Reducing Healthcare Carbon Emissions

A Primer on Measures and Actions for Healthcare Organizations to Mitigate Climate Change

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Institute for Healthcare Improvement

For 30 years, the Institute for Healthcare Improvement (IHI) has used improvement science to advance and sustain better outcomes in health and health systems across the world. We bring awareness of safety and quality to millions, accelerate learning and the systematic improvement of care, develop solutions to previously intractable challenges, and mobilize health systems, communities, regions, and nations to reduce harm and deaths. We work in collaboration with the growing IHI community to spark bold, inventive ways to improve the health of individuals and populations. We generate optimism, harvest fresh ideas, and support anyone, anywhere who wants to profoundly change health and healthcare for the better. Learn more at ihi.org.

Table of Contents

A Call to Action

Climate change represents a major threat to human health. Warming temperatures, increased frequency of extreme heat days, other extreme weather events, declining air quality, and growing food and water insecurity are directly and indirectly impacting health. The growing severity of climate events threatens healthcare operations, presenting challenges in ensuring care continuity, patient safety and quality of care, and managing costs.

These climate-related risks are particularly acute for marginalized people both around the world and in the United States. While no one is immune to the health impacts of the climate crisis, those who suffer most live at racial, ethnic, socioeconomic, and geographic disadvantage. Climate change multiplies inequities in access and quality of care for the most vulnerable communities.

Healthcare delivery organizations must help lead the response to this crisis by immediately reducing emissions that are threatening life on the planet, while also meeting the climate health needs of disproportionately affected communities.

The Biden-Harris Administration has set clear goals for the country: to cut greenhouse emissions in half by 2030, then move quickly to net-zero before 2050. The Federal Government is working rapidly, through an ambitious Federal Sustainability Plan, which obligates federal health systems to emissions reductions.

To meet these goals, the Administration and the U.S. Department of Health and Human Services (HHS) have called on healthcare stakeholders to help tackle the climate crisis by: (1) reducing their organization's emissions by 50 percent by 2030 and achieving net zero by 2050; (2) publicly reporting on their progress; (3) completing an inventory of Scope 3 (value chain) emissions; and (4) developing climate resilience plans for their facilities and communities. As of June 30, 2022, 61 of the largest U.S. hospital and health sector companies have agreed.

AHRQ is a proud partner in this effort. Leveraging our expertise in quality measurement and dissemination and implementation of best practices, AHRQ contracted with the Institute for Healthcare Improvement to develop this primer to assist healthcare organizations on their decarbonization journey. With input from experts in healthcare sustainability, clinical practice, and health system leadership, this project features a prioritized set of measures and potential interventions to reduce greenhouse gas emissions.

These measures, implementation tools, and strategies build on the contributions of many leading individuals and organizations. AHRQ hopes to update, improve, and expand the primer as we learn more about how healthcare organizations can achieve their goals.

This primer serves as a starting point for a more comprehensive climate mitigation strategy that will require integrating environmental impacts into the definition of healthcare value, shifting to a circular economy, and expanding preventive models of care.

Thank you for joining us.

Robert Otto Valdez, Ph.D., M.H.S.A

Director

Executive Summary

The climate crisis is the single greatest public health challenge of the 21st century.[1] Healthcare is a significant contributor to climate change and is also responsible for managing the adverse impact of climate change on health. The healthcare sector now faces an urgent call to action to reduce its carbon footprint and protect communities from climate threats.[2]

Recognizing the devastating effects of climate change on human health, in April 2022 the U.S. Department of Health and Human Services, in partnership with the White House, issued a call to action for the healthcare sector to tackle the climate crisis.[3] A growing number of healthcare organizations are committing to reduce their greenhouse gas emissions and others are beginning to explore next steps. Most of these organizations need guidance and support in monitoring their carbon footprint and mounting a strategic response.

This primer serves as an action guide for healthcare organizations to begin the journey to reduce greenhouse gas emissions. It offers **prioritized measures** to monitor progress and guide strategic management and examples of **interventions** that healthcare organizations may use toward their decarbonization goals. While not all strategies are equally feasible or carry equal weights across organizations, Figure 1 provides several options for healthcare organizations to consider based on their local conditions.

Figure 1. Summary of Key Measures and Strategies for Healthcare Decarbonization

HIGH-LEVEL AIM

Reduce organizational emissions by 50% by 2030 and to net zero by 2050

	High-Priority Measures		Key Strategies	
	Core Measures	**Elective Measures**	**Reduce Waste**	**Reduce Emissions Intensity**
Energy	• Total GHG emissions from energy use	• Energy use intensity of health care facilities • ENERGY STAR® score of health care facilities	• Conserve and optimize energy efficiency	• Transition to zero-carbon fuel sources • Meet and exceed the current green building/retrofitting standards
Transportation	• Total GHG emissions of owned and leased vehicles	• Total GHG emissions from staff and patient travel	• Centralize oversight to actively manage transportation reduction	• Transition to sustainable transportation systems
Anesthetic Gas	• Total GHG emissions from inhaled anesthetics	• Mean fresh gas flow rates	• Minimize fresh gas flow rates • Decommission or avoid construction of central nitrous oxide piping	• Manage anesthetic choices
Pharmaceuticals & Chemicals	Overarching Scope 3 Measure: • Total GHG emissions from (or total spend on) goods and services	• Metered-dose inhaler outpatient prescriptions as a percentage of all inhaler prescriptions	• Prevent disease exacerbation • Launch appropriate use campaigns	• Maximize lower carbon alternatives for inhalers
Medical Devices & Supplies		• Percent purchased goods and services supplied by companies performing carbon disclosures with a science-based target for emissions reduction	• Ensure resource stewardship	• Adopt and expand circular economy policies and practices related to reuse, reprocessing, repair, repurposing, and recycling • Adopt preferential purchasing with suppliers or service providers that perform carbon disclosures and have set a science-based target for decarbonization
Food		• Total GHG emissions from food procurement	• Adopt food waste prevention and diversion programs	• Design plant-forward menus and retail options

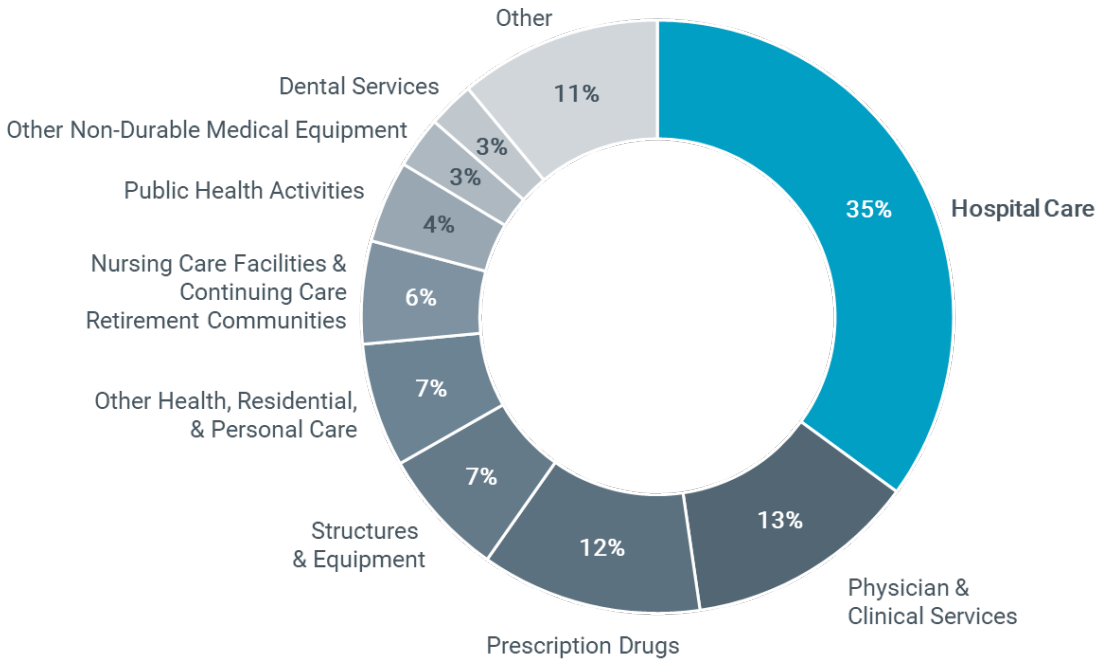
Goals

This Primer proposes a prioritized set of measures and system-level interventions to reduce healthcare's carbon footprint, which were developed in close collaboration with experts in healthcare sustainability, clinical practice, and health system leadership. The recommendations outlined here are intended to inform organizations beginning their journey in measuring and strategically reducing greenhouse gas (GHG) emissions. (A glossary of key terms, including GHG emissions, can be found in the Appendix.)

Focus on Hospitals and Health Systems

Anthropogenic climate change is a consequence of GHG emissions generated from human activities. U.S. healthcare sector GHG emissions assessment, by national health expenditure category, shows that the largest emissions contributor is hospital care (see Figure 2).[4] Supporting hospitals and large health systems in measuring and advancing decarbonization-related activities thus represents a significant opportunity to reduce health sector GHG emissions.

Figure 2. U.S. Healthcare Greenhouse Gas Emissions by National Health Expenditure Category (2018)[5]



While the measures and actions identified in this primer can extend to all types of healthcare organizations, the measurement framework and potential actions are developed specifically to guide senior leaders of hospitals and large healthcare systems in measuring and guiding strategic actions to decarbonize their organizations.

Approaching Healthcare Decarbonization: An Accounting Framework

Alignment With Global Standards

To meaningfully track and reduce GHG emissions, healthcare organizations should use the Greenhouse Gas Protocol (GHGP) framework, a comprehensive, globally recognized standard for quantifying and reporting on emissions. The GHGP organizes emissions into three categories (Scopes 1, 2, and 3) based on their source:[6]

- Scope 1: Direct emissions from owned or directly controlled sources
- Scope 2: Indirect emissions from the generation of purchased energy
- Scope 3: All other indirect emissions, such as those that occur in producing and transporting goods and services across the supply chain

In 2020, the National Health Service (NHS) in England conducted an analysis of sources of major GHG emissions and quantified the major emissions contributors.[7] Figure 3 illustrates the emissions produced by the NHS England in alignment across the three GHGP scopes and beyond.

Figure 3. Greenhouse Gas Protocol Scopes in the Context of the NHS[8]

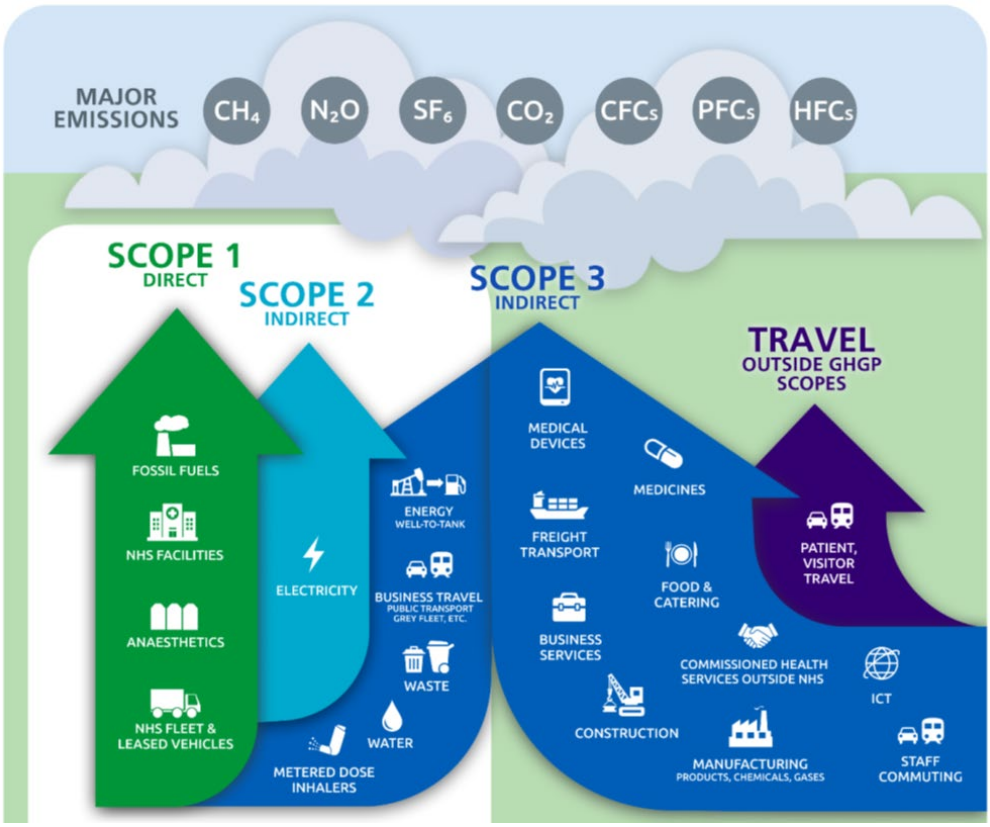
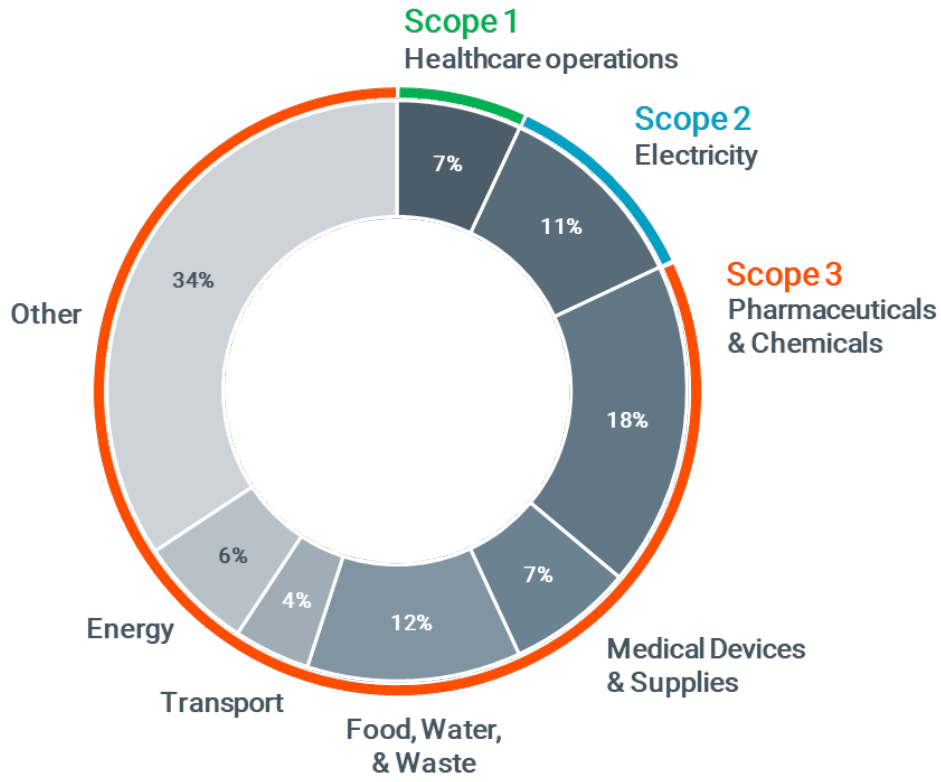


Figure 4 illustrates the proportion of U.S. healthcare sector GHG emissions by GHGP Scopes, indicating high-impact domains for measurement and healthcare decarbonization action. Note: Waste anesthetic gas and metered dose inhaler propellant emissions are not included.

Figure 4. U.S. National Healthcare Greenhouse Gas Emissions by GHGP Scopes (2018)[9]



The priority measures identified by the Technical Expert Panel (TEP) to track and manage GHG emissions span all three Scopes of the GHGP. A small set of non-protocol measures are also suggested as additional areas of opportunity for emissions reduction.

Key Considerations for Getting Started

Essential components that support healthcare organizations in their activities for monitoring and reducing their GHG emissions include:

- A **high-level aim** to offer clarity and purpose to measurement and mitigation activities. We recommend healthcare organizations adopt an aim consistent with the HHS voluntary call for non-federal institutions to halve emissions by 2030, compared with 2008 baseline, and to reach net zero by 2050.[10] The HHS proposed climate goals were, in turn, informed by the Intergovernmental Panel on Climate Change's Sixth Assessment Report on the impacts of global warming of 1.5°C above pre-industrial levels.[11]

- **Structural enablers** to help establish goals, support measurement and improvement activities, and drive accountability within the institution (see below).
- A discrete set of **technical measures** to track and assess decarbonization progress, and common **normalization factors** to help benchmark and compare performance both within and between institutions.
- **Improvement initiatives** within each of the key measurement domains to reduce emissions across an entire healthcare organization and all relevant emissions.

Support Through Structural Enablers

Advancing healthcare decarbonization goals requires an enabling environment within an institution and dedicated resources to effectively carry out measurement and improvement activities. There are four types of structural enablers necessary to support decarbonization initiatives. Some are critical to getting started, while others are more long term.

Critical Enablers

Establish a Management System

- ❑ Nominate executive leadership to take responsibility for sponsoring and supporting climate action
- ❑ Build a system of whole organizational GHG (or proxy) accounting to inform strategic management and track progress
- ❑ Establish a cross-functional team to build data collection and management infrastructure
- ❑ Develop a climate action plan to strategically prioritize decarbonization activities
- ❑ Develop a financing plan and resource commitment for implementing interventions
- ❑ Build a governance structure for accountability and internal reporting

Set Targets and Timelines

- ❑ Set a net-zero emissions goal and associated timelines for decarbonization targets
- ❑ Set a baseline year to assess decarbonization performance improvement
- ❑ Set interim annual decarbonization targets

Long-Term Enablers

Build Workforce Capability

- ❑ Institute education and training programs to promote climate literacy across the workforce
- ❑ Embed sustainability in administrative and clinical roles and responsibilities
- ❑ Promote a culture of sustainability and resource stewardship

Manage Carbon Accounting and Finance

- ❑ Establish procurement policies that prioritize suppliers based on verified environmental disclosures
- ❑ Limit carbon offset purchases so they only apply to residual emissions that cannot otherwise be mitigated

High-Priority Measures and Key Strategies for Healthcare Decarbonization

In addition to establishing structural enablers, organizations should track emissions using certain high-priority measures across the institution. We have organized these measures into two tiers:

- **Core measures:** Foundational to assessing progress toward decarbonization goals
- **Elective measures:** Recommended for deeper engagement and activity in sustainability efforts

The strategies and measures in Table 1 offer hospitals and health systems a starting point for decarbonization of their institutions. Organizations are strongly encouraged to pursue even more detailed measures and targeted decarbonization strategies that fit local conditions of impact and readiness.

The high-priority measures and key strategies in Table 1 are organized by six technical domains reflecting significant proportions of healthcare GHG emissions (see Figure 4 above).

To test, learn, and improve their way in decarbonization, healthcare organizations are encouraged to select one site or facility within the system to begin piloting the ideas in this primer. Tests at the pilot site will help the organization develop know-how and understand conditions for success. The successes at the pilot site contribute to building will throughout the organization to continue and expand the change. Once an idea has been tested in a pilot site and demonstrated promising results, leaders can scale the intervention across their system, with the aim of halving organizational emissions by 2030.

Table 1. Key Strategies and Measures for Healthcare Decarbonization

High-Level Aim:	Reduce organizational emissions by 50 percent by 2030 and to net zero by 2050			
	HIGH-PRIORITY MEASURES		KEY STRATEGIES	
	Core Measures	Elective Measures	Reduce Waste	Reduce Emissions Intensity
Building Energy	• Total GHG emissions from energy use	• Energy use intensity of healthcare facilities • ENERGY STAR® score of healthcare facilities	• Conserve and optimize energy use	• Transition to zero-carbon fuel sources • Meet and exceed the current green building/retrofitting standards
Transportation	• Total GHG emissions from owned and leased vehicles	• Total GHG emissions of staff and patient travel	• Centralize oversight to actively manage transportation reduction	• Transition to sustainable transportation systems
Anesthetic Gas	• Total GHG emissions from inhaled anesthetics	• Mean fresh gas flow rates	• Minimize fresh gas flow rates • Decommission or avoid construction of central nitrous oxide piping	• Manage anesthetic choices
Pharmaceuticals & Chemicals	Overarching Scope 3 Measure:	• Metered-dose inhaler outpatient prescriptions as a percentage of all inhaler prescriptions	• Prevent disease exacerbation • Launch appropriate use campaigns	• Maximize lower carbon alternatives for inhalers alternatives
Medical Devices & Supplies	• Total GHG emissions from (or total spend on) goods and services	• Percent purchased goods and services supplied by companies performing carbon disclosures with a science-based target for emissions reduction	• Encourage resource stewardship	• Adopt and expand circular economy policies and practices related to reuse, reprocessing, repair, repurposing, and recycling • Adopt preferential purchasing with suppliers or service providers that perform carbon disclosures and have set a science-based target for decarbonization
Food		• Total GHG emissions from food procurement	• Adopt food waste prevention and diversion programs	• Design plant-forward menus and retail options

Building Energy

Rationale: Measuring and reporting GHG emissions related to energy use by healthcare facilities is foundational to reducing Scopes 1 and 2 emissions. Hospitals are the second most energy-intensive commercial buildings in the United States, due to their continual, all-weather operation; heating, cooling, and ventilation requirements; and sophisticated diagnostic and therapeutic medical equipment.[12,13] Based on 2018 data, 7 percent of total healthcare sector emissions were linked to healthcare operations (Scope 1, excluding waste anesthetic gases and metered dose inhalers) and 11 percent attributed to purchased energy (Scope 2).[14] As such, hospitals and health systems have an important opportunity to reduce emissions associated with energy use.

High-Priority Measures

Core Measures	Elective Measures
• Total GHG emissions from energy use **Potential Normalization Factors:** o Building area o Weather (for annual variations) o Climate (for regional variations) o Patient encounter volume o Patient encounter type	• Energy use intensity of each healthcare facility • ENERGY STAR® score of each healthcare facility

Total GHG emissions from energy use

Capturing and reporting data on the aggregated emissions from energy use is critical to tracking overall progress toward carbon reduction goals. However, to meaningfully benchmark and compare performance both within and between institutions, this measure must be normalized (e.g., by building area, geographical climate, and patient encounter volume and type). The normalization factors associated with patients are more important than building area, due to the variations in hospital size relative to volume and type of patient encounters.

Energy use intensity of healthcare facilities

This is the most widely used measure to track energy use in healthcare organizations, based on both energy source and facility physical size. Having access to energy data at the facility can make it easier for healthcare organizations to understand their emissions contribution, identify outliers, and implement targeted interventions. Consider that building energy performance can be surprisingly high in hospitals attempting to optimize efficiency of their operations by extending their hours or by reducing the size of their facilities, suggesting the need for alternative measures and denominators.

ENERGY STAR® score of healthcare facilities

ENERGY STAR® is a joint program, managed by the U.S. Department of Environmental Protection (EPA) and the Department of Energy, internationally recognized for its ability to compare energy and water performance between similar building types, including hospitals and medical office buildings. ENERGY STAR® scores are based on a percentile score comparing like building types. For example, an ENERGY

STAR® score of 75 indicates that the building is in the top 75th percentile of performers among buildings nationwide that have the same primary use. The score takes into account not only energy usage per square foot per year, but also other weighting factors such as climate (location), imaging equipment, and number of staffed beds. As average performance improves across similar building times, participants are encouraged to continuously improve to maintain or better their scores. ENERGY STAR® regularly updates the methods used to determine scores and ENERGY STAR® scores change as a user updates the building's energy use data and characteristics.

Key Strategies

Reduce Waste

Conserve and optimize energy use

Energy use reduction presents a critical opportunity to curb carbon emissions. A sizeable portion of hospital energy is consumed in transporting and conditioning ventilated air, operating energy-intensive equipment, and powering lighting systems. Actions to conserve and optimize energy use are highly dependent on individual facility factors, including building age, envelope, and space use. The American Society for Health Care Engineering and the Department of Energy's Office of Energy Efficiency and Renewable Energy have issued more in-depth guidance on conserving and optimizing energy use. Some potential interventions to improve energy conservation and efficiency include:

- Reduce air changes overnight and weekends in unused operating rooms
- Set max air changes per hour (ACH)
- Minimize ACH where feasible based on infection prevention protocol or code
- Use LED lighting
- Establish lighting controls with timers and motion sensors
- Switch equipment off (not standby mode) when not in use
- Purchase equipment with favorable ENERGY STAR® or similar efficiency ratings

Reduce Emissions Intensity

Transition to zero-carbon fuel sources

Long-term decarbonization efforts will require hospitals to move to cleaner energy sources. The transition to the lowest carbon sources might involve a range of coordinated interventions, including:

- Identify and implement onsite or offsite renewable projects
- Pursue purchase power agreements (PPAs), which are long-term renewable energy contracts

Meet and exceed the current green building and retrofitting standards

A growing number of health systems are aiming for net-zero design for new or updated facilities by pursuing comprehensive building electrification and other strategies. Leadership in Energy and Environmental Design standards or Building Research Establishment's Environmental Assessment Methods can help ensure the environmentally responsible design and management of the built environment.[15]

Illustrative Vignettes

Kaiser Richmond Medical Center

50-bed tertiary care facility • Richmond, CA, US

In Kaiser Permanente's pursuit of carbon neutrality (achieved in 2020 for Scope 1 and 2 emissions and select Scope 3 emissions), it installed the first solar-powered microgrid with battery storage for a hospital in California at Kaiser Richmond Medical Center in 2018. The microgrid, a 250-kilowatt solar panel installed atop the center's five-level parking garage, connects renewable energy and battery storage to a pre-existing, diesel-fueled backup power system. It supplements the hospital's electrical demand with cleaner energy, augmenting energy loads at peak hours, offsetting the need for power from the major grid, and reducing consumption by at least 365,000 kilowatt-hours annually, the equivalent of removing nearly 60 cars from the road per year. The microgrid can store 1 megawatt-hour of energy in batteries, and, if a power outage were to occur, the microgrid will furnish power, allowing the hospital to operate as an "island," supporting critical systems for up to 3 hours.

Department of Veterans Affairs

The Veterans Health Administration within the Department of Veterans Affairs (VA) is one of the largest integrated healthcare system in the United States, serving 9 million enrolled veterans each year. The VA strives to accomplish the agency mission of care while pursuing opportunities for energy efficiency and resilience identified through quadrennial energy audits. Through combined capital investment and third-party financing, VA upgrades its facility infrastructure and equipment while installing renewable power where feasible. From these efforts, VA has successfully reduced its energy intensity (kBtu/gross square foot) by over 26 percent since 2003.[16] VA hospitals overall use 38 percent less energy per square foot than the national average for all hospitals (which is approximately 234.3 kBtu/gross square foot).[17]

Transportation

Rationale: While transportation is a significant contributor to GHG emissions across the United States, accounting for 27 percent of total national emissions, healthcare organizations might face some challenges in calculating and controlling these emissions, due to their multiple and heterogenous sources.[18] Emissions from vehicles owned or controlled by hospitals and health systems are most readily accounted for in either Scope 1 (for fuel use), or in Scope 2 (for electricity use when electric vehicles are charged from the healthcare organization's purchased energy).[19] Emissions associated with business travel, employee commuting, and vendor transportation largely fall into Scope 3. Finally, emissions associated with visitor and patient travel (excluding owned or leased vehicles, such as ambulances) typically fall outside GHG Protocol Scopes and can be challenging to account for or influence.

High-Priority Measures

Core Measures	Elective Measures
• Total GHG emissions of owned and leased vehicles **Potential Normalization Factors:** o Patient encounter volume	• Total GHG emissions from staff travel **Potential Normalization Factors:** o Workforce size • Total GHG emissions from patient travel **Potential Normalization Factors:** o Patient encounter volume

Total GHG emissions of owned and leased vehicles

Aggregate emissions from all fleet vehicles—both owned and leased—is a core measure for this domain. This measure should be normalized by factors associated with patient encounter volume and whether the location is rural, urban, or suburban, to meaningfully benchmark performance within and between institutions. Factors such as location type may signal availability of public transportation.

Total GHG emissions from staff and patient travel

With the growth of remote work and telehealth, opportunities to reduce emissions associated with staff commuting and patient travel should be explored. This can be a challenging measure to track, requiring interdepartmental collaboration between the sustainability, human resources, and information technology teams.

Key Strategies

Reduce Waste

Centralize oversight to actively manage transportation emissions reduction

To reduce GHG emissions associated with transportation, healthcare organizations should establish a centralized oversight function for sustainability management across all operational functions. This structure would enable redesign of operations and adopt systemwide strategies to decarbonize

transportation emissions. Other potential interventions to manage and reduce emissions in this domain include:

- Group department purchase orders to cut down on delivery emissions
- Prioritize distributors/suppliers with commitments to the EPA SmartWay program[20]
- Use route optimization/vehicle informatics for fleet vehicles
- Expand telehealth services when appropriate

Reduce Emissions Intensity

Transition to low-carbon transportation systems

Decarbonizing transportation systems entails building more environmentally sustainable fleets and promoting low-carbon, public, and active transportation options to staff, patients, and visitors. The following strategies can help this transition:

- Develop environmental criteria for vehicle leases and purchases and electrify or transition to low-GHG models for owned and leased vehicles that require replacement
- Conduct employee commute surveys to determine travel mode and drive alone rate
- Install electric vehicle charging infrastructure with access for staff and the community
- Enable and incentivize public and active transport use (e.g., establish regional park and ride, active transport infrastructure, bicycling incentives, and staff public transportation discounts)

Illustrative Vignettes

Department of Veterans Affairs

The Department of Veterans Affairs (VA) has begun to transition its roughly 23,000 vehicle fleet to zero-emission vehicles (ZEVs). VA auditing its medical facilities to assess and plan for charging infrastructure while also acquiring solar chargers to provide more immediate capacity. Simultaneously, VA is replacing its petroleum-fueled vehicles with ZEVs. Since October 2021, VA has confirmed 507 ZEV orders, which make up 34 percent of its light-duty vehicle acquisitions this annual cycle.

NHS England

In 2021, NHS England announced its transition to a fully zero-emissions ambulance fleet, aligned with the national specification to decarbonize while ensuring the highest standards of safety and patient care. Decarbonizing the ambulance fleet is estimated to reduce emissions by 87 kilotons of carbon dioxide equivalent ($ktCO_2e$) every year, equivalent to 215,952 miles driven by an average gasoline-powered passenger vehicle.

Anesthetic Gas

Rationale: Direct emissions of inhaled anesthetics can account for up to 5 percent of an acute healthcare organization's carbon footprint and more than half of total emissions from perioperative services.[21,22] Firmly within the control of healthcare organizations, emissions from anesthetic gas represent immediate opportunities, in terms of both measurement and mitigation.

High-Priority Measures

Core Measures	Elective Measures
• Total GHG emissions from inhaled anesthetics **Potential Normalization Factors:** o Anesthetic hour	• Mean fresh gas flow rate **Potential Normalization Factors:** o Anesthetic hour

Total GHG emissions from inhaled anesthetics

Inhaled anesthetics agents, which include volatile fluorinated hydrocarbons (desflurane, sevoflurane, and isoflurane) and nitrous oxide, are potent greenhouse gases. They are essentially unmetabolized and so virtually all procured inhaled anesthetics are ultimately released to the outdoor environment. Tracking procured anesthetic drugs (volatiles through the pharmacy department and nitrous oxide through the medical gas department) permits simple estimation of their emissions.

Due to the relatively high global warming potential of all inhaled anesthetics (especially desflurane and nitrous oxide) compared with their alternatives, the choices made by anesthesia providers can significantly reduce direct atmospheric emissions of healthcare organizations.[23] Normalizing the core measure of total emissions from inhaled anesthetics by total number of anesthetic hours can meaningfully compare performance.

Mean fresh gas flow rates

In addition to anesthetic selection, the other meaningful mitigation strategy is waste reduction. By tracking fresh gas flow rates, and normalizing by hour of anesthetic, organizations can compare performance both at the department level and provider level. These data can be used to provide feedback and benchmark progress.

Key Strategies

Reduce Waste

Minimize fresh gas flow rates

The rate of carrier gas flow, and therefore the quantity of inhaled anesthetic delivered, typically exceeds patient requirements. Fresh gas flow alerts can be added to electronic anesthesia records to nudge performance improvement in real time.

Decommission or avoid construction of central nitrous oxide piping

Most nitrous oxide is typically lost prior to use through central piping systems that should be decommissioned in existing infrastructure and avoided in new construction. Portable E cylinders should be substituted in those locations where the option to use nitrous oxide is deemed essential, and these tanks should be closed between uses to avert continuous leaks.[24]

Reduce Emissions Intensity

Manage anesthetic choices

Engaging the clinical workforce is critical to reducing emissions associated with anesthetic gases. In addition to building awareness of the cost and associated climate impact of anesthetic choices, hospitals should consider removing desflurane from their formularies.

Illustrative Vignettes

Yale New Haven Health System

2,409-bed health system • Headquarters in New Haven, CT, US

Due to its disproportionately high global warming impact, desflurane was eliminated from the Yale New Haven Health System formulary in 2013 in favor of sevoflurane. The resultant annual savings were approximately $1,200,000 USD that year across the health system. From the largest hospital alone (1,490 beds), 1,600 tons carbon dioxide equivalent (CO_2e) emissions were eliminated that year, equivalent to removing 360 gasoline-powered passenger vehicles from the roads.

Providence Health and Services

8 regional hospital facilities • Oregon, US

Eight regional hospitals in Providence, Oregon, ranging from critical access to quaternary medical centers, engaged in an iterative clinical quality improvement program to reduce emissions associated with inhaled anesthetics, through personalized clinical benchmark reports and education. This quality improvement program reduced inhaled anesthetic emissions by 4,550 tons CO_2e per year (equivalent to 980 passenger vehicles per year), largely through avoiding use of desflurane, and sustained a 94 percent annual reduction in GHG emissions and 70 percent cost reduction.

In 2021, Providence St. Vincent Medical Center decommissioned central piped nitrous oxide and substituted portable E cylinders after discovering high rates of infrastructure leaks.[25] The overall facility leak rate was 1.89 liters per minute (l/min), resulting in clinical use efficiency of 5.4 percent. The decommissioning of central nitrous oxide piping reduced losses by 958 tons CO_2e (the equivalent of 206 gasoline-powered passenger vehicles off the road) in 1 year and saved $12,000 USD in procurement costs. Similar assessments at 24 other Providence hospitals found leak rates ranging from less than 0.1 to more than 3.5 l/min, with use efficiency of 0.9 to 29 percent, suggesting additional opportunity across the health system.

Measuring Overarching Scope 3 Emissions

Rationale: Scope 3 emissions account for 82 percent of U.S. national health sector GHG emissions and present the most significant opportunity for decarbonization.[26] Accounting for and reducing Scope 3 emissions requires healthcare organizations to assess their value chain impact and examine their product portfolios to better inform environmentally sustainable procurement, use, and disposal management decisions.

High-Priority Measures

Core Measures

- Total GHG emissions from (or total spend on) goods and services
  Potential Normalization Factors:
  - Patient encounter volume
  - Patient encounter type

Total GHG emissions from (or total spend on) goods and services

While accounting for Scope 3 emissions is an ambitious undertaking, total GHG emissions from goods and services can be considered a core measure given its dominant contribution to organizational emissions. Industry standardized reporting at the level of products can help organizations to better assess these emissions and identify critical opportunities for decarbonization; however, this type of reporting is not yet commonplace. In the interim, proxy measures such as total spend can be used to estimate supply chain emissions using tools that combine economic input-output tables from the U.S. Bureau of Economic Analysis and emissions factors from the EPA. Healthcare organizations already routinely track supply chain spend for financial performance improvement. The GHGP and the EPA offer some technical guidance for calculating Scope 3 emissions.

Pharmaceuticals and Chemicals

Rationale: Within Scope 3, pharmaceuticals and chemicals are the single largest contributors to GHG emissions, accounting for 18 percent of total healthcare sector emissions.[27] Understanding the carbon footprint of pharmaceuticals and their alternatives can guide providers toward environmentally preferable selections when clinically safe to do so.

High-Priority Measures

Elective Measures
• Metered-dose inhaler outpatient prescriptions as a percentage of all inhaler prescriptions

Metered-dose inhaler outpatient prescriptions as a percentage of all inhaler prescriptions

Metered dose inhalers (MDIs) are of particular interest as their propellants are potent greenhouse gases and MDI prescriptions can account for 3 percent of a health system's footprint.[28] Based on 2019 data, approximately 75 percent of total inhaler prescriptions in the United States are MDIs,[29] whereas Sweden was able to reduce MDI prescriptions to 13 percent of their total. As such, this measure presents a significant opportunity to reduce GHG emissions in the U.S. healthcare system.

Key Strategies

Reduce Waste

Prevent disease exacerbation

Improving management of patients with respiratory illnesses can avoid GHG emissions associated with medications as well as clinic and hospital visits for acute disease exacerbation. For example, educating patients about eliminating environmental exposure to allergens (e.g., pet dander, dust, and mold), and assisting patients with smoking cessation can improve asthma and chronic obstructive pulmonary disease control and reduce inhaler requirements.

Launch appropriate use campaigns

Promoting appropriate prescribing practices and pharmacologic management across the organization improves patient safety, optimizes medication use, and reduces associated costs and GHG emissions. Appropriate use campaigns can entail the following:

- Educate patients on appropriate inhaler use (indications and techniques)
- Provide clinicians with best practice decision support tools, promoting appropriate choices of pharmacologic interventions
- Conduct a regular review of polypharmacy and duplicative prescriptions

Reduce Emissions Intensity

Maximize lower carbon alternatives for inhalers

Inhaler emissions can be reduced by shifting from the carbon-intensive MDIs to low-carbon alternatives, such as dry-powder inhalers or soft mist inhalers, which are clinically equivalent for most patients. If patients cannot be prescribed these alternatives, for example, due to poor inspiratory

force, consider MDIs with smaller volumes of propellant for shorter-term needs (e.g., treatment of acute lower respiratory infection) and select MDIs with propellants with lower global warming potential.

Illustrative Vignettes

Providence Health and Services

8 regional hospital facilities • Oregon, US

MDIs serve as an example of using environmental costs (emissions per treatment day) to help prioritize best practice recommendations and guide formulary decision making for inhaled medications. After performing a detailed formulary review of propellant-based GHG emissions for each inhaled medication formulation, Providence Oregon hospitals identified clinically equivalent MDI formulations of albuterol with 3-fold differences in emissions. By prioritizing the lower emissions intensity inhalers, these emissions are projected to drop by 42 percent, or 298 tons of CO_2e (the equivalent of 64 gasoline-powered passenger vehicles driven) per year.

NHS England

In 2020, NHS England conducted a systemwide carbon footprint analysis and found that MDI prescriptions contribute approximately 3 percent of total GHG emissions from the NHS.[30] The footprint of dry powder inhalers, for example, is approximately one-tenth that of MDIs, presenting a more sustainable alternative for prescriptions. Thus, reducing unnecessary prescriptions of MDIs is a part of the NHS's strategy to achieve a net-zero carbon healthcare service.

Medical Devices and Supplies

Rationale: Medical devices and supplies contribute approximately 7 percent of U.S. healthcare sector GHG emissions.[31,32] Reliance on single-use disposable medical supplies and devices not only leaves health systems vulnerable to supply chain disruptions, as seen with the COVID-19 pandemic, but they are frequently cited as containing higher life cycle emissions per use compared with equivalent application of reusable alternatives.[33,34] Healthcare organizations should strongly encourage and facilitate resource stewardship. Emissions embodied in the supply chain are beyond the direct control of healthcare organizations. However, organizations can leverage their considerable purchasing power to influence manufacturers to improve the environmental performance and carbon intensity of products through cleaner energy usage, as well as better design for reuse, repair, remanufacturing, and recovery of materials (principles of circular economy, as discussed below).

High-Priority Measures

Elective Measures

- Percent purchased goods and services supplied by companies performing carbon disclosures with a science-based target for emissions reduction

Percent purchased goods and services supplied by companies performing carbon disclosures with a science-based target for emissions reduction

Verified accounting and transparency remains the single greatest barrier to managing emissions related to medical devices and supplies. While product-level emissions information is largely lacking at present, healthcare organizations can leverage their purchasing power to drive the marketplace toward a more transparent, low-carbon supply chain ecosystem. NHS England has adopted a similar measure in their net-zero strategy, to mitigate the risk of greenwashing (i.e., the use of interventions that falsely claim to be more sustainable) while encouraging manufacturers and suppliers to verifiably report their emissions and adopt net-zero mitigation trajectories. The Science-Based Target initiative offers independent, standardized guidance on measuring and reporting emissions reductions, with targets and timelines in accordance with climate science.

Key Strategies

Reduce Waste

Ensure resource stewardship

Avoidance of inappropriate material consumption (both single-use and reusable) is one of the most important strategies for minimizing environmental impact. Common opportunities include streamlining the contents of prefabricated procedure kits, both reusable (e.g., surgical trays) and single-use (e.g., epidural kits), as well as enculturating an attitude of resource stewardship among all staff.

Reduce Emissions Intensity

Adopt and expand circular economy policies and practices related to reuse, reprocessing, repair, repurposing, and recycling

Healthcare organizations can further shift the marketplace toward a more climate-sensitive economy by utilizing carbon intensity as a consideration in purchasing decisions, in addition to cost, quality, and patient safety. Embracing a circular economy involves appreciating emissions present across the life cycle of products, materials, and services.[35] To meaningfully reduce emissions within this domain and improve resilience, healthcare organizations must shift away from single-use disposable devices and expand reusable inventories to maximize material value and minimize pollution.

Adopt preferential purchasing with suppliers or service providers that perform carbon disclosures and have set a science-based target for decarbonization

To influence industry to reduce embodied emissions in products and services, healthcare organizations should establish value analysis guidance and purchasing criteria to prioritize vendors. Mechanisms to enable preferential purchasing with these vendors include:

- Embed purchasing criteria into RFIs/RFPs that state a preference for suppliers or service providers who have a transparent, standardized GHG inventory and have set a science-based target
- Where appropriate and feasible, give preference to bids and proposals from suppliers that meet established criteria
- Ask suppliers to disclose and verify GHG emissions and climate-related financial risk

Illustrative Vignette

Providence St. Vincent Medical Center

523-bed tertiary care facility • Portland, OR, US

In 2020, Providence St. Vincent Medical Center reduced supply purchases by reviewing clinical use data and incorporating environmental impact assessments to re-engineer processes to efficiently manage surgeon preference cards. In total, 39,506 products and 9,411 instrument sets were removed from the organization's supply, reducing annual CO_2e by 834 metric tons (the equivalent of 189 gasoline-powered passenger vehicles driven for one year) and water consumption by 820,000 gallons and yielding a financial savings of $1.77 million.

Food

Rationale: Food comprises 12 percent of total healthcare sector GHG emissions.[36] Animal products are among the highest emissions-intensive food sources. Meanwhile, red meat consumption is associated with increased risk of heart disease, type 2 diabetes, stroke, and colorectal cancer, all of which increase the need for healthcare services, whereas diets higher in whole plant-based foods (such as whole grains, fruits, vegetables, nuts, and legumes) are associated with lower health risks.[37] Campaigns to promote sustainable, whole foods, plant-based choices, that prevent food waste, and divert food that would otherwise be wasted to address food insecurity are highly visible healthcare initiatives that clearly promote health while minimizing food-related emissions.

High-Priority Measures

Elective Measures

• Total GHG emissions from food procurement
Potential Normalization Factors:
  ○ Patient encounter volume
  ○ Workforce size

Total GHG emissions from food procurement

Measuring and reducing emissions associated with food and beverage procurement offers a sizable opportunity for healthcare decarbonization. While collaboration with food suppliers, contracted food service providers, and broadline distributors is essential, healthcare organizations should perform their own emissions calculations. Results can inform more sustainable purchasing and management decisions that reduce GHG emissions and better support staff and patient health. To measure and improve performance, healthcare organizations need to account for emissions related to the type, volume, and source of food purchased.

Key Strategies

Reduce Waste

Adopt food waste prevention and diversion programs

Initiatives to prevent food waste, coupled with efforts to appropriately manage and divert the waste, are effective strategies to reduce GHG emission associated within this domain. Food donation initiatives also divert waste from landfill or incineration and can aid in addressing food insecurity in the community.

Specific interventions to support food waste prevention and diversion include:

- Provide on-demand inpatient food services
- Establish patient-adjusted portion sizes
- Track food return/waste
- Compost organic waste into usable products
- Establish food recovery and donation

Reduce Emissions Intensity

Design plant-forward menus and retail options

Plant-forward diets that prioritize minimally processed plant-based foods contain fewer embodied carbon emissions compared with meat- and dairy-laden alternatives and can improve staff and patient health. Healthcare organizations can meaningfully reduce their GHG emissions and support sustainable food systems with the following tactics:

- Design inpatient menus with an abundance of plant-forward options and plant-based defaults
- Increase plant-forward retail food offerings for staff and visitors

Illustrative Vignettes

Sutter Health Valley Region

10 hospitals ranging in size from 40 to 523 beds (1,402 total beds) • Northern California, US

In 2020, Sutter Health implemented a food donation pilot program in their Valley Region facilities to reduce wasted food. From January 2020 to February 2021, the 10 hospitals donated almost 65,000 pounds of food to more than 40 area nonprofits within 5 miles of each facility using a food donation logistics company. This program diverted food waste from the landfill, reducing carbon emissions by 142 metric tons CO_2e (the equivalent of 32 gasoline-powered passenger vehicles driven for one year), and provided an estimated 54,000 meals to organizations addressing food insecurity in their communities. The pilot also led Sutter Health to expand the food donation program to six additional facilities within its health system.

UCSF Health

3 hospitals with 1,675 total beds • San Francisco, CA, US

UCSF Health has three hospital sites that serve approximately 2.3 million meals annually, comprising 537,000 patient meals and 1.7 million retail transactions with faculty, staff, students, and visitors. UCSF Health joined the Cool Food Pledge aimed at achieving a collective target of reducing GHG emissions from food by 25 percent by 2030.[38] Between 2017 and 2020, UCSF Health's plant-forward efforts have reduced the climate impact of the food served by 12.5 percent overall, translating to an 8 percent reduction in GHG emissions per meal—equivalent to 455 gasoline-powered passenger cars off the road annually. This effort was driven by a reduction of beef procurement by 28 percent, an increase in legumes by 13 percent, and an increase of almost 70 percent in plant-based milk during this time period.

Emerging Area: Carbon Accounting and Finance

Carbon accounting and finance is an emerging and important area of opportunity for GHG accounting and emissions reduction in healthcare. This domain relates to all three scopes of the GHGP.

Carbon accounting practices outline how GHG emissions are assessed within an institution and are transparently reported, offering insight into whether and how carbon emissions are internalized and translated into financial costs to inform purchasing and investment decisions. Meanwhile, carbon finance relates to non-capital investments encompassed within Scope 3 emissions. This includes the makeup of an organization's investment portfolio, including the proportion of fossil fuel holdings.

High-Priority Measures

Elective Measures
• Percent of investment portfolio aligned with net-zero targets

Percent of investment portfolio aligned with net-zero targets

Achieving the decarbonization of the healthcare sector, together with the global goal of net-zero emissions by 2050, will depend to some extent on how assets are managed. Therefore, it is advisable that healthcare organizations measure and improve assets management in line with the attainment of net-zero targets and timelines.

Healthcare organizations often possess significant portfolios of investments across asset classes such as listed equities and bonds. Organizations are responsible for their proportional share of the GHG emissions of these assets and need to account for these emissions as Scope 3 emissions.

Key Strategies

Use an internal price of carbon

Carbon pricing refers to initiatives that put an explicit price on GHG emissions (i.e., a price expressed as a value per ton of carbon dioxide equivalent). In 2019, 699 companies reported to CDP (formerly the Carbon Disclosure Project) that they are using an internal price on carbon. Internal carbon pricing (ICP) is a way to incorporate environmental metrics into financial decision making. ICP applies a cost to carbon emissions and a benefit to carbon savings. It increases the payback period of high-carbon projects and reduces the cost of carbon reduction projects. Most organizations that use ICP apply it in the form of a shadow price in investment and operational decisions. Sometimes the ICP is used to simply track anticipated compliance costs without directly affecting business decisions; in more influential uses of the ICP, it is embedded in overall cost calculations as a financial indicator, or internal carbon fees are collected and used for climate action or rewarding low-carbon decisions. As a very simple example, an organization may set a price of $150 to $300 per ton of CO_2e, adding that amount to the internal cost of any project that increases emissions or subtracting that amount for any project that decreases emissions.

Divest from fossil fuels

Healthcare organizations can begin to improve their performance in this domain by working with asset managers that have committed to reach net-zero emissions before 2050 across all "assets under management" (AUM), and evaluating these asset managers based on their respective levels of ambition

and demonstrated progress toward achieving their ambition. Organizations can consider requesting that asset managers formalize their commitments by signing onto the Net Zero Asset Managers Initiative (NZAM), an international group of asset managers committed to supporting these science-based targets and timelines. As part of the commitment to NZAM, asset managers must disclose:

- The initial percentage of their portfolio that will be managed in line with net zero goals
- Their “fair-share” interim targets for AUM that will be managed in line with net zero, and target date
- The methodology used in target setting

Signatories to the NZAM must also prioritize real economy emissions reductions, consider material Scope 3 emissions, increase investment in climate solutions, and create investment products in line with net zero. The signatories also agree to only use offsets that involve long-term carbon removal where there are no technologically and/or financially viable ways to eliminate emissions.

Accelerating Systemwide Decarbonization

System transformation is necessary to achieve the goal of halving emissions by 2030 and achieving net zero by 2050, as set forth by the international scientific community. Three critical shifts must take place within the next few years to accelerate systemwide decarbonization in healthcare:[39,40]

1. **Shift from cost-based to value-based accounting**

   As hospitals and health systems pursue value management strategies, they hold a tension between reducing waste and unnecessary care and observing sizable revenue streams from care. The traditional triple bottom line framework should be expanded to integrate the social, financial, and environmental costs of activities:

   $$\text{Value} = \frac{\text{Outcomes for Patients} \ + \ \text{Populations}}{\text{Environmental} \ + \ \text{Social} \ + \ \text{Financial Costs}}$$

   This approach would allow healthcare organizations to conduct full-cost accounting and weigh these costs against patient and population outcomes to calculate care value. This shift will require healthcare organizations and clinicians to work together to reduce unnecessary and wasteful care contributing to GHG emission to improve care value.

2. **Shift from a linear to a circular healthcare economy**

   With over 80 percent of healthcare emissions embedded in the supply chain, procurement decisions present a significant opportunity to curb carbon emissions. Adopting sustainable procurement practices requires a systemwide transition from a carbon-intensive, wasteful linear economy toward a circular approach, with an understanding of and appreciation for the embedded carbon present across the life cycle of products, materials, and services.

3. **Shift from curative to preventive models of care**

   Acute care is highly energy- and resource-intensive. An integral part of healthcare's sustainability strategy is shifting the point of care to less carbon-intensive settings that concurrently offer better access. This requires that health systems reduce demand by promoting health education, addressing health inequities and social determinants of health, strengthening telehealth options, and supporting upstream care management. Investments in public health infrastructure will further enable this transformational shift.

Healthcare organizations can begin their decarbonization journey by implementing the strategies outlined in this primer. It is important to note that for some domains there are myriad existing practice models that make these interventions feasible and highly impactful in the initial phase of a carbon mitigation strategy. For other domains, healthcare organizations must spur clinician and supply chain engagement, as well as drive innovation, to codify best practices. It is critical for healthcare leaders to develop a decarbonization strategy and prioritize action based on relative impact, feasibility, and time to deployment of the different interventions based on local needs. Well-established quality improvement methods can be a vehicle by which to advance these ambitions. See the Appendix on Strategic Improvement for more details.

Appendix

Glossary of Terms

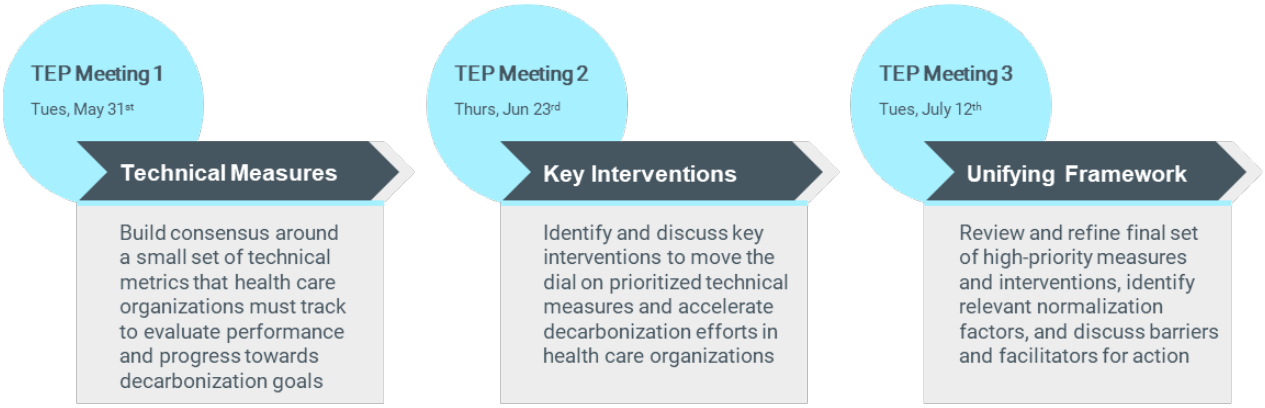
- **Baseline year**–A reference point in time against which emission reductions in the future are measured.
- **Carbon dioxide equivalent (CO_2e)**–Expression of heat trapping capacity of different types of greenhouse gas emissions using carbon dioxide as the standard unit of comparison. This enables straightforward, apples-to-apples comparisons of different climate impacts.
- **Carbon footprint**–Here, colloquially refers to the amount of carbon dioxide and other greenhouse gases that stem from a given activity.
- **Carbon offsets**–Purchased credits that support activities by an external actor that reduce greenhouse gas emissions or increase their removal from the atmosphere. Claims are only valid under a rigorous set of conditions, including that the reductions/removals involved are additional, not overestimated, and exclusively claimed. Further, offsetting can only be used to claim net zero status when used for residual emissions that cannot be mitigated.
- **Carbon price**–A financial instrument that captures the external costs of an entity's greenhouse gas emissions that the public pays for, such as through crop damages, healthcare costs from heat waves and droughts, and loss of property from flooding and sea level rise.
- **CDP**–The CDP (formerly the Carbon Disclosure Project) global disclosure system enables companies, cities, states, and regions to manage environmental impacts. CDP disclosure involves providing granular and data-focused information on greenhouse gas emissions and sources of energy consumption. CDP recognizes organizations with high-quality disclosure in its annual scoring process.
- **Circular economy**–An economic system design intended to eliminate waste and protect ecologic systems. Three fundamental principles of design include: 1) eliminate waste and pollution; 2) circulate products and materials (at their highest value); and 3) regenerate nature.
- **Decarbonization**–The process of reducing or removing greenhouse gas emissions produced directly or indirectly by activities.
- **ENERGY STAR®**–A program run by the U.S. Environmental Protection Agency and U.S. Department of Energy that provides guidance and promotes energy efficiency of buildings and appliances.
- **Energy use intensity (EUI)**–Represents the relative efficiency of a building's energy usage, which is calculated by dividing the total annual energy consumed (in units of 1,000 Btu, or kBtu) by the gross floor area (in units of square feet) of the building.

- **Greenhouse gas (GHG) accounting**–A process used to measure the amount of carbon dioxide equivalents (CO_2e) emitted by the activities of an entity such as an individual, population, organization, industry, or country.
- **Greenhouse gas (GHG) emissions**–Those gases released to our atmosphere that trap and radiate heat.
- **Greenhouse Gas Protocol (GHGP)**–A globally recognized accounting framework that is used for reporting and managing greenhouse gas emissions stemming from an enterprise. The Greenhouse Gas Protocol provides accounting and reporting standards, sector guidance, calculation tools, and trainings for businesses and local and national governments.
- **Linear economy**–The current economic model where raw materials are extracted and transformed into products that consumers use until discarding them as waste, with no concern for their ecological footprint and consequences, a so-called "take-make-dispose" system.
- **Net-zero**–The balance between the amount of greenhouse gas emitted and the amount removed from the atmosphere.
- **Plant-forward**–A diet that prioritizes consumption of plant-based foods, including fruits, vegetables, legumes, whole grains, and nuts and seeds, without being strictly limited to them.
- **Power purchase agreement (PPA)**–A long-term contract under which a business agrees to purchase electricity directly from a renewable energy generator.
- **Science-based targets**–Reduction goals set by an entity that comport with mitigation timelines set forth by the international scientific community, limiting global warming to 2°C above pre-industrial temperatures.
- **Triple bottom line accounting**–A sustainability framework that incorporates three dimensions of performance: social, environmental, and financial. The inclusion of environmental and social measures in an accounting framework makes it distinct from the traditional reporting standards.

Methods

The research activities for this project were informed through three virtual Technical Expert Panel (TEP) meetings held between May and July 2022. The aim of each TEP meeting is outlined in Figure 5 below.

Figure 5. Technical Expert Panel Meetings and Objectives



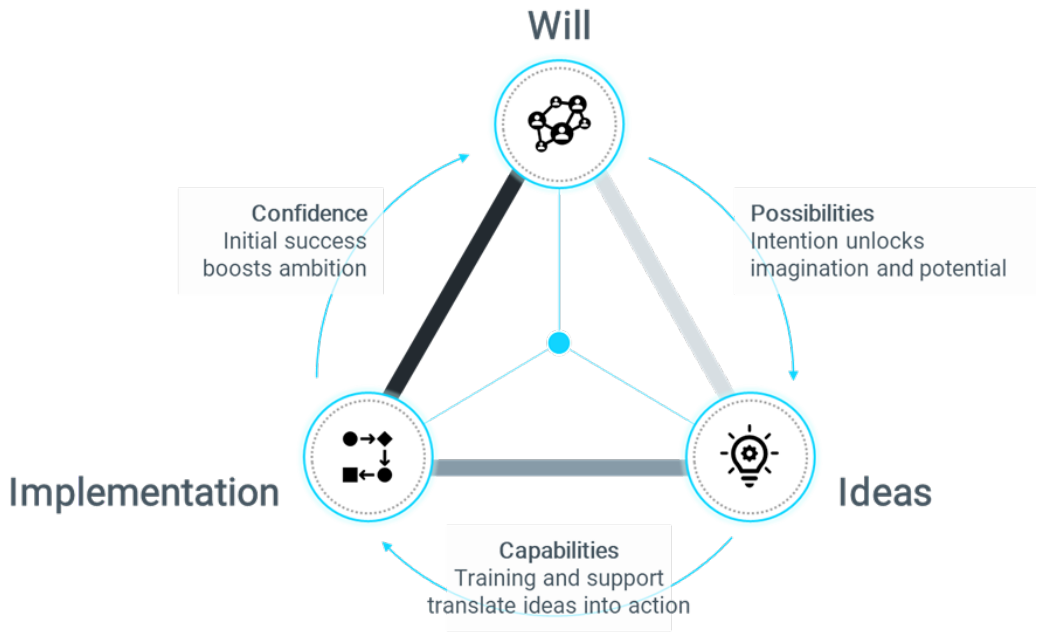
In advance of each TEP meeting, the Institute for Healthcare Improvement (IHI) team gathered input from the technical experts to inform the agenda and main points of discussion. Mechanisms to harvest ideas, insights, and guidance from the TEP members included surveys and one-on-one semi-structured interviews.

In addition, the IHI team conducted a literature review and semi-structured interviews with additional field experts and sustainability leaders of healthcare organizations in varying stages of decarbonization. These interviews served as an opportunity to assess the feasibility of emerging ideas from the TEP meetings and to understand organizational readiness considerations and challenges to implementing measures and recommended actions.

Framework for Strategic Improvement

IHI uses a simple framework to describe the essential elements for strategic improvement: Will, Ideas, and Implementation (see Figure 6).[41,42]

Figure 6. Framework for Strategic Improvement



Building Will

Achieving results at the system or organizational level requires building will at all levels, but especially the will of top management to make a new way of working attractive and the status quo uncomfortable.

Building will involves strong leadership focused on sponsoring measurement and improvement activities and establishing the structural enablers. Leaders must also allocate adequate resources to carry out work, enable the capture of baseline data to understand the current state, launch an institution-wide communication strategy to engage the workforce, and regularly review progress to understand and remove barriers to improvement. Organizations can apply the same tools and methods used in improving quality and safety to decarbonize their system.

Gathering Ideas

An improved system requires new ideas about ways of working to provide safe, high-quality care while reducing emissions. Ideas come from the experience and wisdom of technical experts, the insight and imagination of the workforce, and learning from organizations within and outside of healthcare. In addition to piloting these ideas, the strategies outlined in this primer offer broad recommendations on where healthcare organizations can begin decarbonization activities.

Supporting Implementation

Improving system-level performance requires action to translate change ideas into changes in processes and changes to purchased goods and services. IHI advocates for a learn by doing approach. Organizations are encouraged to conduct adequate testing and acquire strong evidence on the impact of change ideas before implementing them across their systems.

Resources to Support Measurement and Action Towards Decarbonization

Some publicly available resources recommended by experts to begin tracking and reducing GHG emissions include:

- **ENERGY STAR®**—Joint program run by the U.S. Environmental Protection Agency and U.S. Department of Energy to help organizations benchmark energy performance and improve energy efficiency. Portfolio Manager® is the ENERGY STAR® tool used to measure and compare energy performance of buildings.
- **Energy to Care Dashboard**—Tool developed by the American Society for Health Care Engineering (ASHE) that offers an at-a-glance view of healthcare facilities' energy use.
- **Better Buildings Solutions**—U.S. Department of Energy initiative that offers best practices to improve energy efficiency across sectors.
- **Leadership in Energy and Environmental Design (LEED) rating system**—A certification program developed by the U.S. Green Building Council that provides a framework for healthy, highly efficient, and cost-saving green buildings.
- **Building Research Establishment Environmental Assessment Method (BREEAM)**—A suite of validation and certification systems for sustainable built environment that involve assessments using scientifically-based sustainability metrics and indices which cover a range of environmental issues.
- **EPA SmartWay Program**—A public-private program launched by the U.S. Environmental Protection Agency that provides a comprehensive and well-recognized system for measuring, benchmarking, and improving freight transportation efficiency.
- **EPA Scope 3 inventory guidance**—Resources consolidated by the U.S. Environmental Protection Agency to track and reduce Scope 3 emissions.
- **GHGP Calculation Tools**—Cross-sector resources that help organizations estimate their GHG emissions based on the GHG Protocol.
- **Science-Based Targets Initiative**—Tools on target setting methods and guidance to set science-based targets in line with the latest climate science.
- **Healthcare Supply Chain Carbon Calculator**—A spend- and volume-based tool aligned with the GHGP framework that is specifically designed for healthcare organization accounting of emissions embodied in goods and services.
- **Designing a Net Zero Roadmap for Healthcare**—Health Care Without Harm's resource outlining technical methodology and guidance for national or regional health authority to measure its healthcare emissions and develop a Paris-compatible decarbonization roadmap.
- **Carbon Value Analysis Tool**—Screening tool to help companies integrate the value of carbon dioxide emissions reductions into energy-related investment decisions.

In considering tools to support their decarbonization efforts, healthcare organizations can use the following criteria to inform the selection of tools and data platforms:

1. **GHG Protocol Compliance**–The Greenhouse Gas (GHG) Protocol is a set of internationally accepted standards of measuring and reporting emissions. These standards are often the basis for accounting resources designed by organizations or consultancies, such as sector-specific guidance, calculation tools, and reporting programs. The "Built on GHG Protocol" mark recognizes accounting resources that are in conformance with Protocol standards.
2. **Third-Party Verification**–An independent third-party verification process serves to improve the overall assurance of the system and to bring additional expertise and scrutiny to bear. Tools and data platforms that are third-party verified meet a higher standard of consistency, transparency, and integrity as a resource.
3. **CDP Disclosure**–The CDP (formerly the Carbon Disclosure Project) global disclosure system enables companies, cities, states, and regions to manage environmental impacts. CDP disclosure involves providing granular and data-focused information on greenhouse gas emissions and sources of energy consumption. CDP recognizes organizations with high-quality disclosure in its annual scoring process.
4. **SBTi Alignment**–The Science Based Targets initiative (SBTi) offers guidance on setting science-based targets in line with the latest climate sciences and conducting independent assessment and validation of targets. Since SBTi doesn't currently assess targets for public sector institutions, educational institutions, and non-profit organizations, alignment with SBTi's criteria should suffice as an indicator of science-based emissions targets.

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