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Executive Summary

Hospitals and care systems increasingly are looking for ways to improve efficiency and reduce overall costs while also improving the overall patient experience. Sustainability initiatives offer significant environmental and financial benefits for organizations—benefits that will help hospitals and care systems thrive now and in the future.

Sustainability can be defined as the ability of a system to continue doing what it is doing over time. In recent years, society has increased its focus on being “green” and becoming more environmentally friendly. To be truly sustainable, however, initiatives must stand the test of time by being fiscally sound while also helping the community and the environment.

Hospitals and care systems that pursue sustainability initiatives find benefits in multiple areas. Their efforts contribute to a healthier environment, improve the organization’s public perception and can help their local communities. Environmental sustainability is also good business, as it helps lower operational costs and allows hospitals to direct more resources to patient care.

Hospitals and care systems pursue sustainability efforts for a wide range of reasons and in a variety of ways, with leaders seeking solutions that work best for their organizations. Those who commit to sustainability reap the rewards, as illustrated by examples in this guide.

- Memorial Hermann Health System saved \$47 million over five years by implementing energy efficiencies
- The University of Arkansas for Medical Sciences saved enough through efficiency efforts from one project that it was able to create 60 new beds, remodel five operating suites, build out a floor of a cancer institute, and buy seven acres of land.
- Kaiser Permanente saved \$4 million a year by purchasing energy-efficient, environmentally responsible computers.

Hospital leaders should ask their management teams to assess the organization’s current approach to environmental sustainability and create an action plan for finding greater efficiencies. This *Hospitals in Pursuit of Excellence* guide can help leaders explore options and understand the steps needed to harness the strategic power of sustainability.

This guide details the path that executives can take to set the course for their organizations:

1. Make the commitment.
2. Create a culture for supporting environmental sustainability.
3. Support and finance environmental sustainability.
4. Set goals and measure, report and evaluate change.
5. Celebrate and share successes.
6. Continue to assess and identify new opportunities.

These universal steps outline the process of creating successful long-term sustainability within an organization, but each hospital and care system must determine the best course of action based on its own goals. An approach that works for one hospital may not be an option for another. Hospital and care system leaders can consider the questions included in this guide to help determine their organization’s most appropriate path toward sustainability.

This guide includes information on a variety of sustainability opportunities:

- Energy
- Water
- Supply chain
- Waste
- Commissioning and retrocommissioning

Focusing on one area or even one project can lead to substantial savings. But by combining multiple projects and taking advantage of the wide range of sustainability opportunities, hospitals and care systems can gain even more benefits.

This guide provides case studies and examples from hospitals and care systems around the country that are benefiting from sustainability efforts. Hospitals are saving significant resources every year—resources that can be used to support the mission of patient care. The examples featured in this guide are just a small fraction of the case studies available through resources like the Sustainability Roadmap for Hospitals website (www.sustainabilityroadmap.org). Additional resources found in this guide include a sample hospital sustainability statement, information on benchmarking tools and a sample energy efficiency project.

Hospital and care system leaders can use this guide as they move toward environmental sustainability. Executives can discuss the information and resources with their management teams to find an appropriate path toward sustainability that will lead to many benefits, including greater efficiencies that contribute to the mission of patient care.

Introduction

Hospitals and care systems increasingly are looking for ways to improve efficiency and reduce overall costs while also improving the overall patient experience. One often overlooked opportunity is environmental sustainability. Making an active commitment to sustainability and aggressively pursuing goals provides multiple strategic benefits that can help hospitals and care systems thrive.

Sustainability is a broad topic, but a simple definition is the ability of a system to continue doing what it's doing over time. A growing number of scientists are focusing on sustainability and global trends to make the case that business as usual is unsustainable for our planet. Many organizations and campaigns are focused on "green" initiatives and ways to become more environmental friendly. But to be continued over time—to be truly sustainable—initiatives must be fiscally sound while also helping the community and the environment.

Hospitals and care systems that accomplish truly sustainable initiatives reap benefits in multiple areas. Their efforts contribute to a healthier environment, improve the organization's public perception and can help their local communities. Environmental sustainability is also good business, as it helps lower operational costs and allows hospitals to direct more resources to patient care. These benefits can help hospitals meet the Triple Aim—improving population health, improving the patient experience and reducing per capita cost.¹

Sustainability can improve population health by contributing to healthier communities, reducing pollution and reducing the use of community resources such as water and energy. Sustainability can contribute to a better patient experience by improving a hospital's environment and public perception and by promoting loyalty among patients concerned about the environment. Finally, sustainability can reduce the per capita cost of health care by reducing health care expenses; for example, spending less money on utilities enhances hospitals' ability to free up resources for patient care.

The benefits of sustainability are more important than ever before. Hospitals and care systems are facing incredible financial and regulatory pressures to make changes as the health care environment shifts from a volume-based market to a value-based market. In a 2011 report "Hospitals and Care Systems of the Future," the American Hospital Association outlined key strategies hospitals must use to succeed in the future, value-based environment. Achieving sustainability goals can help hospitals pursue several strategies listed in the report, including becoming more efficient and focusing on population health.²

Most hospital CEOs rank financial pressures as their top concern.³ In the current health care climate, sustainability efforts must be financially viable to succeed long term. Hospitals and care systems around the country are already saving resources by adopting sustainability measures.

- PeaceHealth, a nine-hospital system serving Washington, Oregon and Alaska, created a strategic energy management plan that cut energy use by 10 percent over three years, generating \$800,000 in savings annually.⁴
- Gundersen Health System, which serves Wisconsin, Iowa and Minnesota, made energy reduction a priority in 2007, and by 2009 had achieved a 25 percent improvement in energy efficiency and more than \$1 million in annual savings.⁵

Implementing energy efficiency efforts—a major sustainability strategy—can help hospitals reduce costs and protect scarce resources. However, hospitals by their very nature are energy-intensive facilities, operating around the clock and using complex medical systems and equipment critical to patient care. Hospitals often house departments that use a lot of energy, such as laundry, sterilization, food service, refrigeration facilities and computer and data centers. The most recent data from the U.S. Energy Information Administration states that large hospitals make up just 2 percent of commercial floor space in the United States but use about 5.5 percent of energy delivered to the commercial sector.⁶

Rising energy costs coupled with the unique requirements of health care facilities are increasingly leading to financial challenges. Health care organizations spend more than \$6.5 billion on energy costs every year.⁷ That figure represents a tremendous opportunity for savings. By trimming just 5 or 10 percent from energy bills, hospitals and care systems can make a real impact on their finances. Every \$1 a nonprofit hospital or care system saves on energy is equivalent to generating \$20 in new hospital revenues, and for-profit hospitals can raise their earnings by a penny a share by reducing energy costs just 5 percent.⁸ Energy projects are just one of many sustainability strategies. By expanding sustainability to encompass more than just energy reduction, hospitals and care systems can make even greater gains.

Many hospitals and care systems have made commitments to becoming more efficient in all aspects through performance excellence initiatives, Lean training or the Baldrige award criteria. Sustainability aligns well with all these efforts. Hospitals that can become more efficient through sustainability initiatives have more resources to direct toward their missions of patient care.

In addition to cost savings, hospitals and care systems reap other benefits from become more sustainable. CEOs of all fields most often cite the following drivers as the reasons they are pursuing environmental sustainability initiatives:

- Improving brand image and reputation
- Saving money
- Increasing employee satisfaction and retention
- Managing risk and regulatory compliance
- Improving facility operations and pursuing performance excellence
- Demonstrating corporate social responsibility⁹

In addition to these benefits, sustainability also brings a variety of other benefits specific to the health care field:

- With community health becoming a top priority for hospitals and care systems, many leaders are placing greater value on reducing pollution and creating a smaller environmental footprint.
- Health care organizations are also increasingly pursuing Lean approaches to become more efficient in various processes, a natural fit with sustainability efforts.
- Some sustainability efforts, such as retrocommissioning, can improve patient health by contributing to lower infection rates and fewer patient transfers.¹⁰

The multiple drivers behind sustainability initiatives often overlap. Kaiser Permanente, for example, has attracted headlines with its public commitment to respond to climate change and create a healthier environment while saving millions of dollars through efficiency measures.¹¹

This guide aims to help hospital and care system leaders navigate the world of sustainability and build upon their organizations' existing efforts. Hospitals are at different points on the journey toward sustainability. Some organizations are leading the charge and developing best practices, while others are addressing the issue for the first time. Leaders should consider options and determine what is right for their organizations.

Environmental sustainability in hospitals is more than purchasing a single piece of energy-efficient equipment. Efficient hospitals create a culture of sustainability that creates lasting change. These sustainability efforts do not happen in hospitals and care systems without vision and commitment. Rather, these efforts are the result of strategic thinking from leaders who are committed to creating a culture of change.

It is important to note that reducing energy expenses and other costs through sustainability efforts is only achievable if hospitals find solutions that work in the complex hospital facility. Switching to a more environmentally friendly cleaning solution, for example, is not an option for hospitals unless it is proven to kill germs and reduce infections as effectively as traditional products. The solutions and examples included in this guide are all proven to be effective in health care facilities. More information can be found on the AHA's Sustainability Roadmap for Hospitals website (www.sustainabilityroadmap.org), an online resource that includes detailed material tailored specifically to hospital and care system needs.

Steps to Environmental Sustainability

Hospitals and care systems should make environmental sustainability a priority and create a culture of change to achieve lasting results. Health care leaders should examine the steps in Figure 1 and consider which options will work best in their organizations.

Figure 1. Six Steps to Environmental Sustainability



Source: American Society for Healthcare Engineering, 2014.

1. Make the commitment.

The first step toward any change is making a commitment. Hospital and care system executives and trustees should consider the drivers behind their decision to pursue environmental sustainability. Reasons for deciding to implement sustainability initiatives include:

- Saving money
- Demonstrating corporate social responsibility
- Contributing to community health by reducing pollution
- Making facility operations more efficient
- Increasing employee satisfaction, engagement and retention
- Fostering a positive public image
- Meeting compliance or regulatory requirements
- Improving the patient experience

Potential barriers to sustainability in a health care organization also should be considered. Leaders may be concerned about the resources needed to become more sustainable, including time and finances. By understanding an organization's goals as well as potential barriers, leaders can choose appropriate strategies. For example, a hospital concerned about investing in major sustainability initiatives may opt for low-cost efforts with short project-payback periods. A health system wanting to make fundamental change in environmental practices may embark on a wider range of long-term sustainability projects.

Once leaders determine their approach, executives and trustees should consider adopting a formal statement to document the organization's commitment to sustainability. Sustainability statements typically include the motives for change, the results the organization hopes to achieve and activities planned to reach those goals. (A sample sustainability statement is available in the Resources section of this guide.) Hospitals and care systems can announce their commitments externally through press releases, local newspaper articles and digital media platforms and internally through staff communication channels and meetings.

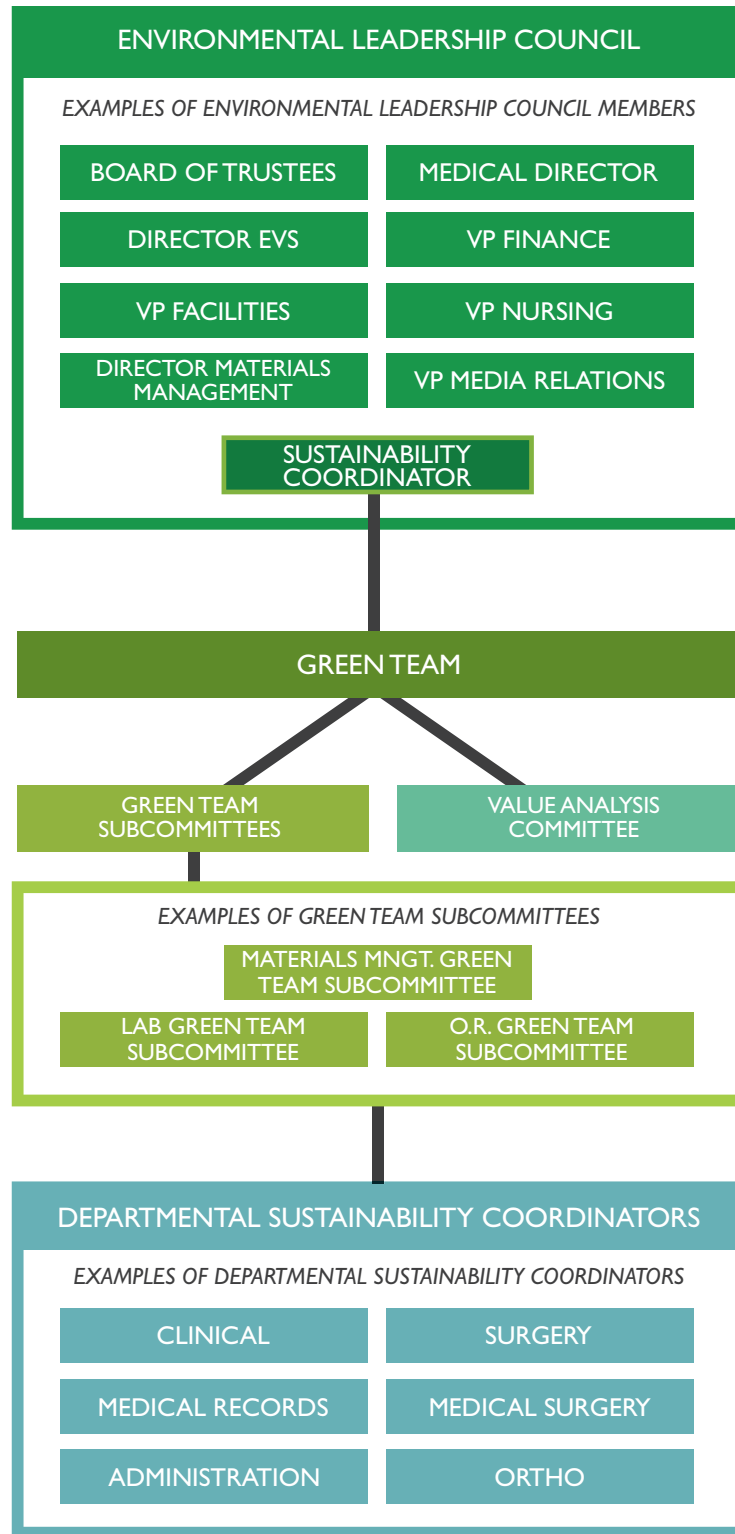
2 Create a structure for supporting environmental sustainability.

Implementing lasting sustainability initiatives in hospitals and care systems requires participation from multiple leaders across multiple departments, from senior executives to department-level advocates. Hospitals and care systems use various structures to integrate sustainability and may consider establishing groups such as:

- **Sustainability Leadership Council:** This group of senior leaders has the authority to approve high-level initiatives and allocate financial resources. Because this group is focused on long-term approaches, it may need to meet once a quarter or less often.
- **Sustainability Committee or Green Team:** This team consists of director-level representatives from departments responsible for implementing sustainability programs on a day-to-day basis. Some green teams are divided into subcommittees focused on energy, water, waste and purchasing.
- **Value Analysis Committee:** This group provides a systematic approach to selecting products and services and addressing supply chain performance issues such as cost, utility and effectiveness. Adding sustainability criteria to the selection of products is one way to integrate environmentally preferable purchasing principles.
- **Departmental Sustainability Coordinators:** Department-level coordinators are important for championing and implementing sustainability efforts.

Figure 2 shows how sustainability efforts can become integrated into a hospital's structure. While some groups and committees include staff members who must be involved by the nature of their roles and responsibilities—the director of environmental services should be involved in recycling, for example—the most successful groups have energetic volunteers, including clinicians, who serve simply because they are committed to environmental sustainability.

Figure 2. Integrating Environmental Sustainability into an Organization



Source: American Society for Healthcare Engineering, 2014.

3. Support and finance environmental sustainability.

Leaders set the tone for sustainability in their hospital or care system. Sustainability often requires a cultural change supported by effective leadership, appropriate policies, adequate resources and a clearly communicated vision.

It takes more than leadership to accomplish sustainability goals however. To succeed long term, sustainability efforts must be financially viable. Many executives see cost as the primary barrier to undertaking sustainability efforts, and some sustainability projects can be expensive. However, some well-planned programs can be implemented at no cost, and many projects have short payback periods. Calculators such as the business case cost-benefit worksheet available on the Sustainability Roadmap for Hospitals (www.sustainabilityroadmap.org) can help organizations determine life cycle costs and payback periods.

For projects that require a lot of up-front investment, hospitals and care systems are increasingly turning to alternative funding sources. These include:

- Grants, rebates and donations: Many utilities have grant or rebate programs that can help fund energy projects. Sustainability strategies are also attractive to potential donors, including individuals, organizations and businesses.
- Shared-savings agreements: Under shared-savings agreements, a third party agrees to finance, design and install energy projects, with the costs paid from energy savings that result from the projects.
- Power purchase agreements: Under power purchase agreements, a third party owns, installs and operates a power-producing asset such as a renewable energy source. In turn, the hospital agrees to purchase the power generated from the plant.
- Carbon-emission offsets: A number of voluntary markets are available to sell carbon offsets and renewable energy credits.

Hospitals can combine these various methods and other strategies to find creative ways to implement sustainability initiatives. Many hospitals and care systems have foundation departments that can help write grant applications or solicit donations for sustainability projects. Leaders should explore various options and determine the appropriate solutions for their organization.

4. Set goals and measure, report and evaluate change.

Using their organization's sustainability statement as a blueprint, health care leaders can set measurable goals for sustainability efforts. Hospitals and care systems should begin by measuring baseline levels of energy use, water consumption and the waste stream. Several resources are available to track this data over time, including the Environmental Protection Agency's ENERGY STAR Portfolio Manager. (See the Resources section for more information on benchmarking and tracking.)

Once hospitals and care systems are collecting data, it is important to analyze performance and track progress toward sustainability goals. Facility managers and other facility professionals can monitor and report trends to leadership to evaluate progress toward goals.

5. Celebrate and share successes.

Celebrating successes is a key motivator that helps keep sustainability efforts moving forward over time. Rewards and celebrations for employees can inspire renewed focus on sustainability initiatives. External recognition shines a spotlight on the good work being done by hospitals and care systems. High-performing hospitals, for example, can earn the ENERGY STAR designation, created by the U.S. Environmental Protection Agency. The Energy to Care program from the American Society for Healthcare Engineering recognizes hospitals that cut energy consumption by 10 percent over baseline numbers—another visible way to celebrate sustainability efforts in health care. Sharing success stories and case studies on platforms such as the Sustainability Roadmap can help other hospitals find similar results. Hospitals and care systems can work with their public relations departments to announce successes.

6. Continue to assess and identify new opportunities.

Sustainability is a journey of continuous performance improvement. Many hospitals and care systems start with simpler projects before moving on to more complex sustainability projects. Even hospitals leading the sustainability movement seek additional opportunities to become more efficient. With technological advancements providing new opportunities to be efficient, hospitals should continue to assess their progress on the path to sustainability and find ways to advance toward their goals.

Guiding Questions

Health care executives should consider and answer several questions as they explore the strategic power of environmental sustainability. These questions can be integrated into strategic planning discussions and will help hospital leaders find the appropriate path toward sustainability.

- What environmental sustainability efforts has our organization already undertaken?
- Why are we pursuing sustainability efforts? What factors are driving our choices?
- What do we hope to gain by implementing environmental sustainability measures?
- What do we consider our greatest barriers to implementing sustainability measures?
- What approach to environmental sustainability will be the most effective in our organization?
- What resources will be needed to accomplish our goals?
- Who should be involved in our organization's sustainability efforts?
- How can we create a long-lasting culture of environmental sustainability?

Sustainability Opportunities

Health care leaders should consider the following opportunities for becoming more sustainable, though this is not an exhaustive list. Focusing on one area or even one project can have a substantial effect on the ability to free up resources for patient care. By combining multiple projects and taking advantage of the wide range of sustainability opportunities, hospitals can gain the most benefit.

Some sustainability projects require little time and financial investment while others are more complex. Table 1 illustrates the various investments and returns for several energy projects. More information about these and other sustainability projects, including case studies and step-by-step instructions for facility professionals, can be found on the Sustainability Roadmap for Hospitals. Health care leaders should consider what strategies they want to use and how sustainability goals align with their organizational missions.

Table 1. Investments and Returns for Selected Energy Efficiency Projects

EFFICIENCY PROJECT	TIME INVESTMENT	FINANCIAL INVESTMENT	RETURN ON INVESTMENT
Establish energy use baseline			*
Schedule preventive maintenance			
Program heating and cooling to ramp up only when spaces are occupied			
Install energy efficient lighting			
Insulate hot water system equipment and piping			
Implement operating room setbacks that reduce air changes per hour when the operating room is not in use			
Install on-site renewable energy			**

*The act of establishing energy use baselines does not provide much return on investment itself, but is a critical component of other sustainability efforts.

**On-site renewable energy may have lower return on investment short term, but the potential for long-term return on investment is tremendous.

Source: American Society for Healthcare Engineering, 2014.

Energy



Energy initiatives provide multiple benefits to health care facilities. Cutting energy consumption reduces utility costs and helps the environment by reducing the amount of natural resources used. Creating alternative energy sources on site can reduce utility costs and mitigate power interruptions during disasters. Being recognized for energy savings through programs such as ENERGY STAR and the Leadership in Energy & Environmental Design, or LEED, program can showcase an organization's efforts to the public.

In addition, several state and local governments have mandated energy reductions or adopted green building codes. Other states require hospitals to comply with energy-saving programs to receive a certificate of need.

Health care leaders should ensure that energy efficiency efforts will work in the hospital setting. Using high-efficiency light bulbs in the operating room will not work unless they provide the level of lighting surgeons require.

Example: Installing new energy-efficient lighting or upgrading existing lighting systems can result in lower operation and maintenance costs while providing the type of lighting required by clinicians and preferred by patients. Lighting represents more than 10 percent of energy consumed in hospitals¹², providing an opportunity for significant savings. Replacing the light source in illuminated exit signs with LEDs, for example, can save thousands of dollars a year. For a typical 600-bed hospital with 300 exit signs, this project would cost \$17,100 and save \$14,755 a year, resulting in a payback period of 1.15 years.¹³

St. Mary's Hospital in Leonardtown, Maryland, evaluated its lighting in 2004 and replaced light sources with more energy-efficient options. After the project payback period of 4.35 years, the annual energy savings of \$20,000 was directed back to the hospital's operating budget.¹⁴

Other energy projects proven to be effective in hospitals and care systems include:

- Reducing heating and cooling in unoccupied areas
- Purchasing ENERGY STAR office equipment
- Evaluating and repairing the building envelope (the physical separators between interior and exterior spaces)

Water



Large U.S. hospitals consumed an estimated 133 billion gallons of water in 2007, totaling \$615 million in expenditures—about 43 million gallons and \$200,000 per building.¹⁵ Water conservation can help hospitals save operating costs and energy. Decreasing consumption also provides environmental benefits by decreasing the strain on municipal water supplies and reducing the energy needed to treat and deliver water. Hospitals using newer water technologies can also reap clinical benefits, such as better infection prevention that comes with faucets that reduce splashing in hand-washing stations.

Hospitals rely on water quality and availability to protect patient health, and should prioritize these needs while reducing wasteful or unnecessary water consumption. As with other sustainability projects, health care leaders should ensure solutions will work in a hospital setting.

Example: Water flow can be reduced by upgrading lavatory faucets to low-flow fixtures. Replacing shower heads and toilets can also save significant amounts of water and money.

The Huntington Veterans Affairs Medical Center in West Virginia implemented a faucet and shower head replacement program in 2007. The new fixtures save the 80-bed hospital more than 1.5 million gallons of water a year. The project cost less than \$3,500 and saves the hospital \$12,900 in water and sewer costs annually, plus an additional \$7,200 in energy savings by reducing the amount of hot water used. The project payback period was just two months.¹⁶

Other water projects proven to be effective in hospitals and care systems include:

- Eliminating equipment and piping leaks
- Minimizing water used for laundry
- Insulating hot water system equipment and piping

Supply chain



An organization's supply chain can have a major effect on sustainability. Supply chain managers adopting a CQO (cost, quality, outcomes) approach to purchasing consider the purchase price as well as quality for patient care, facility operations and maintenance costs, disposal costs and other factors. This more holistic approach can save hospitals money while reducing the impact on the environment. Environmentally preferable purchasing can lower energy and water consumption, reduce packaging waste and minimize the amount of hazardous chemicals that enter the hospital. A sustainable purchasing policy can be used to enhance or complement other policies. In addition to cost savings and environmental benefits, promoting sustainability decisions for the supply chain can contribute to a positive public image. As with other sustainability opportunities, policies should reflect an organization's goals and expectations.

Example: In 2006, Kaiser Permanente specified in a contract with a new computer supplier its strong preference for energy-efficient and environmentally responsible computers. The change led to the purchase of computer equipment manufactured with fewer toxic materials, packed with minimal materials and designed to operate using minimal energy. The up-front purchase of the computer systems was cost-neutral compared to other computers, but the energy savings for Kaiser Permanente totaled \$4 million a year.¹⁷

Other supply chain projects proven to be effective in hospitals and care systems include:

- Reprocessing approved single-use medical devices
- Choosing reusable textiles for gowns, drapes and towels
- Recycling fluorescent lighting

Waste



The majority of the products procured by health care organizations ultimately become waste. About 80 percent of hospital waste is considered general, unregulated waste, while regulated medical waste and hazardous chemical waste make up a smaller portion of waste by volume.¹⁸

Waste management programs and changes in consumption trends can help a health care organization reduce the amount of waste it generates, saving on both handling and disposal costs and providing environmental benefits. Better waste management systems also can provide safety benefits to patients and staff, such as reduced needle sticks when using reusable sharps containers.

Example: By switching from disposable sharps containers to reusable containers, hospitals can decrease waste and expenses. Sacred Heart Hospital in Eau Claire, Wisconsin, switched to reusable sharps containers in 2008. The change prevents about 40,000 pounds of waste generation annually, saving the hospital about 5 percent of its sharps container costs.¹⁹

Other waste projects proven to be effective in hospitals and care systems include:

- Developing or enhancing an organization's recycling program
- Reducing regulated medical waste generation
- Implementing a battery recycling program

Commissioning and retrocommissioning



Commissioning is a process hospitals can use to ensure that complex buildings and equipment operate as intended. A hospital constructing a new building may purchase top-of-the-line equipment for its project. But once the equipment is installed and integrated with other complex systems, it does not always function as designed. The process of commissioning, which stems from a naval term used to describe preparing a ship for active service, ensures that a new hospital will function as designed.

While the other sustainability opportunities included in this guide focus on individual projects, the commissioning process examines a wide range of systems—including heating and cooling, fire protection, lighting, plumbing and medical gas systems—and how they work together. Retrocommissioning, the term for applying this process to existing facilities, provides opportunities to find and correct problems by conducting a comprehensive investigation into the building and its systems.

Commissioning a project carries up-front costs; for new construction, the cost typically runs between 0.25 percent and 1.5 percent of total construction costs.²⁰ The return on investment can be quite large—sometimes in the hundreds of thousands of dollars or more—which is often surprising to leaders who assume that if they have purchased high-efficiency equipment the equipment will automatically function as promised when integrated with the rest of the hospital system.

Example: The University of Arkansas for Medical Sciences commissioned a project that included a central energy plant. The return on investment was so significant that additional projects could be funded without lowering the financial margin. The commissioning process helped UAMS create 60 new beds, increase the capacity of preoperative and post-anesthesia care units, remodel five operating room suites, build out a floor of a cancer institute, and purchase seven acres of land.²¹

Commissioning entails a variety of projects in one process, including

- Examining equipment to determine whether it is operating as designed
- Examining building systems, such as fire safety features, to ensure they operate as designed
- Examining medical systems, such as medical gas systems, to ensure they operate as designed

Conclusion

Hospitals and care systems can reap multiple benefits and help fulfill their missions by tapping into the tremendous power of environmental sustainability.

Before setting goals and committing to projects, health care executives should examine the organizational goals behind sustainability efforts. Each hospital and care system should find its own path on the journey to sustainability, using the information and tools in this guide, as well as the Sustainability Roadmap for Hospitals, to help plot the organization's course and stay on track.

The case examples included in this guide highlight ways that sustainability projects can make a difference. Each study and example is only focused on one particular project. Hospitals and care systems that combine initiatives across various focus areas will achieve even greater efficiencies, as shown in the Case Studies section.

By understanding the strategic importance of environmental sustainability, hospitals and care systems across the nation can improve community health, build their public image, streamline facility operations, and improve financial performance—all key aspects to thriving in the health care environment of today and tomorrow.

Case Study I: Memorial Hermann Health System Houston, Texas

Background: Memorial Hermann Health System is a nonprofit health care system in southeast Texas with 12 hospitals and 18 medical office buildings, comprising a total of 11 million square feet. The health system built four new campuses in 2006 and discovered that the newer hospitals had lower energy efficiency performance than the older ones. Two of the new hospitals were nearly identical in design and were located just 18 miles apart, but an energy benchmarking project found that one used 50 percent more energy than the other.

Efficiency Activities: Memorial Hermann established baseline energy consumption to measure energy use at each hospital. By investigating energy use across the system, Memorial Hermann found that construction issues, training gaps, and poor use of energy-smart technology led to the disparities. The organization set targets for energy reduction, reprogrammed air volume controls, implemented operating room airflow setbacks, and retrocommissioned all HVAC controls. In addition, Memorial Hermann adopted a new culture of healthy competition among technician teams, with staff striving to achieve the lowest level of per-square-foot energy consumption while still providing excellent customer satisfaction. The goal was to focus on sustainability to support Memorial Hermann's mission by improving existing facility operations. Memorial Hermann implemented best practices and used a performance improvement process to help meet its goals.

Results: The new hospitals near each other are now performing at the same level and are using less than half the amount of energy used by the worst performers in 2008. Memorial Hermann invested about \$3.8 million from existing expense budgets and capital allocations over a five-year period and adopted a philosophy of repairing existing equipment rather than purchasing new systems. The payback period for each sustainability project was less than two years, and many had immediate payback periods. Cumulative savings to the bottom line from this initiative totaled \$47 million in documented utility reductions. Between 2008 and 2012, Memorial Hermann's portfolio-wide ENERGY STAR score rose from below the 40th percentile to the 68th percentile. Memorial Hermann has earned ENERGY STAR status for eight of its 12 hospitals and nine of its 18 medical office buildings. Memorial Hermann also has been recognized by the American Society for Healthcare Engineering's Energy to Care program for reducing energy consumption and is the ENERGY STAR Healthcare Partner of the Year for both 2013 and 2014.

Lessons Learned: Setting a baseline and retrocommissioning facilities helped Memorial Hermann identify problems that would otherwise have gone unnoticed. Creating a culture of competition among facilities helped motivate the staff and create lasting success.

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Case Study 2: Wentworth-Douglass Hospital Dover, New Hampshire

Background: Wentworth-Douglass is a 178-bed general medical and surgical center with nearly 1 million square feet of space. Hospital leaders initiated a series of sustainability projects that were completed in 2012, though sustainability and efficiency are ongoing priorities.

Efficiency Activities: Wentworth-Douglass optimized its existing energy management system, installed energy-efficient lighting, installed low-flow flush fixtures, used motion sensors to turn off vending machine lights when not in use, and completed other projects. The hospital's green team examined a wide variety of sustainability initiatives, and the facilities department largely took the lead on energy projects. The hospital's approach to sustainability was to look for places where efficiencies could reduce costs and focus on those areas.

Results: Each project brought returns. Lighting controls in conference rooms and garages led to annual savings of \$45,000. Using the energy management system more effectively generated \$150,000 a year in savings. Low-flow fixtures saved \$200,000 a year. Using motion-sensing controls with vending machines saved \$1,700 a year. In total, Wentworth-Douglass created more than \$470,000 in annual energy and water savings. The payback period varied from project to project but generally was between three and five years.

Lessons Learned: Wentworth-Douglass used the Sustainability Roadmap for Hospitals to find simple projects that are easy to implement without major financial or time investments. By completing multiple projects, the results added up to major financial savings.

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Case Study 3: Carilion New River Valley Medical Center Christiansburg, Virginia

Background: The Carilion New River Valley Medical Center is located on a 112-acre campus. The hospital, a Level III trauma center, has 146 beds and 500,000 square feet of interior space. The medical center was experiencing positive social pressure to improve energy efficiency and explored a series of energy reduction projects.

Efficiency Activities: The Carilion New River Valley Medical Center benchmarked its energy use using the Environmental Protection Agency's Portfolio Manager tool. The hospital changed its natural gas contracts and upgraded lighting in parking lots. It also made a series of HVAC improvements and insulated steam valves. The organization has made sustainability a priority and created a corporate green team that works on various initiatives. Carilion New River Valley Medical Center has created a culture of sustainability that encourages all hospital staff members to think of ways the hospital can become more sustainable.

Results: The HVAC adjustments required investments of about \$35,000 and resulted in \$305,000 in annual savings. The steam valve insulation cost \$43,000 and provided annual savings of \$24,000. Switching natural gas suppliers cost \$8,500 for the installation of new meters but saved the medical center about \$55,000 a year. Lighting improvements were needed to address visibility concerns in the parking lot, and the hospital decided to use sustainable options. That project cost about \$175,000 and, although its primary purpose was not sustainability, the changes are estimated to save about \$6,000 a year and reduce maintenance costs. The efficiency improvements resulted in a total of about \$390,000 in savings each year. Even with the parking lot expenses included, the payback period was less than one year.

Lessons Learned: Benchmarking energy use over time was an important first step for Carilion New River Valley Medical Center because all of the opportunities for savings were identified from those statistics. Monitoring energy use in the future will allow the hospital to track savings and find new areas for improvement.

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Case Study 4: Sullivan County Community Hospital Sullivan, Indiana

Background: Sullivan County Community Hospital is a 25-bed acute care hospital that includes 100,000 square feet and provides inpatient and outpatient services. In 2012, the hospital initiated a retrocommissioning process.

Efficiency Activities: Sullivan County Community Hospital hired Duke Energy consultants to perform retrocommissioning at the hospital. The process identified low-cost approaches to improving efficiency with existing equipment. For example, the hospital reevaluated its HVAC controls and created nighttime settings for unoccupied spaces such as the cafeteria.

Results: The total cost of the project, including contractor fees, was \$70,000. The Sullivan County Community Hospital estimates its annual savings are more than \$20,000 (\$15,200 in electric costs plus \$5,500 in gas savings). The project payback period is about 3.5 years.

Lessons Learned: Hiring a consultant from a utility company helped the community hospital complete multiple projects as part of a retrocommissioning process that helped increase efficiencies.

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Resources

Sample Hospital Sustainability Statement

Dartmouth-Hitchcock Medical Center

Statement of Environmental Principles

In an effort to promote healthier communities, both locally and globally, Dartmouth-Hitchcock Medical Center (DHMC) is committed to improving environmental management throughout the organization. DHMC will manage its operations in a manner demonstrably protective of environmental and human health.

DHMC will constantly seek new and innovative ways to meet its environmental goals through conservation, reduction, reuse and recycling programs, and through partnering with others in the community to safeguard the environment.

DHMC will apply these principles to achieve optimal environmental standards consistent with institutional goals and financial consideration.

In an effort to respect and protect the earth's resources, and to minimize environmental damage, DHMC will:

- Manage, minimize and eliminate, whenever possible, the use of hazardous materials.
- Use renewable natural resources and conserve nonrenewable natural resources through cost-efficient use and careful planning.
- Use pollution prevention initiatives to reduce negative environmental impacts.
- Minimize the generation of waste through source reduction, re-use and recycling programs.
- Conserve energy and improve the energy efficiency of our operations and make every effort to use and promote environmentally safe, cost-effective and sustainable energy sources.
- Ensure the health and safety of our employees by promoting safe work practices, reducing exposure, using safe technologies, and implementing effective emergency preparedness programs.
- Provide employees with safety and environmental information through training and education programs in order for them to make work/practice decisions in support of these principles.
- Monitor and evaluate our practices as they relate to these environmental principles.

(reprinted from the Sustainability Roadmap for Hospitals)

Benchmarking Tools and Other Sustainability Resources

Portfolio Manager: Facility managers and others use the Environmental Protection Agency's ENERGY STAR Portfolio Manager online benchmarking tool to securely track energy and water use over time. Access the tool and get more information at <http://portfoliomanager.energystar.gov>.

Energy to Care program: The free Energy to Care program helps hospitals track energy consumption and rewards progress. Participating hospitals track their energy use through the Portfolio Manager online benchmarking tool and can visualize energy trends using a robust dashboard. In addition to gaining recognition for reducing energy use, hospitals can participate in challenges that add friendly competition to the mix. Hospitals can compete against other facilities in their health systems, states or regions. The program is coordinated by the American Society for Healthcare Engineering. Information is available at www.energytocare.com.

Sustainability Roadmap for Hospitals: The Sustainability Roadmap website—accessible at www.sustainabilityroadmap.org—shows hospitals how to implement real-world sustainability projects that can enhance their existing efforts and give them a platform for sharing successes with other facilities. The website features search functions, how-to guides, tools, case studies and other technical resources. The roadmap was created by three personal membership groups of the American Hospital Association: the American Society for Healthcare Engineering (ASHE), the Association for the Healthcare Environment (AHE) and the Association for Healthcare Resource & Materials Management (AHRMM).

Energy University: Energy University, a vendor-neutral, e-learning program from Schneider Electric, offers online courses to facility managers and others involved in operations and maintenance of facilities. Members of the American Society for Healthcare Engineering can access these tools for free. Visit www.ashe.org/energyuniversity for more information.

ASHE commissioning publications: Commissioning hospital facilities is a more complex process than commissioning other types of buildings because of the unique and complex systems and equipment found in health care facilities. However, one set of commissioning guidelines is specifically tailored to health care facilities. The *Health Facility Commissioning Guidelines* book outlines the process of commissioning health care facilities. An accompanying *Health Facility Commissioning Handbook* includes step-by-step instructions on how to implement the *Guidelines*. Access both at www.ashestore.com.

ASHE, AHE, AHRMM membership: Facility managers and others involved in environmental sustainability can have free access to valuable resources and tools by becoming members of one of three personal membership groups of the American Hospital Association.

- The American Society for Healthcare Engineering (ASHE) has more than 11,000 members who rely on ASHE as a key source of professional development, industry information, and advocacy, including representation on issues that affect their work in the physical health care environment. www.ashe.org
- The Association for the Healthcare Environment (AHE) represents, defines, and advances the work of professionals responsible for care of the patient environment to ensure quality patient outcomes and healthy communities. AHE serves more than 2,000 members and provides education, networking and recognition for personal and professional achievements as well as collaboration with the AHA on public policy and advocacy issues related to the health care environment. www.ahe.org
- The Association for Healthcare Resource & Materials Management (AHRMM) is the leading national association for executives in the health care resource and supply chain profession.

AHRMM serves more than 4,200 active members. Founded in 1951, AHRMM prepares its members to contribute to the field and advance the profession through networking, education, recognition, and advocacy. www.ahrmm.org

Sample Sustainability Roadmap Performance Improvement Measure

This example is adapted from a performance improvement measure found on the Sustainability Roadmap for Hospitals. Each performance improvement measure has talking points about the project, a step-by-step guide to implementing the project, case studies demonstrating its benefits, and links to more information. As this sample performance improvement measure illustrates, the Sustainability Roadmap contains a wealth of technical information that can help hospitals and care systems achieve their efficiency goals. Facility management professionals, those responsible for completing sustainability projects and others involved in the operation of hospitals may find this resource especially useful.

Performance improvement measure: Retrocommissioning heating, ventilation and air conditioning controls

Description: Perform retrocommissioning of HVAC controls to fine-tune operating conditions and improve performance. Retrocommissioning is a three-stage process:

- Develop an operations plan.
- Test systems to determine whether they are meeting the plan's requirements.
- Repair or replace under-performing systems.

Talking points:

- Provides a comprehensive picture of the facility's HVAC systems and optimal operating conditions.
- Identifies opportunities for repairing or replacing equipment, which would lead to substantial savings on utility bills.
- Optimizes performance of individual pieces of equipment and of the entire facility's HVAC system.
- Extends the life and efficiency of HVAC equipment through preventive maintenance.
- Locates and addresses leaks, moisture accumulation and faulty sealants before they attract mold growth or pests.
- Sets the foundation for development of a preventive maintenance plan.

Benefits:

- **Cost benefits:** Energy savings result in cost savings. Retrocommissioning is an inexpensive way to adjust system controls with immediate payback. Extending the life of equipment also saves on costs.
- **Environmental benefits:** Reducing energy use always has an environmental benefit. Extending the life of equipment also has environmental benefits, although these are harder to quantify.
- **Social benefits:** Depending on the improvements made to operations during retrocommissioning, improvements to the comfort and safety of patients, visitors and staff may be significant. Track and report all benefits that result from retrocommissioning efforts.

How-to:

1. Determine who's on the team: health facility commissioning authority (HFCxA), building engineer, HVAC maintenance personnel and building automation system (BAS) manager.
2. Establish an ENERGY STAR Portfolio Manager account for the health care facility.

3. Review the whole-building energy performance baseline data gathered under Sustainability Roadmap performance improvement measure "Establish baseline for current energy consumption."
4. Document the retrocommissioning effort in a written report.
5. Perform a walk-through of the facility to identify and record the status of all meters, sensors and other building system controls. Examples of critical sensors to calibrate include:
 - a. Outside air, supply air, mixed air and return air temperature sensors
 - b. Chilled water and hot water temperature sensors
 - c. Carbon dioxide sensor
 - d. Carbon monoxide sensor
6. Develop a log of all controls and include the manufacturer's recommended calibration interval, the baseline calibration and the calibration history (if available) for each control. Consider the accuracy and reliability of the sensors.
7. Access your systems to answer the following questions:
 - e. Were your sensors and actuators calibrated when originally installed?
 - f. Have your sensors or actuators been calibrated since installation?
 - g. Have temperature complaints come from areas that ought to be comfortable?
 - h. Are any systems performing erratically?
 - i. Do any areas or equipment repeatedly have comfort or operational problems?
 - j. Are any systems simultaneously cooling and heating?
 - k. Is there a written sequence of operations describing the control logic for air handlers and zone temperature control?
 - l. How are your buildings currently being used and occupied? In particular, have former health care areas been converted to administrative uses? If so, this may present an opportunity to recommission systems accordingly.
8. If the facility is equipped with a building automation system (BAS), verify that the controls included in the log are tracked by the BAS and that the system has been programmed to issue an alarm if sensors or controls vary outside acceptable set points.
9. Calibrate controls within the manufacturer's recommended interval.
10. Integrate regular recalibration into the facility's preventive maintenance program, scheduling it every five years at minimum or in accordance with the manufacturer's recommendation (whichever is shorter).
11. Develop an HVAC systems manual with operating plan using the facility's operations and maintenance manual (if available) or manufacturer's recommendations. At a minimum, include the following information:
 - m. Description of all HVAC systems and narrative sequence of operations under normal and emergency scenarios
 - n. Description of all controls, the manufacturer's recommended calibration interval, the baseline calibration, and the calibration history (if available)
 - o. Monitored conditions (e.g., air temperature, humidity, pressure relationship, filtration, ventilation, etc.)
 - p. Mode of operation (e.g., occupied/unoccupied)
 - q. Time-of-day schedule for every day of the week plus holidays (include seasonal variation, if applicable)
 - r. Optimal operating setpoints (stratify information by occupancy type, if applicable)

12. Use an electronic commissioning tool that interfaces with the automatic temperature control system to significantly expedite the retrocommissioning effort. Such tools use a standard communication protocol to query a massive database and quickly identify previously undetected problem areas. After the retrocommissioning effort is completed, operations and maintenance staff can use the tool to continuously monitor HVAC controls and dispatch maintenance personnel to handle problems. The retrocommissioning effort should lead toward implementation of a continuous commissioning effort that is appropriate for the specific facility.

Case studies:

- PeaceHealth, St. Joseph Hospital, Bellingham, Washington: First-year savings of \$100,000 simply from modifying sequence of operations and scheduling.
- Saint Francis Care, Hartford, Connecticut: Correcting the night setback controls contributed to \$9,100 energy savings per year in a 30,000 square foot area.
- St. Luke's Regional Medical Center, Boise, Idaho: Retrocommissioning process identified potential for \$250,000 savings annually.
- University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania: \$2 million in annual gas savings from retuning boilers.

About ASHE

The American Society for Healthcare Engineering (ASHE) is a personal membership group of the American Hospital Association. More than 11,000 members rely on ASHE as a key source of professional development, industry information, and advocacy, including representation on issues that affect their work in the physical health care environment. www.ashe.org

About HPOE

Hospitals in Pursuit of Excellence (HPOE) is the American Hospital Association's strategic platform to accelerate performance improvement and support delivery system transformation in the nation's hospitals and health systems. HPOE shares best practices, synthesizes evidence for application, and engages leaders in the health care field through education, research tools and guides, leadership development programs and national engagement projects. www.hpoe.org

Endnotes

1. Institute for Healthcare Improvement. (Undated). *The IHI Triple Aim*. Retrieved from <http://www.ihl.org/Engage/Initiatives/TripleAim/Pages/default.aspx>
2. American Hospital Association. (2011). *Hospitals and care systems of the future*. Retrieved from <http://www.aha.org/about/org/hospitals-care-systems-future.shtml>
3. American College of Healthcare Executives. (2013). *Top issues confronting hospitals: 2013*. Retrieved from <http://www.ache.org/pubs/research/ceoissues.cfm>
4. Butcher, L. (2014, March). Harnessing the power of sustainability. *Trustee*. Retrieved from http://www.trusteemag.com/display/TRU-news-article.dhtml?dcrPath=/templatedata/HF_Common/NewsArticle/data/TRU/Magazine/2014/Mar/1403TRU_coverstory
5. Healthier Hospitals Initiative. (2013). *Gundersen Health System: Achieving energy efficiency and cost savings*. Retrieved from <http://healthierhospitals.org/get-inspired/success-stories/gundersen-health-system-achieving-energy-efficiency-and-cost-savings>
6. U.S. Energy Information Administration. (2012). *Energy characteristics and energy consumed in large hospital buildings in the United States in 2007*. Retrieved from <http://www.eia.gov/consumption/commercial/reports/2007/large-hospital.cfm>
7. ENERGY STAR. (undated). *Healthcare: An overview of energy use and energy efficiency opportunities*. Retrieved from http://www.energystar.gov/a/business/challenge/learn_more/Healthcare.pdf
8. Ibid.
9. Sustainability Roadmap for Hospitals. (2010). *Drivers and motivators for sustainability*. Retrieved from <http://www.sustainabilityroadmap.org/drivers/index.shtml>
10. Dombrowski, J. (2013, summer). Commissioning is key. *Inside ASHE*. 21 (2). Retrieved from <http://www.nextbook.com/haylor/ENVO/ENVO0213/index.php#/10>
11. Kaiser Permanente. (2013). *Responding to climate change*. Retrieved from http://share.kaiserpermanente.org/wp-content/uploads/2013/12/ClimateEnergy_factsheet_2013.pdf
12. U.S. Department of Energy Building Technology Program. (2011). *Energy-efficient hospital lighting strategies pay off quickly*. Retrieved from http://apps1.eere.energy.gov/buildings/publications/pdfs/alliances/hea_lighting_fs.pdf
13. Ibid.
14. Ibid.
15. U.S. Energy Information Administration. (2012). *Large hospitals tend to be energy-intensive*. Retrieved from <http://www.eia.gov/todayinenergy/detail.cfm?id=7670>
16. U.S. Department of Energy's Energy Efficiency & Renewable Energy Information Center. (2009). *Huntington Veterans Affairs Medical Center—Faucet and showerhead replacement project*. Retrieved from http://www1.eere.energy.gov/femp/pdfs/huntingtonva_watercs.pdf
17. Healthier Hospitals Initiative. (2012). *Kaiser Permanente electronic products environmental assessment tool—Purchasing environmentally responsible computers*. Retrieved from <http://healthierhospitals.org/get-inspired/case-studies/kaiser-permanente-electronic-products-environmental-assessment-tool-repeat>
18. World Health Organization. (2011). *Waste from health-care activities*. Retrieved from <http://www.who.int/mediacentre/factsheets/fs253/en/>
19. Wood, D. (2009). Hospitals switch to reusable sharps containers. *NurseZone.com*. Retrieved from http://www.nursezone.com/nursing-news-events/devices-and-technology/Hospitals-Switch-to-Reusable-Sharps-Containers_29558.aspx
20. Dombrowski, J. (2013, summer). Commissioning is key. *Inside ASHE*. 21 (2). Retrieved from <http://www.nextbook.com/haylor/ENVO/ENVO0213/index.php#/10>
21. Ibid.