc (generally 75% of total)
- Return on investment
- Savings: equivalent revenue
- Cost of capital
- Financing options
- Effect of facility on operations

The Bottom Line

- Choose low risk energy conservation projects first
- Always install the most efficient system available
- Accomplish some sort of energy project every year to demonstrate progress in generating additional savings
- Invest in modernizing oldest systems first

Infrastructure Funding

- At Geisinger, we have been able to leverage our utility savings to establish a Routine Infrastructure Fund.
- We started funding at \$1.25/sqft and increase the allotment \$.10 annually, till we reach \$2/sqft. This funds upgrades/replacements <\$500,000 throughout the system.
- Projects >\$500,000 are considered as Major Infrastructure, and compete for funding with other clinical requests.

Sustainable Funding

In May of 2013, a “Green Fund” was established within the Geisinger Foundation to accommodate donors wishing to endorse sustainability. The goal of the fund is to implement sustainable energy projects that may not economically survive without external support. To date, \$350,000 has been donated or pledged to the fund from employees and vendors.

The inaugural project utilizing these funds is a solar PV array on the Janet Weis Children’s Hospital, augmenting a generous grant from the West Penn Power Sustainable Energy Fund. The project demonstrates our commitment to the health of our future generation.

Appendix – Grants/Philanthropy

Grant Name	Agency	Entity	Amount
EnergyWerks Grant	PADEP	GMC	\$2,250,000
Act 129	PPL	GMC	\$500,000
Act 129	PPL	GSWB	\$116,000
RCAP	PADECD	GSACH	\$600,000
Solar Energy Grant	WPPSEF	JWCH	\$100,000
Act 129	PPL	GMC	\$360,000
Act 129	Penelec	GLH	\$70,000
Misc Act 129	Various	All	\$200,000
Geisinger Green Fund	Development	All	\$350,000
Scott Electric	Development	GBH	\$25,000
		Total	\$4,571,000

Future Endeavors

We hope to make all our sites as efficient as the main campus in Danville. The sites we acquire generally suffer antiquated infrastructure and high energy consumption (and cost).

As we grow, planning for energy efficiency is paramount. We are currently planning an expansion in Wilkes Barre that will include CHP and chilled water storage.

Continuing LEED design and construction assures energy efficiency and lower operating costs.

We will continue to publish our accomplishments, not for recognition, but to encourage these strategies for all organizations, which will ultimately benefit the populations we serve.

Working Together

The Geisinger Mission: *Enhancing quality of life through an integrated health service organization based on a balanced program of patient care, education, research and community service. (Heal, Teach, Discover, Serve)*

Assisting other organizations to implement energy reduction strategies lies within our mission.

?Questions?

Al Neuner
570 271 5515
aneuner@geisinger.edu



Transforming
Healthcare
Together™

Leading your healthcare organization toward energy efficiency: A call to action



By Alan R. Neuner, CHFM, Vice President, Facilities Operations
Geisinger Health System

EXECUTIVE SUMMARY

Energy costs are soaring exponentially (as much as 60 percent in some regions), sapping ever-valuable dollars from vital patient care activities and consuming up to 3 percent of hospital's total operating budgets and up to at least 15 percent of their annual profits. ¹ Worse, billions of dollars are wasted annually because hospitals' may not have energy-efficient building systems. Compounding matters is the fact that access to capital has become more strained and expensive throughout the recession, making it challenging for hospitals to pursue necessary upgrades. ²

There has never been a better time for healthcare executives to take a leadership role in investing in energy efficiency.

There are proven energy efficient initiatives that can positively — and relatively quickly — impact your hospital's bottom line. Up to 30 percent of a hospital's consumed energy can be saved at little or no cost, without sacrificing the quality of care through energy efficient technologies and improved management practices. ² Even in an environment of tight funding, there are many ways to finance improvements. And, investments in energy efficiency are among the soundest ones today. Most energy projects yield a one- to five-year payback, which translates to a yield of 20 to 100 percent with little or no risk.

TOP 10 BENEFITS OF ENERGY INVESTMENTS

- ▶ Net profit increases — energy savings go direct to bottom line
- ▶ Reduces operating and maintenance costs
- ▶ Low- or no-risk investments
- ▶ High ROI, fast payback
- ▶ Bottom-line savings that can finance capital needs and patient care investments
- ▶ Improves average age of plant
- ▶ Mitigates inflationary effects of volatile energy costs
- ▶ Improves environmental performance and reduces carbon footprint
- ▶ Improves facility/community health — *the right thing to do*
- ▶ Provides *excellent* public/community relations

GEISINGER'S ENERGY SUCCESS

- More than \$6.3 million annual savings
- Average ROI of 3.7 years on investments
- 80 percent annual reduction of greenhouse gas emissions (more than 42,000 tons)
- 20 percent annual water use reduction (25 million gallons)
- Doubling of campus square footage since 1988 with no increase in electrical demand

“Investing in energy efficient systems is good business. It begins with thorough research and sound business plans, with positive returns on investments, ultimately improving our bottom line and the health of our patients, employees and community.”

Kevin F. Brennan, CPS, FHFMA
Executive VP, CFO Geisinger Health System

INTRODUCTION

Acknowledging that every healthcare organization is unique and there are no “cookie cutter” solutions to long-range cost reduction plans, this white paper will discuss the non-technical aspects of initiating a successful energy reduction program, with examples of projects that can be implemented in any facility and tips for investments, using Geisinger Health System successes as examples.

THE STATE OF ENERGY WASTE

Excess energy use should be viewed as waste, the same as any other business system or process. To fully understand the imperative for taking energy initiatives now, it's important to know the extent of healthcare's energy consumption.

- ▶ **Hospitals are the second largest energy consumer in U.S.**
According to the EPA, inpatient healthcare is the second most energy intensive industry in the United States (behind just foodservice), consuming more than twice as much energy per square foot as non-healthcare facilities.
- ▶ **Hospitals' \$5 billion/year energy bill keeps rising**
According to the Department of Energy, hospital energy costs rose 56 percent from \$3.89 per square foot in 2003 to \$6.07 per square foot in 2008, and those costs will continue rising in the near term.³
- ▶ **Energy demand is soaring – unabated**
A recent American Society for Healthcare Engineering (ASHE) survey found that electricity demand in the U.S. alone will grow by at least 40 percent over the next 25 years.⁴
- ▶ **Growing negative impact on the environment, and public health**
Healthcare alone accounts for nearly a tenth of the nation's emissions of carbon dioxide. One average-sized U.S. hospital annually produces approximately 18,000 tons of carbon dioxide,⁵ which has been linked to a host of illnesses, including premature mortality, chronic bronchitis, asthma attacks and various respiratory symptoms.⁶

“Investment in energy efficiency is the only investment that simultaneously results in lowering costs (increasing profitability) and boosting your organization's sustainability by improving the environment and the health of the communities we serve. It is the perfect 'win-win.'”

Alan R. Neuner, CHFM
Associate Vice President Facilities Operations
Geisinger Health System

The cost reductions available from energy efficiency improvements increase profitability or margins more dramatically than revenue increases.

A LITANY OF BENEFITS

The list of benefits from implementing energy efficiencies in your hospital is too long for this paper. But this much is true: They are the only investment that simultaneously results in lowering costs (and thereby increasing profitability) and boosting your organization's sustainability by improving the environment and the health of the communities we serve — a perfect “win-win.”

Here's why:

- ▶ Increased profitability
- ▶ Reduced operating and maintenance costs
- ▶ Bottom-line savings enhance ability to fund patient care investments
- ▶ Low risk/high return
- ▶ Improved environmental performance and carbon footprint
- ▶ Mitigated inflationary effects of volatile energy costs
- ▶ Improved facility/patient/community health
- ▶ Improved community relations

Increased profitability

Any reduction in energy expense increases profitability as long as the cost to capture the savings doesn't exceed the savings. Every dollar the average hospital saves on energy is equivalent to producing \$25 in revenue (assuming a 5 percent profit margin and a ratio of 80/20 fixed to variable costs). Such investments have yields of 20 percent to 100 percent with little or no risk.

Moreover, the cost reductions available from energy efficiency improvements increase profitability or margins more dramatically than revenue increases. Consider that any effort to increase revenue also increases costs. You cannot add surgeries without adding to staff and facilities expenses. Most healthcare enterprises operate at a 5 percent margin (profit) or less. So, every dollar of revenue would add just 5 cents of profit. Since reducing energy expense goes directly to the bottom-line profit, the equivalent revenue to produce that profit would be 20 times the savings at a margin of 5 percent. Therefore, a project with a \$50,000 savings in an organization with a 5

percent margin would be the same as increasing revenues by \$1 million. Lower operating margins increase the multiplier effect even more.

Reduced operating and maintenance costs

It is well-documented that energy efficient buildings typically cost less to operate and maintain. And lowering your operations and maintenance costs can enhance employee productivity.

Bottom-line savings enhance ability to fund patient care investments

According to the Department of Energy, “investments in energy efficiency and renewable energy *complement*, rather than *compete* with, patient-oriented investments. As hospitals reduce energy costs (and mitigate the risks of future cost volatility), they are in a position to allocate additional resources to life-saving equipment and patient care.”

Low risk/high return

Many energy efficiency initiatives involve low risk and yield high returns. In most instances, in fact, the risk of energy projects is zero. Consider well-proven technologies such as lighting upgrades: If a lamp puts out the same amount of light, but consumes 50 percent less power, those savings are guaranteed. Most energy projects also have a payback period of one to five years and internal rates of return from 20 percent to 100 percent.

Improved environmental performance and carbon footprint

One average size U.S. hospital, each year, produces roughly 18,000 tons of carbon dioxide linked to a host of illnesses, including chronic bronchitis and asthma that, in turn, contribute to lost work days and unnecessary hospital and emergency visits. Energy efficiencies can result in lower greenhouse gas emissions and reduce your carbon footprint. Each kilowatt hour of electricity saved reduces CO₂ generated at your facility's power plant by one pound, and saves about half a gallon of water that won't be evaporated to cool the electricity production process. While these numbers may seem small, they add up quickly.

“Only companies that make sustainability a goal will achieve competitive advantage.”

Harvard Business Review

Many energy efficiency initiatives involve low risk and yield high returns. In most instances, in fact, the risk of energy projects is zero.

Mitigated impact of increases in energy costs

Institutions that exploit opportunities to reduce energy will increasingly benefit from these investments as energy prices continue to escalate. The recent global recession has depressed the energy commodity prices by 30 percent to 60 percent. If energy prices double the next five years, that effectively reduces the payback period of energy projects by half and doubles their internal rate of return.

Improved facility/patient/community health

Numerous studies have confirmed that buildings with cleaner air and “free” natural lighting directly result in better patient outcomes and more productive staff.

Improved community relations

“Green” has no downside in the media, and your hospital will reap the dividends of positive press in your community. Building upgrades will improve your facility’s appearance, present your products or services in a comfortable, well-lit environment, and boost patient and visitor satisfaction.

POSITIVE NEWS ABOUT ENERGY FINANCING

There are many options for financing energy improvements. Certainly scarce capital expenditure dollars need to be allocated wisely and the medical staff is more likely to ask for a Da Vinci robot than a cogeneration plant. But not all energy projects require capital expenditures.

Self-funding infrastructure renewal funds

A planned approach to infrastructure renewal can become self-funding through the savings you realize from energy efficiencies, and ensures reliability and reduces operational costs. The key is identifying where the opportunities are in your facility and getting a return for every dollar spent. Several methods of estimating facilities’ renewal funding exist. By using the value of the asset base, and the desired

average replacement frequency, an annual value can be determined. Geisinger Health Services leveraged the savings generated by energy reduction projects to create an infrastructure renewal fund. This allows us to continue investing savings to generate further energy savings, as well as funding routine equipment replacements.

Operating leases

Since energy projects produce a cash flow (savings) and are low risk, they can be financed via operating leases or some other financial instrument, and still produce a positive cash flow. For example, Geisinger implemented a \$1.8 million lighting upgrade project financed by an operating lease. The annual savings were \$460,000 with a lease payment of \$300,000, yielding a net positive cash flow of \$160,000. Upon fulfillment of the lease, the full savings of \$460,000 annually was realized. (For additional information on the lighting upgrade project, see Appendix B.)

Grants and rebates

These are also common as supplemental funding for energy conservation projects due to the environmental enhancements of reducing pollution. For example, in the past year, Geisinger’s facilities group has received \$156,000 from the local utility for lighting upgrades and the installation of occupancy sensors, which were fully funded by the local utility, and \$2,250,000 from the state for the installation of a combined heat and power system (cogeneration). In the lighting and cogeneration projects, this accounted for 40 percent of the total project costs, and 80 percent in the occupancy sensor project. While these projects had the ability to meet financial hurdles on their own, the infusion of outside capital increased the ROI significantly — to just two years. The anticipated savings from the cogeneration plant are anticipated to exceed \$1,400,000 annually.

Geisinger implemented a \$1.8 million lighting upgrade project financed by an operating lease. The annual savings were \$460,000 with a lease payment of \$300,000, yielding a net positive cash flow of \$160,000. Upon fulfillment of the lease, the full savings of \$460,000 annually was realized.

Start small. Choose low-risk projects such as lighting upgrades first. Get some savings under your belt to prove the concept. Early successes spawn even bigger successes later.

HOW TO EMBARK ON THE PATH TO ENERGY EFFICIENCY

Every hospital and healthcare system is different. But here are a few key ways to get started.

Engage your facilities manager

The most important step is to have a conversation about reducing energy consumption with the true experts about your infrastructure and plant: facilities management. Solicit their ideas for projects to reduce costs.

Keep an energy-efficiency mindset

This will contribute to a more comfortable environment, promoting faster healing and increased staff satisfaction. As with clinical redesign, it takes more than a memo to staff requesting a change to achieve the change. You must plan for and measure the change you desire.

Create an energy management program

Develop an infrastructure master plan. Challenge your staff to reduce consumption by a certain percentage. Plan at least one energy project every year to demonstrate progress. Establish annual funding for improvements and reinvest savings to accomplish more projects.

Gather data and manage information

Decide what data is critical to understanding your facility's infrastructure (age of plant, etc.) and your energy consumption statistics. The effective collection and analysis of data is the key to finding and realizing these savings. And you must continually measure and monitor

your success. This information will help you and your team identify savings opportunities; provide indicators to perform predictive maintenance and reduce equipment downtime; and direct reduced utility costs to mission-critical needs.

Start small

Choose low-risk projects such as lighting upgrades first. Get some savings under your belt to prove the concept. Early successes spawn even bigger successes later.

CONCLUSION

A 2009 article in the *Harvard Business Review*⁷ notes that “only companies that make sustainability a goal will achieve competitive advantage.” Indeed, this is healthcare's calling as it enters a new decade, emerging from one of the worst economic periods in our nation's history. “Investing in energy efficient systems is good business,” according to Kevin F. Brennan, CPA, FHFMA, Geisinger executive vice president and chief financial officer. “It begins with thorough research and sound business plans, with positive returns on investments, ultimately improving our bottom line and the health of our patients, employees and community.”

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FOOTNOTES

- 1 US DOE report; “EnergySmart Hospitals: Creating Energy Efficient, High Performance Hospitals”
- 2 Betterbricks report, “Healthcare: A business and ethical case for sustainability;” http://www.betterbricks.com/sites/default/files/teasers/bb_article_ethicalandbusinesscase.pdf
- 3 U.S. Department of Energy; “Energy Efficiency and Your Hospital's Bottom Line;” http://www1.eere.energy.gov/buildings/energysmarthospitals/bottom_line.html
- 4 “The energy picture: Where Are We Now? Where Are We Headed?;” Inside ASHE; March-April 2008
- 5 Targeting 100 Research Study; May 2010; http://integrateddesignlab.com/Seattle/Resources/HD_Research.html
- 6 U.S. Department of Energy; Commercial Building Energy Alliances; http://www1.eere.energy.gov/buildings/alliances/hospital_energy_alliance.html
- 7 “Why Sustainability is now the Key Driver of Innovation;” Harvard Business Review; September 2009; <http://hbr.org/2009/09/why-sustainability-is-now-the-key-driver-of-innovation/ar/1>

APPENDIX A

The Geisinger story: A path toward energy efficiency

Geisinger Health System, based in Danville, PA, has been recognized nationally and internationally for innovations in healthcare delivery and population health management. Geisinger has been applying this same innovation to non-clinical processes, including energy and facilities management. Their path toward energy efficiency began in the late 1980s to improve their environmental stewardship and “do no harm” as part of their mission to enhance the quality of life. Geisinger has never looked back since that time, and today is fully committed to the green building movement, recognizing that energy efficiency and environmental stewardship should form the basis of design, rather than be an afterthought. Geisinger also recognizes there are even great returns on these investments as most energy projects, with little or no risk, yield a one-to five-year payback that translates to a yield of 20 to 100 percent.

MORE THAN \$6 MILLION IN ANNUAL SAVINGS

Of the \$20 million Geisinger has invested in infrastructure during the past nine years, \$8 million was invested in energy conserving equipment. To date, its energy management program has resulted in:

- ▶ More than \$6 million of annual savings from energy efficiency;
- ▶ An ROI on energy investments averaging 3.7 years;
- ▶ An 80 percent reduction of greenhouse gas emissions (more than 42,000 tons);
- ▶ Doubling of campus size (from 1.2 to 2.5 million square feet) and no increase in utility expense and electrical demand since 1988; and
- ▶ A 20 percent annual reduction of water usage (25 million gallons).

LEED PROJECTS TO NET BIG SAVINGS

Geisinger is a pioneer of LEED (Leadership in Energy and Environmental Design) certified initiatives in Pennsylvania.

- ▶ Using green technology and construction materials at LEED Gold-certified Geisinger-Gray’s Woods, a multi-specialty clinic in State College, PA, added no more than 1-2 percent to costs, and Geisinger will recapture those costs in energy savings.
- ▶ Energy costs at Geisinger’s LEED Silver-certified Hood Center for Health Research in Danville, PA, average 75 cents per square foot, well below the national average. In fact, the center uses 13 percent less energy than originally anticipated.

APPENDIX B

GEISINGER ENERGY PROGRAM CASE STUDIES

Project: Lighting (upgraded 24,000 fixtures)

Cost: \$1.8 million (operating lease – seven years, \$300,000/year)

Annual savings: \$460,000

While no two facilities are alike in terms of energy reduction opportunities, there are common areas that bear low hanging fruit, the first of which is lighting. Lighting generally accounts for nearly 40 percent of a hospital’s electric bill. Depending on the technology installed, savings approaching 50 percent are possible. These savings are achieved by adding reflectors to existing fixtures, changing lamps and ballasts, installing occupancy sensors or adding controls. While these changes can be made on a maintenance basis over time, it is recommended to implement them *en masse* to quickly achieve the savings and ensure all spaces are upgraded.

This type of project is based on proven technology, generally has a payback period of two to three years and has high potential for utility rebates or grant money to further reduce the cost. In addition to this project, our facilities group received \$156,000 from the local utility for lighting upgrades and the installation of occupancy sensors. The utility reimbursed approximately 40 percent for the lighting upgrades and 100 percent of the cost to purchase the occupancy sensors.

Project: Energy distribution upgrades

Cost: \$500,000 project cost

Annual electrical savings: \$100,000

Energy distribution systems transport the converted energy to its final point of use. They can be comprised of pumps in the case of water or fans for air. Older buildings used constant volume systems, which are extremely wasteful. A good analogy would be fixed staffing versus flex staffing based on census. The flex model for energy distribution would be variable flow systems.

This is accomplished by adding an almost magical device called a variable frequency drive that varies the speed of the device (pump or fan) to match the required load. The result is that the power saved (electricity) is the cube of the amount of flow.

For instance, if a system only required half the flow, it would only consume 12.5 percent of the energy of a constant volume system. While it’s not quite as simple

as wiring in these devices, the mechanical modifications required are generally not difficult to achieve. Virtually all systems have been converted to variable flow, saving approximately \$100,000 annually.

Project: Energy conversion systems

Cost: \$2,000,000

Annual savings: \$600,000

Energy conversion systems are major consumptive systems that may provide significant opportunities. In layman's terms, these are the systems that provide cooling (converting electricity to chilled water or air), heating (converting natural gas to steam or heat), medical air, vacuum, etc.

Since these systems have high operating hours and are large consumers of energy, even small improvements in efficiency can produce substantial savings. As a general rule, if the energy conversion equipment is approaching 20 years old, there's a high probability that a project with a positive ROI can be implemented to meet your organization's financial hurdles. An example of a successful energy conversion project at Geisinger is the replacement of boiler burners and controls, saving \$400,000 annually with a one year ROI.

Project: Chiller consolidation

Cost: \$1,500,000

Savings: \$300,000

Chilled water storage reduces electrical demand and mitigates investment in chiller capacity. When Geisinger was building the 70,000-square-foot Hood Center for Health Research, the original design called for chillers to be installed only in that building, which was physically connected to the Weis Center for Research, a structure with more than 20-year old chillers.

The Facilities staff convinced the organization to fund an additional \$1.5 million (from the department's infrastructure capital fund) to create a new chiller plant

in the basement of the new building to replace the existing plant in the Weis Center. The net result is that the electrical savings of the new chiller plant were greater than the energy consumption of the new building, thereby lowering the net electrical consumption of the entire campus.

Project: Remote chiller plant

Cost: \$7,000,000

Savings: \$500,000 annually

During the planning of Geisinger's latest patient tower, the \$100 million, 334,000-square-foot Hospital for Advanced Medicine, facilities staff convinced the organization to add a fourth unplanned chiller to a new remote central chilled water plant adjacent to a building whose existing chiller served the majority of the campus.

The plant was originally designed to comprise three 900-ton chillers, and a fourth was to be added to replace the older chiller. Geisinger sold the relocation of the plant on several points:

- ▶ Building a new plant would free up valuable space in the existing building, requiring less space to be built in the addition (value: \$3 million).
- ▶ By relocating the plant, Geisinger could add a chilled water storage tank, thereby eliminating the need to add additional chillers, cooling towers, pumps, etc., as well as reducing the size of the emergency generator (value: \$2 million).
- ▶ By being able to make cooling at night, Geisinger reduced the operating costs due to lower off-peak electrical rates, as well as improved efficiencies due to lower approach temperatures.

Geisinger was also able to use the new chilled water storage tank as a demand response tool, providing revenue from our electrical suppliers (value: \$75,000 annually). Bottom line: Geisinger added 334,000 square feet of structure to the campus without adding any additional cooling capacity or increasing electrical demand.

Project: Central plant in lieu of unitary systems

Cost: \$1,500,000

Savings: Preserved LEED rating and reduced operational expenses by \$20,000 annually

In the planning of our Gray's Woods facility in State College, PA (the first of three phases), budgetary concerns prompted unitary systems in lieu of efficient central plant equipment. Unitary systems combine heating, cooling and fan sections all in one or a few assemblies for simplified application and installation. Geisinger made the case that utilization of the unitary equipment could jeopardize the building's LEED rating, and that spending the additional capital up-front would result in reduced expenditures on subsequent phases, as well as provide operational savings.

After further review, executive leadership funded the additional capital to include the central plant based on the facilities staff's recommendations. The building was awarded LEED Gold certification, and is now planning phase two construction at lower cost since the central plant equipment is already installed (value: \$500,000).

Project: 69,000-volt substation

Cost: \$560,000 project cost

Annual rate savings: \$250,000

This was Geisinger's very first energy cost reduction project. By increasing the service voltage of the campus from 12,500 to 69,000 volts, Geisinger was able to get a rate reduction from the utility of approximately 10 percent. This required the construction of a substation, the installation of a transformer and some electrical cabling.

Project: Waterside economizers

Cost: \$150,000

Annual savings: \$50,000/year

In all Geisinger's chilled water plants, they have installed heat exchangers between the condenser and chilled water circuits. In winter months, this allows Geisinger to provide cooling to the hospital without running mechanical cooling (chillers), saving 1,400 chiller run hours per year per installation.

Project: Medical air upgrade

Cost: \$100,000 investment

Annual savings: \$20,000

As the hospital grew over 85 years, medical air compressors were added with each patient pavilion, taking the total to 20. This project consolidated all the loads onto two variable speed efficient compressors. These compressors also use a waste heat air dryer that uses the waste heat from the compressor to remove the moisture from the dryers with no air loss (typically 10 percent).



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Geisinger Health System power plant saves \$2.2 million a year

Combined heat and power facility latest in system's energy conservation efforts

Among U.S. healthcare organizations that have successfully implemented energy conservation measures saving millions of dollars while improving community health, Geisinger Health System has few peers.

Since embarking on such programs nearly two decades ago, the Danville, PA-based system has notched close to \$100 million in savings from programs as simple as energy-saving lighting to as complex as an innovative power plant that produces its own electricity, heating and cooling.

In August 2013, Geisinger joined an elite group of hospitals that have earned a perfect score in its Energy Star certification from the U.S. Environmental Protection Agency (less than 4 percent of all hospitals have achieved such recognition).

Geisinger is a six-hospital system with more than 60 care sites across central and northeastern Pennsylvania. Its 20,000 employees serve a population of nearly 3 million people in the state.

According to Betterbricks.com, the commercial building initiative of the Northwest Energy Efficiency Alliance, up to 30 percent of any hospital's consumed energy can be saved at little or no cost, without sacrificing the quality of care through energy efficient technologies and improved management practices.

To Vice President of Facility Operations Al Neuner, a mechanical engineer who came to Geisinger more than two decades ago after work in the American steel and gas industries, there are profound yet remarkably simple

ways for hospitals to conserve energy and dramatically cut costs today.

GEISINGER

As Neuner has discovered, most conservation projects have relatively low risk yet high return (ROIs of fewer than five years are common) and are almost always profitable. Geisinger's return on investment in energy conservation projects has averaged 3.7 years, far lower than the national average among hospitals. And today, as healthcare organizations struggle to squeeze costs and tap new sources of revenue, such projects are literally win-win.

\$9 million/year in energy savings

As detailed in a recent [white paper](#) Neuner wrote for Premier, Geisinger has implemented a series of energy conservation efforts for the past 15 years resulting in dramatic reductions in energy use and greenhouse gas emissions. To date, those efforts have allowed the system to save more than \$9 million a year in lower electric, gas and water bills, as well as avoided costs in expensive maintenance and upgrades of aging technologies and plants.

Energy costs continue taking a bigger and bigger bite out of hospitals' operating budgets, and nearly double-digit rate hikes are becoming commonplace across the country. While most U.S. hospitals are among the highest energy consumers, Geisinger is one of the most efficient healthcare organizations in the country.

Thanks in large part to an innovative co-generation plant on Geisinger's main campus installed in 2011 (see page 2),

SUCCESS SNAPSHOT

- More than \$9 million annual savings from energy conservation programs, bolstered significantly by an innovative co-generation plant on Geisinger's Danville campus.
- Energy cost per square foot is now \$1.69 – roughly a third of national average.
- Co-generation power plant (which accounts for more than 33% of the system's overall reduction in energy cost per square foot).
- An average ROI of 3.7 years on energy conservation investments.
- 80 percent annual reduction of greenhouse gas emissions (more than 62,000 tons).
- 20 percent annual water use reduction (25 million gallons).
- Doubling of Danville campus square footage since 1988 with no increase in electrical demand.
- Received a rare perfect score in Energy Star certification effort in mid-2013.
- Has completed 10 new LEED-certified buildings comprising nearly 1 million square feet since 2008, representing 40 percent of all registered/certified LEED projects in the state of Pennsylvania

Geisinger’s energy costs per square foot are \$1.69 – roughly a third of the national average among hospitals. Geisinger also has successfully cut its energy purchases even while more than doubling its building space since 1988.

Energy-efficient LEED certified ‘green’ buildings

Geisinger also has been a national leader in green construction, completing 10 new LEED-certified hospitals, clinics and office buildings comprising nearly 1 million square feet since 2008.

All told, those structures represent nearly half of all registered/certified LEED projects in the state of Pennsylvania. All of the structures

feature high-efficiency heating and cooling systems and renewable resources such as natural daylight.

Greenhouse gas reduction to improve health

Aside from costs, Geisinger’s energy conservation efforts are in synch with the system’s mission to improve public health, Neuner said. Lower energy consumption reduces pollution and emissions from power plants. The EPA’s Energy Star program recognizes the top 25% of business whose energy efficiencies help reduce greenhouse gas emissions.” It’s obviously something we’re very proud of, but to me, I know of more opportunities,” said Neuner. “We have plans in place to be better.” Unlike

many U.S. hospitals, the system has significantly reduced harmful emissions of greenhouse gases as a result of its energy efficient conservation efforts – up to an 80 percent annual reduction of greenhouse gas emissions of carbon dioxide, nitrogen oxide, sulphur dioxide and mercury (more than 62,000 tons). Neuner arrived at these figures using [Practice Greenhealth’s energy impact calculator](#).

For in-depth information on Geisinger’s energy conservation projects, including lighting upgrades, energy distribution system improvements, and chiller plant upgrades and consolidations, see Neuner’s white paper on [GreenCorner](#) and the Geisinger [website](#).

Case study

Co-generation program a cornerstone of energy conservation initiatives

Co-generation (also called “co-gen”) is a process that simultaneously produces heat and electricity. It’s also commonly referred to as combined heat and power (CHP). After years of research and closely monitoring how successful plants functioned, Geisinger Health System in 2011 constructed and commissioned its own co-gen power plant on its main campus in Danville.

Today, the Geisinger co-gen plant uses a high-efficiency natural gas-powered turbine to generate about 40 percent of the Danville campus’ electricity and heating needs, and unlike major utility companies, captures virtually all waste heat (from the exhaust) and uses the captured energy to power boilers and steam-driven chiller turbines.



Geisinger co-gen plant

According to Neuner, the co-gen plant is responsible for nearly one-third of the \$9 million in savings Geisinger

Health System achieves each year as a result of its energy conservation programs.

The main “engine” of the co-gen plant is essentially a 5 megawatt jet engine powered by natural gas. As it is combusted inside the turbine, a shaft connected to a generator turns, producing electricity.

Geisinger’s central plant also includes:

- An 800 horsepower heat recovery boiler with economizer;
- Two, 1,000 horsepower water tube boilers;
- A 300 horsepower floating head boiler;
- A 6 megawatt high voltage electric boiler;
- Four 900-ton electric chillers;
- A thermal storage tank; and
- A 1,500-ton steam turbine-powered chiller.

The back story on co-gen

Geisinger actually began eying supplementary energy sources back in 1999 following deregulation of Pennsylvania’s utility companies. At the time, the state placed protective caps on electric rates while allowing utilities to depreciate their generating assets at a faster rate. But the rate caps were set to expire in 10 years. “Under rate caps, we in essence had artificially low electric rates,” Neuner said.

“We were protected from the market rates but we knew that would change by 2009.”

Geisinger visited and revisited co-generation nearly a dozen times over that 10-year period as one means to help soften the blow from impending rate hikes. It was only after it did a feasibility study that they knew the math was in their favor. The study showed that the plant would cost \$5.3 million to build and have an ROI of about \$1.4 million per year from energy savings. Those numbers were based on the assumption that the plant would be operated in “economic dispatch mode,” a method in which the plant would run or not run based on current market-based electric rates.

Neuner said he presented the plan to a receptive Geisinger senior leadership team. “They were excited about the project because it was a three-year return on investment,” he said. Coincidentally, federal and state energy conservation grants were plentiful at the time and Neuner was able to secure a \$2.25 million American Resource and Recovery Act (ARRA) grant, which covered about 40% of the total project cost.

In March 2011, Geisinger broke ground on the 2,000-square-foot co-gen plant on the Danville campus. By November, the plant was fully operational. From initial research to project completion, Neuner did face some challenges, all of which he was able to overcome. One was the state EPA, which challenged Geisinger to add gas cleaning equipment Neuner was able to demonstrate as unnecessary. Another challenge was the sheer novelty of co-gen.

“We had never seen a gas turbine and none of the area contractors who got bids had ever installed a gas turbine”

“We had never seen a gas turbine and none of the area contractors who got bids had ever installed a gas turbine,” he said. “So we had to teach ourselves as we went along. My team basically taught themselves this technology from the ground up.” Neuner also attended a turbine school for several days in Connecticut during his free time. The manufacturer periodically dispatched its own engineers to check on Geisinger’s progress and offer installation troubleshooting.

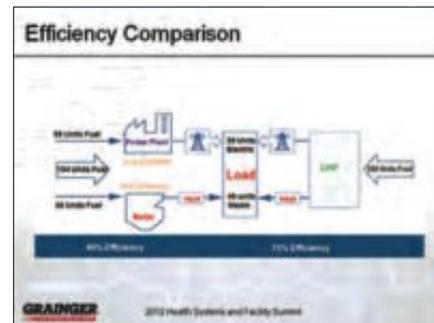
Another challenge was missed opportunities. “After I went to turbine school I learned about duct burners, which I hate to admit I knew nothing,” Neuner said. Duct burners are placed at the boiler inlet to raise the air temperature, improving efficiency. Neuner said he is considering installing duct burners at some point.

How Geisinger has benefitted from co-gen

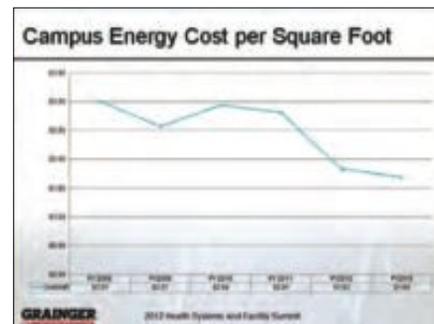
Lower energy costs, fast ROI

According to Neuner, co-generation plants are ideal for hospitals because of their 24-hour-a-day operation and high heat demands for sterilization and humidification in the off-season. Co-gen also significantly helps hospitals contribute less air pollutants. And because they can be powered by natural gas, the cost to operate them is significantly lower than electricity because of the now-plentiful supply of natural gas in most parts of the country.

Geisinger’s electricity costs have dropped from approximately \$4.4 million in 2011 to about \$1.5 million today. Its natural gas costs are higher today than they were in 2011, but natural gas today is significantly cheaper than electricity. Before the shale gas drilling boom, both kinds of power paralleled each other in terms of costs.



In 2008, Geisinger’s energy costs per square foot were \$3.01 – still lower than the national average at the time. Today, its energy cost per square foot has dropped to around \$1.69.



Unlike the scenario laid out on the earlier feasibility study, Geisinger decided to run the co-gen plant as a base load unit (or constantly at near capacity levels) instead of economic dispatch mode,

which resulted in more than \$800,000 a year in additional savings. All told, the co-gen plant saves Geisinger \$2.2 million a year. After deducting the \$2.25 million ARRA grant and a \$500,000 Act 129 Utility Grant, the ROI on the plant is just 14 months.

The how and why behind co-gen’s energy efficiency

In a nutshell, the natural-gas powered co-gen plant is at least a 50 percent more efficient process than the energy provided by coal-powered utility plants, which typically run at 30 percent efficiency. The biggest reason for that is the way

heat energy is recovered by co-gen yet wasted under traditional methods, Neuner said.

Neuner explains the comparison using hypothetical numbers. A traditional power plant and boiler consume 154 units of fuel (coal), while a co-gen plant consumes 100 units of fuel (natural gas) to each produce 30 units of electricity and 45 units of steam.

Presently, Geisinger's co-gen plant provides about 40 percent of the entire electricity needs of the 2.7 million-square-foot Danville campus; the rest is purchased from the local utility. Meanwhile, the co-gen plant now provides about 80 percent of the campuses' steam needs; the rest is provided using natural gas fired boilers.

The main reason for the higher efficiency is the way the system has been engineered to recover and harness waste heat. A heat recovery boiler attached to the main combustion turbine takes in 960-degree exhaust, cools it to 400 degrees, and then produces steam, which is used to heat water and power other devices.

During warm months, a steam-powered turbine chiller, essentially an air conditioner, uses excess waste heat produced by the cogeneration system to provide 1,500 tons of free cooling for the campus. The process reduces

Danville's peak summer electrical load by a full megawatt, saving \$300,000 annually.

"We learned after our first summer of operation that we had excess heat capacity off the turbine. So we took advantage of that," Neuner said. "We needed to increase our chiller capacity anyway." Neuner sourced a brand new chiller from a Connecticut pharmaceutical plant whose construction had been cancelled.

Chilled water storage saves energy

Neuner also implemented another innovative technique called chilled water storage, a process in which water is cooled to 42 degrees and stored in a 1 million gallon insulated thermal tank at night, when electricity rates are off-peak and about 33 percent lower, and the chillers are much more efficient because of cooler nighttime ambient air. The process is used to provide air conditioning to the Danville campuses' Hospital for Advanced Medicine, which added 344,000 square feet to the campus but had no on-site chillers. This allows Neuner to take two chillers off line during the day, saving about 1.5 megawatts of electricity from the campuses' overall electric load.

The process is called peak-load shaving, which, when combining shifting power loads to off-peak hours with thermal storage saves Geisinger an additional \$450,000 a year.

Becoming a smart energy buyer

Geisinger Health System has about 400 electric accounts and 30 natural gas transportation accounts with local energy companies. But Neuner has negotiated a single rate across all of the accounts. And Geisinger buys energy on the open market, using hedges to limit market exposure.

Shifting power loads to access lower rates during off-peak hours is just one way the system efficiently manages and lowers its energy costs, and cogeneration has greatly facilitated that.

While the co-gen plant only serves the system's Danville campus, its benefits extend far beyond.

"The co-gen does serve our other hospitals in a powerful way," Neuner said. "We buy as one customer. What happens is we make a better load profile [otherwise known as peak load contribution] here in Danville since Danville is a sizable consumer compared to the others. We're able to shape the power curve of the whole group."

For example, the co-gen plan is able to lower daily electricity demand by as much as 4 megawatts. When adding the 1.5 megawatts saved with the chilled water storage, the savings become dramatic. The result may only drop Geisinger's rate by 3/10 of a cent, but when you consider the 150 million kilowatt hours the entire system uses in a given

year the savings can be as much as \$450,000 a year, he said.

Of course, Geisinger's co-gen experiment would not have been as successful as it is without Marcellus shale, the natural gas-rich underground field through most of eastern North America. Drilling for shale in many areas in recent years, including Pennsylvania, has resulted in plentiful, cheap fuel. It wasn't that long ago when gas and electric costs virtually paralleled each other.

"Historically, gas and electric prices have moved together," Neuner said. "Electricity today is going to rise higher and quicker than gas because it's a

fixed commodity. We're closing coal plants, not building new ones, so there's much more constrained supply. So I think we'll see that historical relationship widen, which in essence, should increase the savings of co-gen, because it's gas powered. The other thing that's happened is partly pure luck. We used to pay about \$1.35 per 1 million BTU in transportation surcharges to move that gas up from the Gulf of Mexico.

Now, that gas is coming from upstate Pennsylvania, probably from within 50 miles of here. So our transportation costs have gone from \$1.35 to negative 7 cents."

Future co-gen expansion at Geisinger

With almost two years of full capacity operation now under its belt, the co-gen plant and its success is getting the attention of engineers and hospital executives across the Geisinger system. "I've had folks in other parts of the system, including Wilkes-Barre, come up to me and ask, 'Where's our co-gen?'" Neuner said. "Obviously, we're looking at where the economies of scale would make such investment feasible. In order for co-gen to be worth investment, you need a higher energy load profile.

It makes the economics work better because it reduces the capital investment." Neuner said Wilkes-Barre, now planning an expansion project, will likely be the next location for a co-gen operation in the next three to four years.

Geisinger's advice to peers about energy and going green

It helps that the chief architect behind Geisinger's energy conservation efforts is a seasoned and well-heeled mechanical engineer. It also helps that the system's decision to implement co-generation was greatly aided by a serendipitous change in energy policy that led to domestic drilling and cheap and plentiful gas to power the system.

But Neuner's best advice is to other healthcare organizations:

>> Benchmark your efforts against the best practices of leaders, and do your homework. "Double-check your numbers before taking the plunge with co-gen," he said. "The bottom line is size the equipment based on your heat load, because if you're not using all the heat, you're essentially operating like the utility company at 31 percent efficiency. You're dumping all that heat. You're not doing any better than you would buying energy off the street. If there's a perfect candidate for co-gen, it's hospitals. The beauty of hospitals is they're always requiring heat load. Always making hot water for sterilization and humidification. All of these heat loads really help drive the economics."

>> Also, consider establishing a separate account funded by community donors who support sustainability. Geisinger recently established its own "Green Fund" under the Geisinger Foundation. The fund has accumulated \$245,000 to date.

>> Focus on long-term savings, not initial cost. As Neuner states in his recent [white paper](#), up to 30 percent of a hospital's consumed energy can be saved at little or no cost, without sacrificing the quality of care through energy efficient technologies and improved management practices.

Investments in energy efficiency are among the soundest ones today. Most energy projects yield a one- to five-year payback, which translates to a yield of 20 to 100 percent with little or no risk. "When you build a building, most people generally focus just on first cost," Neuner said. "They say 'We can't afford that more efficient chiller because it costs an extra \$100,000. In many cases, this view is the tail wagging the dog. Construction costs are between 11 and 15 percent of the 40-year cost of owning that building. The much *larger* expense is the operating and maintenance expenses over those 40 years. By having more energy efficient technology to begin with, you're lowering your operating expense significantly.

Here's a classic example: When we built the [LEED Silver-certified] Hood Center on campus in 2007, we went through this same argument. They wanted to put rooftop units on instead of using chilled water systems. I was finally able to prevail and actually replace a chiller plant that was in an adjacent building and put a new one in a new building and then back-feed the old building.

Our electric costs decreased \$14,000 by opening that building and the reason was the new chiller plant saved more energy than the 70,000 square foot building consumed. This is quite a statement when you can add that large a building and actually drop your campus utility bills. "Even a five-year ROI is a 20 percent return per year," Neuner added. "And we did this in 14 months on the co-gen plant." "Would you invest your money at 20 percent, particularly when healthcare on average makes 2.5 percent? I can't fathom why more healthcare organizations don't invest in this technology.