Health and Global Policy Institute (HGPI)
Planetary Health Project

Energy Conservation and Greenhouse Gas Emissions Reduction in Healthcare Facilities: Case Studies from New Construction and Facility Renewal

March 2026

HGPI Health and Global Policy Institute

Executive Summary

This collection of case studies draws on practical knowledge from three medical institutions, providing a replicable framework for medical organizations undertaking facility renewal, with the goal of simultaneously reducing greenhouse gas (GHG) emissions, improving operational management, and strengthening disaster response capabilities.

The "Triple Constraint": A Structural Challenge in Hospital Infrastructure

Hospital facility management, which involves the maintenance and renewal of hospital buildings and equipment to ensure safe and efficient day-to-day operations, is faced with a "triple constraint." First, government-set medical fees make it difficult to raise prices in response to rising labor and operational costs, leaving institutions with inadequate margins while providing medical care. Second, construction costs have surged due to inflation and rising material costs. Third, hospitals lack sufficient investment reserves (stocks) to address aging infrastructure. Together, these constraints interact in ways that undermine not just the structural integrity of hospitals, but also broader management issues and the stable provision of medical care. This results in a negative spiral that threatens the long-term sustainability of the healthcare system.

Potential for Simultaneous Solutions through Environmental Impact Reduction

Against these challenging circumstances, facility upgrades, such as new construction, expansion, renovation, and equipment replacement, should be reconsidered as strategic investments that simultaneously reduce environmental impact (energy consumption and CO_2 emissions) while improving business operations. For example, compact designs, known for minimizing excess space while preserving essential functions through streamlined layouts, not only lower construction costs, but also reduce future maintenance, utility, and staffing burdens by optimizing facilities and floor space. Additionally, the adoption of high-efficiency, energy-saving equipment decreases running costs.

Strategic subsidy utilization and support programs tied to energy conservation and renewable energy can reduce initial investment burdens while accelerating business improvements. Additionally, the planned integration of emergency power sources, distributed power sources, and improved building insulation can contribute to business continuity planning (BCPs), ensuring that hospitals can continue providing care even during disasters and recover rapidly in their aftermath. Such efforts represent a mid- to long-term strategy that aligns environmental responsibility, operational efficiency, and disaster resilience. They are also consistent with the global direction set by the World Health Organization (WHO)-led Alliance for Transformative Action on Climate and Health (ATACH), as well as domestic policy calls for strengthening the resilience of medical institutions.

Best Practices and Outcomes from Three Hospitals

This case study collection examines how three hospitals, Japanese Red Cross Kochi Hospital, Odawara Municipal Medical Center (formerly Odawara Municipal Hospital), and Kawakita General Hospital, successfully navigated these constraints. Though they differ in geography and governance, all three achieved simultaneous gains in environmental performance, management efficiency, and BCP resilience through reconstruction and facility renewal. From their experiences, practical knowledge at the planning, design, and operation stages of the facility renewal process has been extracted and condensed into six recommendations, which have been organized into three levels: strategy, design, and operation, and are presented in a form that can be applied to other medical institutions facing similar challenges.

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Six Recommendations Within a Hierarchical Framework

A cross-sectional analysis of three hospitals identified six recommendations for medical institutions seeking ways to reduce their environmental impact. These recommendations are organized into three tiers that are parallel with the facility renewal process:

[Strategy] Mobilizing Resources to Address Operational Challenges (Decision-Making and Framework Development)

Recommendation 1: Position environmental impact reduction as a strategic investment capable of overcoming core business challenges

Recommendation 2: Collaboration with external partners with specialized knowledge as an important prerequisite

Recommendation 3: Design a strategic framework for utilizing subsidies

[Design] Integrating Architectural Approaches and On-Site Knowledge (Building and Facility Concept)

Recommendation 4: Prioritize demand reduction and efficiency through passive architectural design

Recommendation 5: Gather insights through interviews from all departments during the design phase in order to capture operational realities

[Operation] Institutionalizing Continuous Improvement (Improving Through Use)

Recommendation 6: Systematize continuous operational PDCA using a Building Energy Management System (BEMS) or an equivalent platform

Significance of Case Studies

This collection of case studies aims to provide medical institutions nationwide with concrete, actionable knowledge for overcoming the triple constraints, whether they are currently planning, undertaking, or yet to begin reconstruction or renovation. It is our hope that these findings serve as a practical guide for institutions navigating decisions that balance environmental responsibility with operational resilience, and in doing so, contribute to building a sustainable healthcare system.

1. Survey Background

1.1 Changes in the business environment surrounding medical institutions and the increasing difficulty of investing in facility renewal

Hospitals are operating under mounting pressure. Although renewing aging infrastructure and equipment is essential to maintaining safe, high-quality care, the conditions required to do so has steadily become more difficult. This case study collection refers to this predicament as the "triple constraints", a situation in which three mutually reinforcing factors make necessary facility renewal increasingly difficult to achieve: (1) a weakened financial position, (2) a sharp rise in construction costs, and (3) capital investment limitations brought about by the medical fee system. This section examines the structure of the triple constraints and makes the case for why reducing environmental impact represents a viable strategic pathway to overcoming them.

1.1.1. The Triple Constraint Structure

(a) **First constraint: Weakened Financial Position**

Many hospitals continue to suffer chronic losses. With limited growth in medical fees, opportunities to improve profitability are narrow. In fact, by fiscal year 2024, approximately 70% of hospitals were projected to operate at a loss in medical fee profits, and approximately 60% in operating profits, highlighting the difficulty of maintaining fiscal stability through medical fee income alone.[1] Hospitals are struggling to sustain day-to-day provision of medical services, leaving limited capacity to secure funds for medium- to long-term investments, such as facility reconstruction, major renovations, and replacement of outdated equipment.

(b) **Second constraint: Sharp Rise in Construction Costs**

Many hospitals built in the postwar period are now over 30 to 50 years old and are well overdue for renewal. However, a combination of inflation, currency volatility, and rising labor and material costs has caused construction and equipment costs to soar in recent years. In 2024, the unit cost of hospital construction was projected to reach 442,000 yen per square meter, with costs for acute care hospitals nearly double that amount.[2] As a result, projected rebuilding or renovation expenses often exceed initial estimates by a significant margin. These escalating project costs are creating substantial financial uncertainty, making it more difficult for hospitals to make investment decisions.

(c) **Third constraint: Capital Investment Limitations within the Medical Fee System**

The medical fee system is designed primarily to support the provision of day-to-day medical services. However, it has been pointed out that the system is not structured to adequately finance “stock-type” investments, such as rebuilding facilities or undertaking large-scale renovations. While operational expenditures (flow) can be covered through medical fee revenues, capital investments in buildings and equipment (stock) require separate funding streams. This structural limitation creates an imbalance in which financially weaker medical institutions face greater difficulty undertaking essential renewal investments. As a result,

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[1] Japan Hospital Association, All Japan Hospital Association, & Japan Association of Medical Corporations. (2024). *Regular survey on hospital management: Executive summary,Final report (aggregated results)*. https://hmps.hospital.or.jp/pdf/06_20241116_01.pdf

[2] Welfare and Medical Service Agency. (2025). *FY2024 construction costs of welfare and medical facilities*. https://www.wam.go.jp/hp/wp-content/uploads/250722_No004.pdf

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facility and equipment upgrades are often postponed, and are more likely to become obsolete.

1.1.2. The vicious cycle created by the triple constraints

These three constraints do not operate in isolation; rather, they interact in mutually reinforcing ways and create a self-perpetuating vicious cycle. Declining financial performance reduces hospitals' capacity to invest in renovations, while rising construction costs further undermine the feasibility of renewal plans. Consequently, renovation projects are postponed, scaled back, or abandoned altogether, allowing facilities to continue deteriorating. Aging infrastructure, in turn, leads to higher maintenance, repair, and utility costs, placing additional strain on hospital finances. This dynamic generates a negative spiral: inability to renovate → progressive deterioration → worsening financial performance → further inability to renovate.

This cycle is particularly evident in rural areas and among small- and medium-sized hospitals, where limited operating margins and weaker fundraising capacity make it extremely difficult to address facility aging while simultaneously strengthening medical functions. Even core institutions that support regional healthcare systems are increasingly unable to undertake necessary renewal investments, despite fully recognizing their urgency.

1.2 Potential for simultaneous solutions by reducing environmental impact

Despite this challenging financial environment, initiatives aimed at environmental impact reduction should not be regarded as isolated environmental measures. Rather, they can be strategically positioned as integrated solutions that simultaneously address managerial, facility-related, and disaster resilience challenges faced by medical institutions.

1.2.1. Conventional Misconception: Environmental Measures as Additional Costs

Environmental initiatives, such as energy conservation, are often perceived as "additional expenses incurred for the sake of the environment" in the context of facility development or equipment renewal. This perception represents one of the greatest barriers preventing medical institutions from proactively addressing environmental issues. In reality, environmental measures are not merely ethical or regulatory obligations. When properly designed and implemented, they can function as high-impact strategic investments that directly contribute to solving core management challenges faced by hospitals.

1.2.2. Characteristics of Energy Consumption in Medical Institutions

Hospitals typically consume significantly more energy per unit area than general commercial facilities. This is due to their diverse energy demands, including air conditioning, heating and cooling, hot water supply, lighting, and the operation of advanced medical equipment. Moreover, hospitals operate 24 hours a day, 365 days a year, under strict requirements for temperature control, humidity regulation, and infection prevention. Because energy costs constitute a substantial fixed expense in hospital management, energy efficiency initiatives should not be regarded as peripheral measures but as high-priority management strategies. By reducing utility expenses and lowering maintenance and operational burdens, energy-saving investments can directly improve financial performance while simultaneously advancing environmental sustainability.

1.2.3. Three Strategic Benefits Achieved in Parallel

Efforts to reduce environmental impact can simultaneously generate three forms of value:

(a) **Operational Cost Optimization**

Multiple cases have reported annual energy consumption reductions of approximately 10–30% through the introduction of high-efficiency equipment, improvements to building envelope insulation, and the implementation of energy management systems (BEMS: Building Energy Management System/EMS: Energy Management System).[3,4] These measures not only lead directly to lower utility costs, but also help extend equipment lifespan and reduce maintenance demands, contributing to long-term operational stability.

(b) **Strengthening Resilience (BCP measures)**

ZEB (Net Zero Energy Building) is a building approach that significantly reduces energy consumption through high-performance insulation and high-efficiency systems, while aiming to achieve a near-zero annual primary energy balance through the integration of renewable energy sources. The adoption of on-site renewable energy systems, such as solar power generation combined with battery storage, provides benefits beyond routine energy savings. In the event of a disaster, these systems enhance energy self-sufficiency and help secure a minimum level of electricity supply. For medical institutions, ensuring continued power availability during outages is essential to maintaining healthcare services and represents a highly valuable BCP measure.

(c) **Mitigating Construction Cost Risks**

Design innovations, including building compactness, optimized facility capacity planning, and improved circulation and traffic flow, can contribute to reducing overall construction costs. In addition, the strategic utilization of subsidies related to ZEB initiatives can alleviate the initial investment burden while enabling the development of high-performance facilities.

1.2.4. Positioning as a Strategic Investment

In this context, environmental impact reduction measures can be seen as medium- to long-term strategic investments that simultaneously enhance operational efficiency, environmental sustainability, and disaster resilience, rather than additional financial burdens. For medical institutions operating under severe financial constraints, such initiatives represent a critical pathway toward strengthening long-term management stability and ensuring the sustainability of healthcare delivery systems. Amid the structural challenges posed by the “triple constraints,” leveraging environmental impact reduction as a means to address these issues in an integrated manner may constitute one of the most realistic and effective strategic breakthroughs available.

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[3] Ministry of the Environment. (n.d.). *ZEB PORTAL – Net zero energy building (ZEB) portal: Case study,Ueda Hospital*. https://www.env.go.jp/earth/zeb/case/tech_05.html

[4] EMI Co., Ltd. (n.d.). *Case study: Rakuwakai Healthcare System (Otowa Memorial Hospital)*. https://emi-group.co.jp/casestudy/rakuwa_hospital/

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1.3. International and domestic policies support decarbonization of medical institutions
Efforts by medical institutions to decarbonize and reduce their environmental impact are not solely voluntary decisions at an individual level, but also closely aligned with broader international and domestic policy trends.

(a) **International Trends: Decarbonization of the Healthcare Sector as a Global Policy Agenda**
Internationally, the Alliance for Transformative Action on Climate and Health (ATACH), led by the World Health Organization (WHO), is advancing efforts to reduce greenhouse gas emissions and strengthen climate resilience within the health sector. ATACH supports countries that have declared commitments to climate and health action, including through the assessment of climate change–related vulnerability and adaptive capacity (V&A) and the development of Health National Adaptation Plans (HNAPs). The Government of Japan officially joined ATACH in May 2024.

In addition, the 28th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP28) established a dedicated "Health Day" for the first time and adopted the Declaration on Climate and Health, highlighting the growing recognition of health within global climate policy. This momentum has also been reflected in WHO governance processes. Following the adoption of resolution WHA77.14[5] at the 77th World Health Assembly, the Global Plan of Action on Climate Change and Health (GPoA)[6] was further deliberated and adopted at the 78th World Health Assembly, marking significant progress toward the establishment of international policy guidance in this field.

Furthermore, at the 30th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP30) in November 2025, the Government of Japan shared its domestic initiatives with the global community, reaffirming that environmental measures in the healthcare sector constitute an important international agenda.

These developments send a clear message that the decarbonization of medical institutions and the strengthening of their resilience are no longer isolated efforts pursued by individual facilities, but rather firmly positioned within the international policy agenda. Thus, Japan's participation in ATACH presents a valuable opportunity to accelerate concrete actions toward achieving net-zero emissions across its healthcare system.

(b) **Domestic Policy: Clear Positioning of Medical Institutions in Environmental and Energy Policies**
Japan's domestic policy framework equally provides a strong foundation for this agenda. Both the "Grand Design and Action Plan for a New Form of Capitalism (2025 Revised Edition)"[7] and the "Fundamental Plan for National Resilience"[8] explicitly call for the need to reduce the

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[5] World Health Organization. (2024). *Climate change and health* (WHA77.14). https://apps.who.int/gb/ebwha/pdf_files/WHA77/A77_R14-en.pdf

[6] World Health Organization. (2025, May 15). *Climate change and health: Draft global action plan on climate change and health,Report by the Director-General* (A78/4 Add.2). https://apps.who.int/gb/ebwha/pdf_files/WHA78/A78_4Add2-en.pdf

[7] Cabinet Secretariat. (2025, June 13). *Grand design and action plan for a new form of capitalism, 2025 revised edition*. https://www.cas.go.jp/jp/seisaku/atarashii_sihonsyugi/pdf/ap2025.pdf

[8] Cabinet Secretariat. (July 28, 2023). *Fundamental Plan for National Resilience*. https://www.cas.go.jp/jp/seisaku/kokudo_kyoujinka/pdf/kk-honbun-r057028.pdf

environmental impact of medical and welfare facilities, improve energy efficiency, and strengthen their capacity to continue operating in the event of a disaster. The former promotes green transformation (GX) across all areas of social infrastructure, prioritizing "Kurashi (Life) GX," which supports insulation upgrades and the introduction of high-efficiency equipment in the residential sector. This extends to medical and long-term care facilities, articulating a clear policy direction toward a low-carbon, climate-resilient healthcare system. Moreover, waste generated by the healthcare sector, traditionally treated separately from broader resource circulation discussions, is now being considered within the framework of a circular economy, signaling a policy shift toward integrating decarbonization and resource efficiency strategies.

Meanwhile, the Fundamental Plan for National Resilience recognizes medical institutions as critical disaster response hubs and underscores the importance of ensuring uninterrupted care during emergencies. Specifically, the plan covers a comprehensive set of measures to support business continuity, including reinforcing on-site power generation at disaster base hospitals, improving water supply infrastructure, securing emergency communications through satellite systems, and promoting the development and implementation of BCPs.

To translate these policy principles into concrete actions, the Ministry of the Environment, the Ministry of Economy, Trade and Industry, and other organizations are developing a range of financial support programs available to medical institutions. These include grants for achieving Zero Energy Building (ZEB) certification, subsidies for renewable energy installation, and funding schemes for distributed and self-sustaining energy systems that advance both decarbonization and regional resilience. Regional decarbonization promotion grants and related funding mechanisms are also being expanded. Taken together, Japan's policy environment is increasingly designed to encourage medical institutions to pursue energy efficiency, renewable energy adoption, and disaster resilience in an integrated manner, particularly when undertaking facility upgrades or renewal projects.

(c) **Policy Direction: Integrating Environment, Management, and Disaster Response**

In light of these international and domestic developments, environmental impact reduction measures, such as energy efficiency improvements and the adoption of renewable energy, can no longer be viewed as purely environmental initiatives. They are increasingly positioned as core strategies that simultaneously advance the quality and safety of medical care, ensure financial sustainability, and secure business continuity during disasters. Going forward, building a truly sustainable healthcare system will require the integrated pursuit of environmental action, disaster preparedness, and operational efficiency, not as separate tracks, but as mutually reinforcing priorities advanced in concert.

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2. Survey Overview: Three Advanced Cases

This collection of case studies highlights the practices of three hospitals (Japanese Red Cross Kochi Hospital, Odawara Municipal Medical Center (formerly Odawara Municipal Hospital), and Kawakita General Hospital) as leading examples of institutions that have overcome the "triple constraints" facing medical institutions, simultaneously achieving environmental sustainability, management improvement, and strengthened BCP. Although these hospitals differ in geographic location and governance structure, each has pursued environmental impact reduction through unique and context-specific approaches. Their experiences offer practical, adaptable insights that may serve as valuable references for a wide range of medical institutions.

While this collection of case studies focuses primarily on rebuilding projects, future iterations plan to feature cases in which environmental impact has been reduced through renovations and equipment upgrades. For many medical institutions where full-scale reconstruction is not feasible, leveraging existing facilities while incrementally improving energy efficiency and environmental performance represents a realistic and highly practical pathway toward sustainability.

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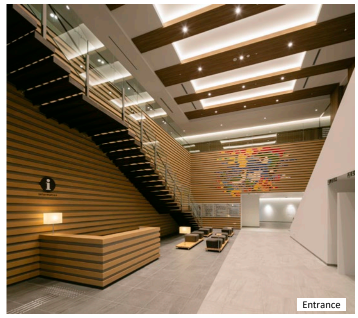
Keyword: ZEB Ready ・Disaster Response ・Compact Design ・Multiple Subsidies ・BEMS

Low-Carbon Transition Case 1：Japanese Red Cross Kochi Hospital


Hospital Exterior


Entrance


4-Bed Room

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1. Facility Overview and Funding / Subsidies

Location: 1-4-63-11 Hadaminami-cho, Kochi Prefecture (16 minutes on foot from JR Kochi Station; 12 minutes by public transportation)
Operated by: Japanese Red Cross Society
Facility Certifications / Designations: Regional Disaster Base Hospital, Regional Medical Support Hospital, Emergency and Critical Care Center (among others)

【Construction Cost and Subsidies】
Total Cost： Approximately JPY 20 billion
Subsidy for Promoting Investment in Energy Conservation｜JPY 810 million
Prefectural Subsidy for Modernization of Medical Facilities｜JPY 330 million
Prefectural Subsidy for Emergency and Critical Care Center Facility Development｜JPY 70 million
Prefectural Subsidy for Regional Disaster Base Hospital Facility Development｜JPY 10 million
Prefectural and Municipal Repayment Cost Subsidy (20-year projected amount) | JPY 1.24 billion

Founded in 1928 as the Kochi Prefecture Branch Clinic of the Japanese Red Cross Society, the facility was renamed Kochi Red Cross Hospital in 1933. As a core regional general hospital, it provides 24-hour emergency and advanced medical care, while delivering seamless services ranging from health checkups to preventive care.

	Previous Hospital	New Hospital
Completion Date	Renovated and expanded in 1995	March 2019
Number of Beds	468 beds	403 beds
Site Area	10,254.95㎡	28,842.56㎡
Total Floor Area	26,112.66㎡ (including administrative building and on-site nursery)	32,849㎡ (including on-site nursery)
Structure	Main Building (steel reinforced concrete; 7 stories above ground with 1 basement level) South Building (steel reinforced concrete; 7 stories above ground with 1 basement level)	Seismic isolation, steel reinforced concrete with partial steel frame; 8 stories above ground
Floor Area per Bed	Approx. 55㎡	71.1㎡

2. Green Systems

Category	Technology	Innovative Approach	Direct Effects	Secondary Effects
Building Impact Reduction	Compact design (71.1 m² per bed) / High-performance insulation (sprayed polyurethane foam, polystyrene foam) / Low-E insulated glass units / Cool tube	Corridors were lessened by streamlining circulation in common areas and reducing walls. Patient areas were designed to maintain openness through window placement and interior design. Insulation and window openings were optimized according to orientation. Stable underground temperatures were also leveraged.	Consistent reduction of annual heating and cooling demands / Reduce solar heat transfer and heat loss	Improved staff communication through the consolidation of shared spaces
Air Conditioning and Heating	Absorption chillers (gas/heavy fuel oil A switchable) / Air-cooled heat pump chiller (modular type) / VAV air conditioning units / High-efficiency packaged air conditioners	Fuel switching is based on price and disaster risk. Only necessary units operate during low load periods. Capacity is adjusted via inverter.	Improved partial load efficiency / Reduction of excessive air supply and ventilation / Reduction of peak power consumption	Enhanced resilience (fuel diversification) / Extended equipment lifespan by reducing unnecessary operation
Electricity and Hot Water Supply	Micro-cogeneration units (35 kW × 10 units) / Electric hot water heat pumps (various capacities) / High-efficiency transformers / LED lighting with motion, light, and time-based controls (sensor coverage >90%)	Multiple units are distributed, with operation adjusted seasonally and by time of day. Heat pumps are partially installed in mechanical rooms to reduce piping lengths. Lighting is managed to automatically shut off by default.	Lower primary energy use via on-site generation and waste heat recovery / Major reduction in lighting and standby losses / Alleviation of heat in mechanical rooms	Enables review of contracted power / Increased awareness of excessive lighting accelerates on-site improvements
Supervision Systems	BEMS (visualization by department and equipment) / Utilization of energy service providers	Visualize energy demand, operating hours, and peak periods, and optimize setpoints through seasonal PDCA cycles.	Early detection and correction of unnecessary operation / Peak reduction	Shortening the cycle for identifying improvement opportunities / Easier verification of effectiveness of measures

Low-Carbon Transition Case 1 : Japanese Red Cross Kochi Hospital

3. Implementation Plan and Overview

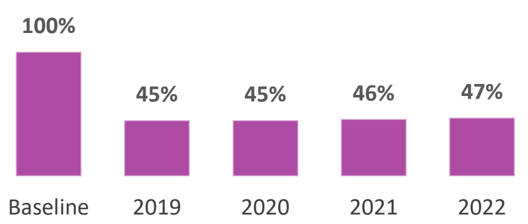
Beginning with the completion of the Main Building in 1957, the hospital underwent a series of expansions and renovations—including the construction of the North Building, extensions and refurbishments of the Main Building, and the construction of the South Building—resulting in a total of six new construction and renovation projects by 1995. While aging and space constraints continued to worsen, efforts to identify a suitable relocation site in the surrounding area faced significant difficulties.

- **March 2011** Great East Japan Earthquake

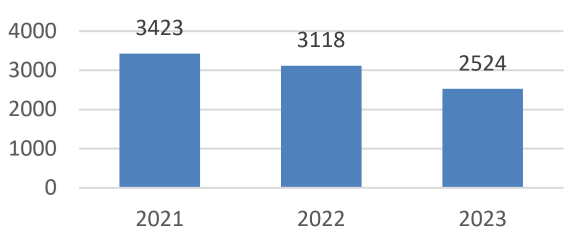
Following the earthquake, it was determined that the site of the former hospital was within an area projected to experience long-term flooding. In contrast, the redevelopment site of a former factory—identified as a potential relocation candidate—was found to have a lower flood risk. By coordinating with the planned relocation of a fire station designated as a disaster response base, it was concluded that the new site could provide enhanced wide-area disaster response capabilities. Consequently, the decision was made to relocate to this site.

- **2013** Construction of New Hospital Announced (Relocation and Reconstruction)
- **April 2014** Formulation of Basic Concept and Plan
- **November 2014** Selection of Design and Supervising Consultants
- **October 2015** Completion of Basic Design
- **October 2015** Selection of Energy Service Provider
- **March 2017** Groundbreaking Ceremony for New Hospital Relocation and Construction
- **March 2017** Construction of New Hospital Begins
- **March 2019** Completion of New Hospital
- **May 2019** New Hospital Opens
  Former Hospital Sold (Land and Buildings)

Annual Energy Consumption (vs. Baseline)



CO_2 Emissions from Energy Use（tCO_2）



Disaster response was prioritized while making the building compact through design ingenuity. By reducing the total floor area, energy demands were lowered, maintenance was simplified, and operational efficiency was improved. Common area ratios were compressed to approximately 10% of total floor area (compared to the typical ~30%).

- Staff movement routes were minimized
- Major equipment was consolidated on areas such as rooftops to make effective use of interior space

【Catalyst for ZEB Implementation】
Although the basic plan had already been finalized, a proposal from the energy service provider prompted extensive discussions between the hospital, the design firm, and the service provider. Deliberations continued even after construction began, ultimately leading to a finalized plan.

【Achieving ZEB Ready】
For each system, energy reduction effects and cost-effectiveness were rigorously evaluated. Considering regulations and price levels at the time, the introduction of a large-scale solar power system was deferred due to limited economic feasibility. Instead, individual equipment was selected at the highest performance standards available at the time, and the overall design was carefully reviewed to avoid additional construction costs. Through the systematic elimination of inefficiencies, **ZEB Ready** was successfully achieved.

【Operational Innovations and Achievements】
Continuous monitoring and data management via the central control system (BEMS) enabled optimization by department, equipment, and season. Through iterative adjustments, energy consumption steadily decreased, reaching levels below those required for designated factories under the Energy Conservation Act. Contracted power capacity has also been gradually reduced. Furthermore, visualizing usage patterns has raised staff awareness, establishing a PDCA cycle of cause analysis and corrective action.

【Best Practices Sharing】
The hospital has already received numerous requests for site visits and information exchange and has been responding accordingly. Opportunities to present the project at academic conferences and other gatherings have also emerged, with proactive dissemination carried out not only by the hospital but also by the design and construction firms involved. Within the Japanese Red Cross Group, consideration is being given to scaling across other sites.

Lessons Learned and Key Messages

With disaster response identified as the highest-priority, it is essential to ensure close coordination with regional disaster management from the site selection stage. By incorporating the necessary elements for decarbonization from the early design phase, rework and additional investments in later stages can be avoided, allowing the overall project cost to be controlled while smoothly advancing the process from planning through construction. A compact design that carefully examines required functions reduces unnecessary floor area and equipment, not only lowering initial investment but also designing for smaller future energy demand, thereby simultaneously reducing long-term operational costs and environmental impact.

Keyword: ZEB Ready ・Regional Decarbonization ・CM/DB Method ・Multiple Subsidies ・Field-Oriented

Low-Carbon Transition Case 2: Odawara Municipal Medical Center

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1. Facility Overview

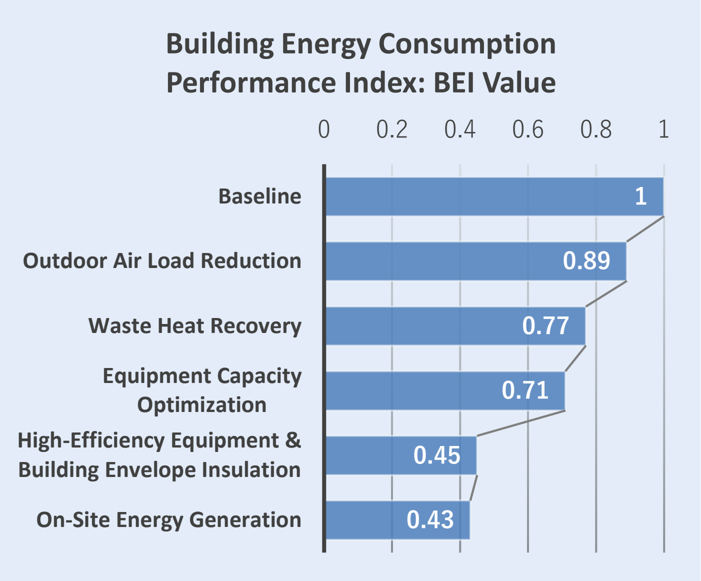
Location: 46 Kuno, Odawara City, Kanagawa Prefecture (1.6 km on foot from JR Odawara Station, 7 minutes by public transportation)
Operated by: Odawara City
Facility Certifications / Designations: Regional Medical Support Hospital, Emergency and Critical Care Center (Tertiary Emergency Care), Regional Cancer Treatment Coordination Hospital, Regional Perinatal and Maternal-Child Medical Center, Disaster Base Hospital, Managing Clinical Training Hospital (among others)

In 1951, Odawara City, which was among the first in Japan to implement the National Health Insurance system (NHI) in cities with populations over 100,000, established this public core hospital in 1958 to support this system and provide stable medical care to its citizens (9 departments, 110 beds). The hospital was completely rebuilt in 1985, resulting in the current facility with 417 beds, 15 departments at the time of renovation (28 departments today).

	Present Hospital	New Hospital
Completion Date	March 1985	February 2026
Number of Beds	417 beds	406 beds
Number of Clinical Departments	28 departments	30 departments
Site Area	21,968.78 ㎡	23,021.60 ㎡
Building Area	6,192.52㎡	6,911.09 ㎡
Total Floor Area	25,026.26 ㎡	42,234.16 ㎡
Structure	Steel reinforced concrete; 7 stories above ground with 1 basement level	Seismic isolation, steel frame; 9 stories above ground, 41.243m
Floor Area per Bed	Approx. 60㎡	Approx. 104㎡

2. Green Systems

Category	Technology
Reduction of Outside Air Load (Ventilation)	Optimized patient room ventilation through night-mode switching Ventilation control using CO2 sensors
Waste Heat Recovery (Air Conditioning)	Water-source heat pump (using waste heat) Heat-recovery heat pump (using waste chilled water)
High-Efficiency Equipment (Ventilation and Air Conditioning)	Set air conditioning and ventilation capacity appropriate for operational needs
Efficiency Improvement and Building Envelope Load Reduction	High-efficiency air conditioning system, high-efficiency lightning, rooftop greening, low-E pair glass units, solar radiation shading
Energy Generation	Micro-cogeneration Solar power generation



Low-Carbon Transition Case 2: Odawara Municipal Medical Center

3. Implementation Plan and Overview

As the facility approached its 40th year, rebuilding became necessary in order to address the aging and spatial limitations of the building and equipment, ensure business continuity, and retain personnel.

- **February 2014** The Odawara Municipal Hospital Management Council identified the necessity of early reconstruction.
- **December 2018** Formulation of the "Basic Plan for the Redevelopment of Odawara Municipal Hospital"
- **December 2020** Formulation of the "Basic Plan for the Construction of the Odawara City New Hospital"
- **April 2021** Public Solicitation for Design-Build
- **November 2021** Execution of the "Basic Agreement for the Odawara City New Hospital Construction Project" with the selected contractor.
- **November 2022** Odawara City Selected as Ministry of the Environment Decarbonization Leading Area
- **December 2022** Basic Design Completed
- **September 2023** Reassessment of Construction Costs

During the design phase, additional costs (approximately ¥9.6 billion) arose due to increased material expenses caused by yen depreciation and surging raw material, crude oil, and logistics costs, as well as higher labor costs stemming from wage increases and labor shortages. However, an understanding was reached because the construction cost per square meter remained competitive at approximately ¥629,000/㎡ compared to market rates.

- **December 2023** Completion of Actual Design and Execution of the Construction Contract
- **January 2024** Groundbreaking Ceremony; Construction Begins
- **July 2024** Construction Contract Amendment (1st)

In response to rising construction costs, a project cost revision of approximately ¥1.68 billion was required. The FY2024 Prefectural Hospital Function Consolidation Subsidy (approximately ¥50 million) was allocated as an additional funding source.

- **August 2024** Obtained ZEB Ready Certification At Design Phase
- **December 2024** Construction Contract Amendment (2nd)

An inflation escalation clause* was applied to the remaining construction works from July 2024 onward, resulting in an increase of approximately ¥520 million in the contract amount. The Prefectural Hospital Function Consolidation Subsidy, which formed part of the financing, was likewise increased.

- **October 2025** Construction Contract Amendment (3rd)

Similarly, for the remaining construction works from March 2024 onward, the contract amount was increased by approximately ¥800 million, and the Prefectural Hospital Function Consolidation Subsidy was also increased.

- **February 2026** Scheduled Completion of New Hospital Transition to Phase II Construction (Planned: Demolition of the Existing Hospital, Exterior Works, Construction of a Multi-Story Parking Structure, etc.)

Since 2016, through the introduction of management consulting and leadership from hospital executives, management improvements have been implemented based on **interviews with medical staff and administrative departments**. Since then, effective management has been consistently maintained. Although the hospital faced a critical situation during the COVID-19 pandemic, it overcame the crisis through a unified response.

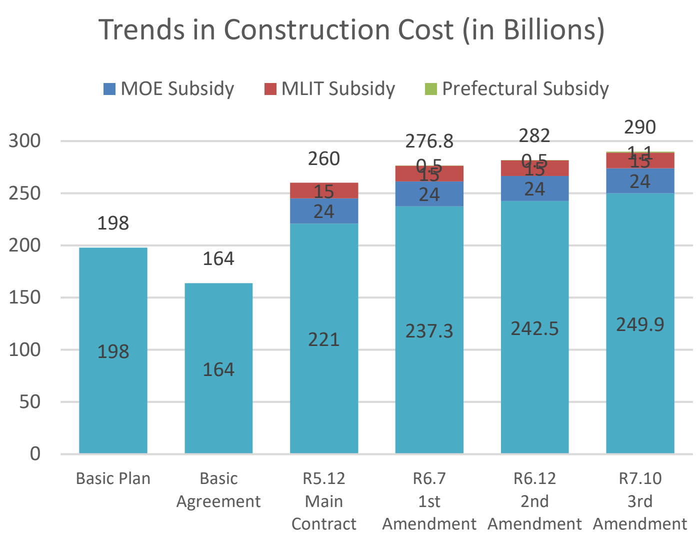
From the initial planning stage, support was provided by a **construction management (CM) firm** to provide supplemental knowledge on hospital construction projects, as well as to augment staffing shortages.

To flexibly respond to changes in the social environment, such as legal systems and technological innovations, that may occur between planning and completion, a **Design-Build (DB)** method was adopted.

As part of the ongoing Odawara City Urban Regeneration Plan (Odawara Station Area), the project was designated as a priority recipient of the Ministry of Land, Infrastructure, Transport and Tourism's Intensive Support Grant for Urban Restructuring, securing ¥1.5 billion in funding.

The project was positioned as a core initiative within the Decarbonization Leading Area model, with the aim of **promoting environmental awareness and behavioral change among citizens**. Funding is being utilized from the Ministry of the Environment's "Regional Decarbonization Transition and Renewable Energy Promotion Grant" (approximately ¥2.4 billion expected). After opening, the hospital plans to achieve net-zero CO_2 emissions from electricity consumption through the use of renewable energy power sources, including locally generated energy.

At each stage—basic planning, basic design, detailed design, and construction—interviews with hospital representatives were conducted to incorporate on-site perspectives throughout the process. About 4-6 sessions were held per stage, each lasting approximately two hours, with 37 hospital departments.



*Inflation Escalation Clause: As stipulated in Article 26, Paragraph 6 of the Construction Contract Agreement, this provision allows the contract amount to be revised through consultation between the client and the contractor in response to unforeseen and rapid price fluctuations during the construction period.

Lessons Learned and Key Messages

Against a backdrop of sound management and organizational culture, the project aligned with urban planning and regional decarbonization strategies, as well as broader healthcare policies, enabling it to secure a diverse subsidies. By introducing CM, project requirements were clarified from the early planning stages, and through the adoption of the Design-Build (DB) method, it became possible to respond flexibly to changes in the social environment and construction conditions while carefully incorporating on-site feedback. Rising construction costs were addressed through thorough explanations and meticulous consensus-building with citizens, the city council, and relevant departments.

Keyword: Regional Development Plan ・ZEB Oriented ・BCP ・Organizational Culture

Low-Carbon Transition Case 3: Kawakita General Hospital

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1. Facility Overview and Funding / Subsidies

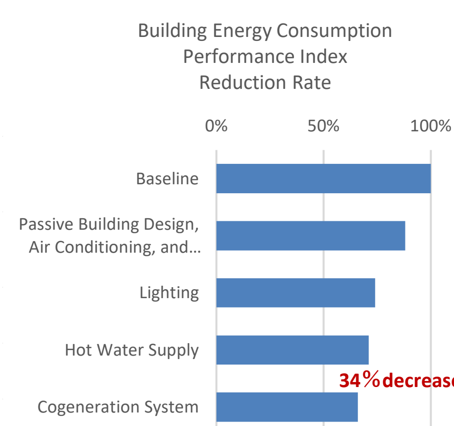
Location: 1-6 Asagayakita, Suginami-ku, Tokyo (3 minutes on foot from JR Asagaya Station）
Operated by: Kawakita Medical Foundation
Facility Certifications / Designations: Core Clinical Training Hospital, Regional Medical Support Hospital, Priority Referral Hospital (among others)

In 1928, Kawakita Hospital was established in Suginami Ward with 30 beds, initially focusing on providing internal medicine and pediatric care to meet the needs of the local community. Through four phases of construction during the mid-Showa period, the hospital facilities expanded to over 300 beds. Following subsequent renovation and upgrade projects, in 2004, the Kawakita General Hospital Branch (76 beds) was opened, bringing the total number of beds to 407. In 2010, the organization changed its legal status to a "Social Medical Corporation – Kawakita Medical Foundation." Since then, it has developed into a general hospital responsible for advanced acute and emergency care in the region, fulfilling its role as a core hospital for the community for many years.

	Previous Hospital	New Hospital
Completion Date	Main Building: 1974 Annex: 2004	July 2025
Number of Beds	331 (Main Building) + 76 (Annex) = 407 beds	353 beds
Site Area	6970.53 (Main Building) + 1688.69 (Annex) ＝8,659.22㎡	11,163.21㎡
Building Area	5333.93㎡	4,846.45㎡ (93.16㎡ of which is parking space)
Total Floor Area	18,236.96 (Main Building) + 3,978.33 (Annex) ＝22,215.29㎡	32,844.43㎡ (1,290.52㎡ of which is parking space）
Structure	Earthquake-resistant, reinforced concrete; 5 stories above ground with 1 basement level (partially 3 stories above ground, 4 stories above ground)	Seismic isolation, RCST (Reinforced Concrete Steel Tube) with partial steel frame; 9 stories above ground with 1 rooftop
Floor Area per Bed	54.58㎡	89.39㎡

2. Green Systems

Category	Technology	Details
Passive (Energy-Saving) Building Design (Enhanced Building Envelope Performance/Impact Reduction)	Envelope Insulation and Solar Shading	Low-E insulated glass units were adopted. Existing trees on the site, including preserved zelkova trees, were retained as much as possible and utilized for solar radiation shading.
	Building Layout and Openings	The ward buildings were arranged along an east–west axis, taking advantage of the site configuration. Openings on the east and west façades were minimized to reduce solar heat gain.
Active Technology (Air Conditioning and Heating)	Mixed Heat Sources	Both electric and gas heat sources were adopted. A high-temperature-difference water supply system was introduced in the central system to reduce pumping energy.
	CGS (Cogeneration System)	A micro gas cogeneration system (Genelight 35kW × 3 units) was introduced, utilizing waste heat for hot water supply and heating.
	High-Efficiency Heating Equipment	Natural chillers (1,125 kW × 2 units) and high-efficiency heat pump water heaters were introduced.
Active Technology (Ventilation)	Ventilation Volume Control	Based on patient activity levels, metabolic rates, and reduced odor generation during nighttime hours, an eco-ventilation mode was implemented in patient rooms, reducing airflow to 50% of normal levels at night.
Active Technology (Lighting)	High-Efficiency and Control	LED lighting was adopted throughout. Occupancy (motion) sensor controls and time-schedule controls were tailored according to room function.



Projected annual reductions of 1,260 tons of CO_2 and approximately JPY 37 million in running costs

Low-Carbon Transition Case 3: Kawakita General Hospital

3. Implementation Plan and Overview

- Since 1986, the organization has upheld the philosophy of "Pursuing Better Healthcare in Harmony with the Global Environment," engaging in environmental initiatives and education across the entire institution. These efforts have been recognized through achievements such as becoming the first medical institution in Japan to obtain ISO 14001 certification and receiving the Minister of the Environment Award at the 2015 "Environmental Human Resource Development Awards," organized by the Ministry of the Environment.
- Meanwhile, existing hospital buildings had been in use for a long time, undergoing repeated expansions and renovations. The oldest building was over 70 years old. While energy-saving measures, such as converting lighting to LED and introducing cogeneration systems, were implemented with careful evaluation of their effectiveness, the buildings reached their limits due to structural and equipment deterioration. Meeting the functional demands of modern medical standards and needs also became increasingly difficult.

2012 Launch of the Grand Design Project for the Construction of the New Hospital

"Why rebuild?" : The discussion went beyond addressing only structural aging, but on realizing "a space where staff can work with pride" and establishing "a next-generation healthcare model for the community." It was ultimately decided that relocation and new construction were essential to realizing these goals.

November 2018 Agreement on Promoting Urban Development in the Northeast Area of Asagaya Station Between the Ward and Landowners

・Execution of agreement between the three parties

August 2019 Commencement of Land Readjustment

In addition to the aging hospital, the aging and cramped neighborhood elementary school, and disaster prevention challenges resulting from the area's designation as an earthquake-preparedness zone, there were also issues in ensuring safe access routes for emergency vehicles and preserving the remaining local woods *(yashikirin).* These complex issues were addressed comprehensively through a land readjustment project, aiming to create a safe and sustainable community.

"A Hospital in a Forest": Preserving as much as possible the natural environment of the *yashikirin* (residential woods) that has long been cherished by the community, striving towards harmony with nature, and aiming to create a hospital that is environmentally responsible and gentle to nature, patients, and staff alike.

September 2022 Decision on Design and Construction

To realize the concept, the project:

1. Preserved as much of the on-site protected woodland as possible, utilizing the characteristics of deciduous trees (providing shade in summer, while allowing sunlight in winter)
2. Used locally sourced Tama timber for the entrance and lobby interiors
3. Introduced a hospital corridor (a bright, open corridor space used by patients and visitors) designed with full-height glass walls, creating a space where the changing seasons can be felt
4. Additionally proposed achieving **ZEB Oriented** standards

Total Construction Cost: approximately JPY 20 billion; Equipment Cost: approximately JPY 5 billion
Selected for the FY2022 ZEB Demonstration Program (JPY 460 million), covering roughly half of the additional costs for achieving ZEB status
Also utilized subsidies for timber use and for postgraduate clinical training infrastructure development

Challenge: Increase in Electricity Demand to Ensure Reliability and Comfort
Adoption of individual air-conditioning units: To avoid the risk of system-wide malfunction (e.g. multiple patient rooms being affected by the failure of a single outdoor unit), **individual air conditioning was installed in all patient rooms**. ⇒ As a result, contracted power (electrical) capacity increased significantly.
Abandonment of extra-high-voltage power supply: Although an extra-high-voltage power supply was initially desired to strengthen disaster resilience, it was ultimately abandoned due to infrastructure development costs.

Solution: Integration of High-Efficiency Equipment and Gas-Based ZEB
Deployment of ultra-high-efficiency equipment: High-cost but **top-runner-standard**, ultra-high-efficiency equipment—including absorption chillers and other major systems—was installed to minimize electricity consumption to the greatest extent possible.
Introduction of Gas ZEB: To offset the constraints imposed by increased electrical capacity, a gas-utilizing ecosystem (Gas ZEB) was implemented.

February 2023 Construction Begins

May 2025 Construction Completed

July 2025 New Hospital Opens
Demolition of Former Hospital

Perceived Effect: Improved Comfort
Complaints from patients and staff regarding air conditioning have virtually disappeared.
Areas such as the ECG examination room—where temperature control had previously been difficult due to adjacency to rooms like the ultrasound suite—can now maintain individually optimized settings, enabling a more comfortable working environment.

Key Concerns
As a result of enhancing advanced medical equipment such as linear accelerators and improving services through IT integration (e.g., medical monitors, call systems), power consumption has increased beyond initial estimates.

Operational Innovations and Countermeasures
A hybrid management system combining data analysis through the Building Energy Management System (BEMS) with on-site inspections and fine-tuning by facility managers.
Given that the new hospital differs significantly from the former facility, operational improvements will initially focus on data collection and analysis.

Lessons Learned and Key Messages

By fully leveraging elements of the surrounding environment, the hospital redevelopment was positioned not as an isolated project, but as core infrastructure aligned with the local government's district plan to address broader challenges in the area, and thus establishing a sustainable operational foundation. Furthermore, beyond simply introducing environmentally responsible equipment, it is essential to continuously monitor operational performance and implement improvement cycles. Synergistic effects are expected through alignment with the environmental culture that has already been cultivated within the organization.

3. Analysis and Discussion: Six Key Recommendations

Through a cross-sectional analysis of the initiatives undertaken by the three hospitals, six key recommendations were identified as common success factors in achieving environmental impact reduction. These recommendations capture practical knowledge at each stage —from planning, design, construction, and operation— and are organized into three layers: strategy, design, and operation.

[Strategy] Mobilizing Resources to Address Operational Challenges (Decision-Making and Framework Development)

- **Recommendation 1:** Position environmental impact reduction as a strategic investment capable of overcoming core business challenges
- **Recommendation 2:** Collaboration with external partners with specialized knowledge as an important prerequisite
- **Recommendation 3:** Design a strategic framework for utilizing subsidies

[Design] Integrating Architectural Approaches and On-Site Knowledge (Building and Facility Concept)

- **Recommendation 4:** Prioritize demand reduction and efficiency through passive (energy-saving) architectural design
- **Recommendation 5:** Gather insights through interviews from all departments during the
- design phase in order to capture operational realities

[Operation] Institutionalizing Continuous Improvement (Improving Through Use)

- **Recommendation 6:** Systematize continuous operational PDCA using a Building Energy Management System (BEMS) or an equivalent platform

This hierarchical structure illustrates both the chronological progression, formulating a strategy, translating it into design, and refining it through operation, and the increasing level of sophistication from foundational to advanced practices. Importantly, medical institutions are not expected to implement all six measures simultaneously. Rather, the priority is to assess each facility's specific circumstances, set clear priorities, and advance initiatives in a phased and strategic manner.

It is hoped that this collection of case studies will provide concrete, practical knowledge for medical institutions nationwide that are considering rebuilding or undertaking major renovations to overcome the "triple constraints."

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4. Six Recommendations for Reducing the Environmental Impact of Medical Institutions

This chapter analyzes three case studies, Japanese Red Cross Kochi Hospital, Odawara Municipal Medical Center (formerly Odawara Municipal Hospital), and Kawakita General Hospital, drawing on findings from interviews. It examines the commonalities, distinctive features, and key success factors observed across the three institutions, focusing on the strategic thinking, decision-making processes, and design and operational innovations that enabled them to successfully implement environmental impact reduction measures.

Although these regional core hospitals differ in geographic location, governance structure, and reconstruction history, a number of shared elements were identified at each stage of planning, design, construction, and operation. By summarizing these insights, six particularly important recommendations have been distilled for advancing environmental impact reduction in medical institutions. These recommendations are expected to offer practical and transferable guidance for healthcare providers nationwide that are considering rebuilding or undertaking major renovations in the future.

[Strategy] Mobilizing Resources to Address Operational Challenges (Decision-Making and Framework Development)

Recommendation 1: Position environmental impact reduction as a strategic investment capable of overcoming core business challenges

The first step in reducing environmental impact is to clearly define the initiative's strategic purpose and approach to resource mobilization. Rather than treating it as an "additional investment for environmental purposes," it must be reframed as a strategic investment aimed at addressing core management challenges, proactively leveraging subsidies and policy support mechanisms, and drawing on external expertise where necessary. Across all three cases, a key commonality was that leadership established a clear policy direction and strategically secured the necessary resources (human capital, specialized knowledge, and funding) to realize it. This strategic alignment significantly shaped the quality and effectiveness of subsequent design and operational phases.

Notably, in all three institutions, measures such as energy efficiency improvements and renewable energy adoption were pursued not simply because they were "good for the environment," but because they were seen as practical responses to pressing management challenges, including:

- Rising utility and fuel costs
- Increased maintenance costs due to aging facilities
- Growth in contracted power capacity in response to growing demand
- Risk of power outages during disasters and vulnerabilities in BCP
- Heavier maintenance burden resulting from labor shortages

These are not isolated operational concerns; rather, they represent structural risks with direct implications for the sustainability of healthcare delivery. In response, all three hospitals pursued environmental impact reduction with the goals of streamlining management, extending building lifespan, and strengthening disaster response capabilities.

As a result, the following environmental and disaster prevention outcomes have been achieved:

- Reduction of primary energy consumption
- Decrease in carbon dioxide (CO_2) emissions
- Improved indoor comfort and safety
- Enhanced energy self-sufficiency during power outages (strengthened resilience)

These results demonstrate that environmental measures are not undertaken merely for the sake of the environment, but constitute strategic investments essential for sustainable management. Reframing decarbonization in this way offers a potentially transformative perspective for discussions on sustainability within medical institutions.

Recommendation 2: Collaboration with external partners with specialized knowledge as an important prerequisite

A close examination of the three cases reveals that the impetus for pursuing ZEB and reducing environmental impact did not necessarily originate from within the hospitals themselves.

- **Japanese Red Cross Kochi Hospital**: After the master plan had been finalized, a proposal was received from an energy service provider. Through extensive discussions between the hospital, the design firm, and the provider, full-scale consideration of ZEB implementation began.
- **Odawara Municipal Medical Center (formerly Odawara Municipal Hospital)**: In coordination with the municipal environmental department, the hospital's transition to ZEB was considered as a major redevelopment project.
- **Kawakita General Hospital**: During the design phase of the new hospital, the contractor proposed adopting a "ZEB Oriented" approach, a strategy for large-scale facilities that improves overall building energy performance and reduces energy consumption by approximately 30–40%. Because this aligned with the foundation's philosophy and the chairman's policy direction, the proposal was adopted.

These cases demonstrate that hospital executives and facility managers do not necessarily need to possess in-depth knowledge of the latest ZEB technologies or subsidy frameworks. What is critical is establishing a governance structure that is open to, and capable of thoroughly evaluating, expert proposals from external partners, such as design firms, construction companies, ESCOs (Energy Service Companies) that receive compensation based on reduction in utility costs, and relevant government bodies. Identifying and leveraging the expertise of capable partners represents a realistic first step toward advancing environmental impact reduction in medical institutions.

Recommendation 3: Design a strategic framework for utilizing subsidies

The three cases demonstrate that subsidies were not treated merely as mechanisms to fill financial gaps. Rather, they functioned as strategic levers that shaped both the definition of the project itself and the quality of its design.

- **Strategic level (framework)**: Odawara Municipal Medical Center (formerly Odawara Municipal Hospital) decided not to treat its reconstruction as a standalone hospital redevelopment. Instead, it strategically positioned the project as part of urban function consolidation (urban development). As a result, the project successfully attracted not only

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healthcare-related subsidies but also substantial funding beyond the medical sector, including the Ministry of the Environment (Regional Decarbonization Transition and Renewable Energy Promotion Grant: estimated amount of approximately 2.4 billion yen) and the Ministry of Land, Infrastructure, Transport and Tourism (Urban Structure Reorganization Support Project: approximately 1.5 billion yen). Similarly, Kawakita General Hospital entered into agreements between the ward, hospital, and landowners to promote urban development. Its rebuilding project has been incorporated into a broader land readjustment and area redevelopment scheme.

- **Tactical level (design)**: At Japanese Red Cross Kochi Hospital and Kawakita General Hospital, meeting ZEB subsidy requirements (insulation performance, energy reduction rate, among others) directly became a driver for improving the quality of design. Japanese Red Cross Kochi Hospital achieved ZEB Ready (reduced primary energy consumption by 50% or more) through collaboration with their energy service provider, while Kawakita General Hospital also used ZEB subsidies (460 million yen) to introduce top-runner equipment.

The common thread across all three cases is not simply using subsidies but strategically designing a project framework in which subsidies can be utilized, and then using the associated requirements as levers to raise design quality. This is the critical insight shared by all successful cases.

[Design] Integrating Architectural Approaches and On-site Knowledge (Building and Facility Concept)

Recommendation 4: Prioritize demand reduction and efficiency through architectural design (passive design)

Across all three cases, the greatest energy-saving effects were achieved not by installing highly efficient equipment, but by improving the building's inherent efficiency and reducing its energy loads in the first place. Specific approaches included:

- **Reduced loads by optimizing floor space and streamlined circulation routes**
  (e.g., Japanese Red Cross Kochi Hospital reduced its common area from approximately 30% of the total floor area to about 10%, improving both thermal loads and staff movement efficiency.)
- **Strengthening the building envelope performance (insulation and heat shielding performance)**
  (e.g., double glazing, optimized insulation, and solar shading. At Kawakita General Hospital, improved insulation has enhanced comfort, to the point where heaters are no longer needed in the electrocardiogram examination room during winter)
- **Incorporating passive (energy-saving) design such as natural lighting and ventilation**
  (A prominent design feature of the new Kawakita General Hospital)
- **Optimizing the capacity of heat sources and air conditioning equipment**
  (Capacity settings that match operational needs, reducing both initial and ongoing costs)

This passive design approach produces long-term energy-saving effects that cannot be achieved through installing highly efficient equipment alone. Success depends not on which equipment to install but on which loads to reduce. This is consistent with the core principles of ZEB and is an extremely important perspective for medical institutions undergoing reconstruction or large-scale renovations, as it also serves as a practical countermeasure to the second constraint: rising construction costs.

Recommendation 5: Gather insights through interviews from all departments during the design phase in order to capture operational realities

In all three cases, extensive dialogue with frontline staff during the design phase and a true understanding of actual working conditions proved decisive in determining the effectiveness of energy-saving measures.

- **Odawara Municipal Medical Center (formerly Odawara Municipal Hospital)** conducted five to six rounds of two-hour interviews with each of its 37 clinical departments at every stage of the construction project, incorporating on-site information on workflows, safety, and logistics directly into the design.
- **Japanese Red Cross Kochi Hospital** benchmarked comfort indicators, including lighting levels, air conditioning settings, and noise, against the perceptions of frontline staff, and made room-level adjustments to temperature settings in response to patient feedback, with operational flexibility built into the design.

As a result, the benefits that were realized include:

- Elimination of unnecessary equipment
- Optimized facility layouts
- Stronger staff buy-in and cooperation
- Reduced operational discrepancies post-design
- Lowered initial investment

Rather than the performance value of the energy-saving equipment, it is important to consider whether the design can be operated on-site. The depth of interviews at the design stage is one of the most important factors that determine the effectiveness and sustainability of reducing environmental impact.

[Operation] Institutionalizing Continuous Improvement (Improving Through Use)

Recommendation 6: Systematize continuous operational PDCA using a Building Energy Management System (BEMS) or an equivalent platform.

The final commonality across all three cases is that the real-world effectiveness of installed equipment is largely determined by continuous improvement after installation.

- **Kawakita General Hospital** has embedded detailed BEMS monitoring and feedback mechanisms within the environmentally conscious culture cultivated under the foundation's guiding philosophy of "healthcare in harmony with the global environment," with synergistic effects anticipated as a result.
- **Japanese Red Cross Kochi Hospital** also employs continuous monitoring and data management through BEMS, iterating systematically at the operational stage, including through trial-and-error adjustments to outdoor air intake temperature settings, the introduction of automatic air conditioning timers by department, and incremental reductions in contracted electricity demand based on accumulated data, to sustain an active PDCA cycle.

All three hospitals shared the operational philosophy of achieving a 70-point baseline through design and construction, then advancing toward 100 points through the PDCA cycle of ongoing operation.

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The environmental impact of medical institutions can only be fully realized when the stages of design, construction, and operation are treated as a seamless continuum rather than discrete phases. The six recommendations presented in this report provide concrete, practical knowledge for achieving that goal.

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