Case Study

Holy Family Hospital's World Class Decarbonization Retrofit

Holy Family Hospital (HFH), operated by Providence Health Care in Vancouver, BC, has undergone a series of retrofit initiatives guided by Providence's commitments to exceptional care, sustainability, and innovation. Upgrades completed between 2021 and 2023 cut carbon emissions by 75%, earning "Best in World" recognition from the International Federation of Healthcare Engineering (IFHE). Providence didn't stop there, further upgrades are ongoing which have exceeded 85% carbon reduction. This case study outlines the strategies, challenges, and outcomes of these efforts to inform similar decarbonization initiatives.

Project Background

Providence Health Care and Holy Family Hospital

Providence is a faith-based health care provider committed to delivering high-quality patient care while practicing strong environmental stewardship. The organization aims to "be the public health care sector industry environmental sustainability leader in B.C. by exceeding the goals laid out in the Provincial Clean BC Plan," including a 50% reduction in GHG emissions from public sector buildings by 2030 (relative to 2010 levels). Providence has made significant progress toward this target. Its *2024 Climate Change Accountability Report* (1) shows a 28% reduction in carbon emissions across all facilities since 2010.

This success stems from integrating sustainability goals into everyday decision-making and embedding climate risk and resilience planning into major capital projects. For example, when HFH—a 326-bed rehabilitation and residential care facility—required upgrades to improve patient comfort and address aging infrastructure, Providence used the opportunity to also tackle rising energy costs and advance its climate commitments.

Holy Family Hospital Overview

- **Original construction:** 1947
- **Beds**: 65 Acute / 126 LTC
- **Floor Area:** 121,000 Sq. ft.
- **Location:** South Vancouver, B.C
- **Type:** Acute Care (Rehabilitation) and Long-Term Care

Motivation and Drivers

- **Aging Infrastructure:** HFH's mechanical systems were outdated, relying heavily on natural gas boilers for heating and domestic hot water
- **High Carbon Footprint:** About 70% of the hospital's energy use was natural gas, responsible for 95% of its carbon emissions.
- **Limited Cooling:** Rising summer temperatures exposed shortcomings in cooling systems, affecting patient and staff comfort.
- **Space Constraints:** Retrofit options are always constrained by the existing mechanical rooms with limited space for small changes let alone major new equipment; in this case the constraint was partially reduced by the forward-thinking original design team who left space for future cooling equipment.
- **Climate Goals:** Providence aimed to meet and exceed provincial and federal decarbonization targets.
- **Operational Resilience:** The retrofit was designed to enhance patient comfort, reduce operational risks, lower costs and future-proof the facility.

Project Execution and Impact

The capital upgrades at HFH built on Providence's track record of successful projects that achieved multiple objectives cost-effectively through an integrated approach.

A key precedent was set in 2018 when a failed chiller at St. Paul's Hospital led to the installation of a heat recovery chiller and the thermal gradient header (TGH)—an advanced heat recovery system invented by Canadian mechanical engineering firm Thermenex. This project cut energy use, carbon emissions, and operating costs while boosting overall facility performance. The innovation stemmed from a simple idea: treat heat not as waste but as a resource.

The success of this small project led to harnessing this powerful idea and the TGH technology again to achieve similar benefits at two other Providence facilities: St. Vincent's Brock Fahrni and St. Vincent's Langara.

Tony Munster joined Providence as Executive Director in 2020 and secured funding to add mechanical cooling to these two long term care homes in order to address rising temperatures due to climate change. In simple terms, both projects added a heat recovery chiller to deliver cooling and a TGH to enable waste heat recovery, achieving over 80% carbon reduction by taking a holistic approach to both thermal energy and asset management.

Image 1: HFH rooftop unit (before retrofit). Source: Ben Mills, Impact Engineering (2).

Image 2: Heat recovery coil into exhaust air stream (major waste heat source - after retrofit). Source: Ben Mills, Impact Engineering (2).

Mechanical Upgrades

Building on these past successes, Providence partnered with Impact Engineering and Thermenex to tackle aging infrastructure at HFH with the goal of reducing carbon emissions by 80%. Project Manager Lawrence Penkar led the effort for Providence, coordinating closely with both firms. Impact Engineering served as the prime consultant, delivering the energy study, engineering design, and measurement and verification (M&V) services. Thermenex contributed their expertise in construction management, systems integration, and the innovative TGH technology, designed to integrate seamlessly with existing HVAC systems to reduce fossil fuel use and operating costs.

The energy study and design started in 2020 and core mechanical scope was completed in phases spanning 2021 to 2023. Before the retrofit, all heating and service hot water needs were supplied by the two existing Cleaver Brooks boilers, partial cooling was provided by direct expansion (DX) units, and an aging heat pump and glycol run-around system recovered some waste heat. The retrofit removed one gas boiler and added four smaller condensing gas boilers, two electric boilers, two heat recovery chillers and new exhaust heat reclaim coils, all connected by the TGH system to deliver a unified heating, cooling, heat rejection and waste heat collection system. Together, the team turned necessary infrastructure upgrades into a strategic investment, aligning environmental sustainability with operational efficiency.

> **"You need someone with a clear vision who can keep everyone focused — and Tony Munster was that person. He set ambitious goals, and as engineers and contractors, we appreciated that drive."**
>
> Ben Mills, Professional Engineer and Founding Principal, Impact Engineering,

Window Upgrades and Solar PV Installation

Building on the success of the award-winning retrofit, Holy Family Hospital continued to pursue ambitious sustainability improvements.

Driven by their commitments to exceptional care, sustainability, and innovation, Providence extended its efforts with targeted upgrades to the building envelope and renewable energy systems—further enhancing patient comfort, reducing energy use, and advancing the hospital's low-carbon goals.

From January 15 to March 14, 2024, George Gemmell, Project Manager with Providence, led the replacement of the North Building's original 1954 single-pane windows, which had long exceeded their lifespan.

Image 3 (left): Two Cleaver Brooks boilers (before retrofit). Source: Ben Mills, Impact Engineering (2). Image 4 (right): TRANE RTWD heat recovery chiller (integrated with TGH and electric boilers to replace previous chiller and gas-fired boilers - after retrofit). Source: Ben Mills, Impact Engineering (2)

Deteriorated seals, frames, and glass contributed to significant heat loss and gain, increasing reliance on HVAC systems and reducing occupant comfort.

The installation of Silex 2100-series triple-glazed windows dramatically improved thermal performance. Enhanced seals, frame materials, argon-filled cavities, and low-e coatings reduced drafts, stabilized indoor temperatures, and lowered energy use and HVAC maintenance.

Residents and staff experienced greater comfort, while the building's safety, energy efficiency, and visual appeal were significantly improved. All work was completed without disrupting patient care, thanks to the phased retrofit plan and close collaboration among staff, engineers, contractors, and administrators. During installation, certified crews safely mitigated asbestos and lead paint using containment, negative pressure, and HEPA filtration measures. The results were immediate: lower utility costs, improved thermal comfort, and reduced emissions.

Post-installation feedback highlighted a reduction in heating and cooling demand, with some spaces requiring downward adjustments to heating, generating further energy savings.

In parallel, Marc Adams, Project Manager with Providence, led the installation of 370 solar photovoltaic (PV) panels on the HFH roof, covering approximately 1,126 square metres and generating a total of 200 kilowatts (kW) of direct current (DC) power.

The system is supported by a kinetic rail framework and polymer pedestals designed to withstand snow and wind loads.

Image 5 (left): HFH before solar installation. Image 6 (right): HFH after solar installation. Source: Photo by Ali Miri from Opticon Visuals with permission from Providence.

Image 7 (left): Original 1954 single-pane windows, before replacement. Image 8 (right): New silex 2100-series triple-glazed windows. Source: George Gemmel, Providence Health Care (2).

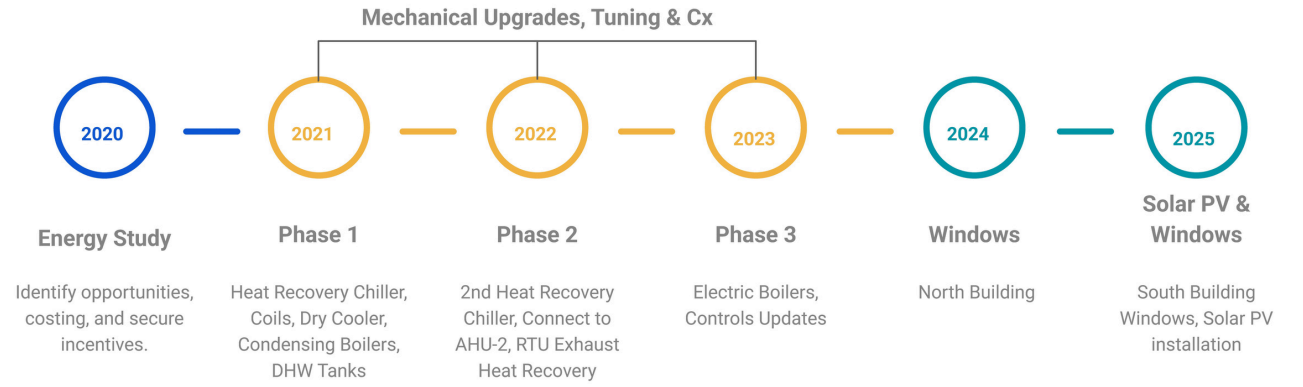


Figure 1: Holy Family Hospital Project Timeline. Source: Ben Mills, Impact Engineering (2).

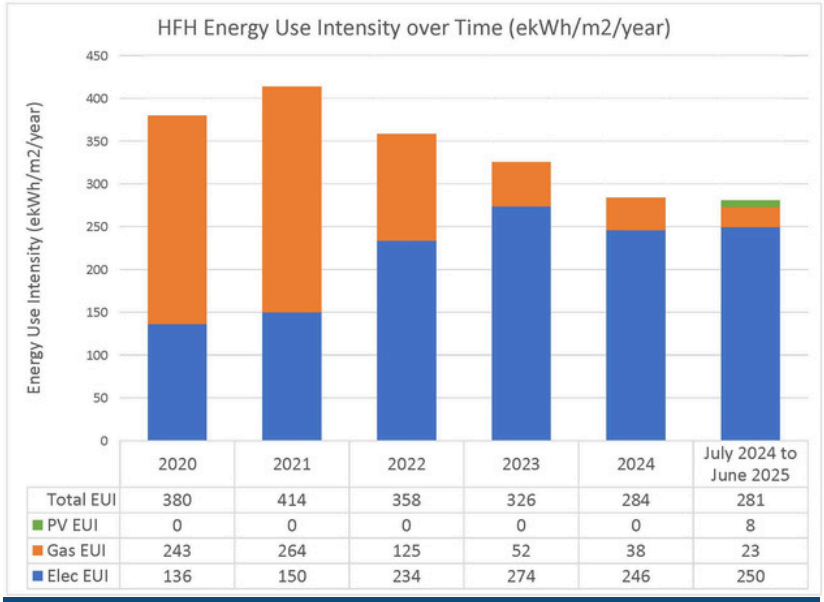
Electricity produced by the panels is managed through a SolarEdge system with three 50 kW alternating current (AC) inverters connected to a three-phase, 600-amp combiner panel.

The system is projected to produce approximately 211 megawatt-hours (MWh) annually—enough to power 18 average Canadian homes for a year—while offsetting about 20% of the hospital's peak electricity demand and about 7% of annual electricity consumption.

Phased Retrofit Approach

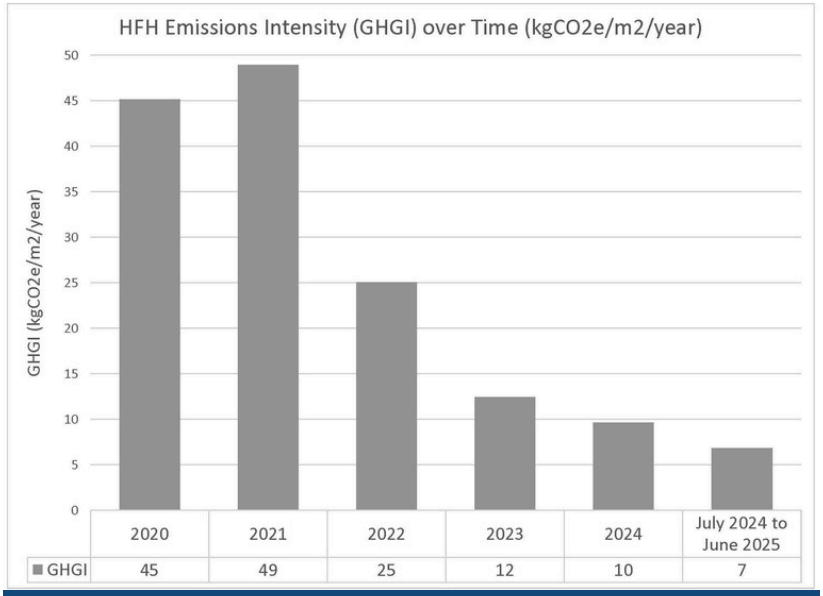
To minimize disruptions to patient care and critical hospital operations, the HFH retrofits were implemented in phases over time as outlined in Figure 1. Figure 2 and Figure 3 show the energy and carbon emissions intensity (per square meter) over the same time period.

When viewed together, these three figures illustrate that the core mechanical scope completed between 2021 and 2023 achieved most of the gas savings, with additional savings coming in 2024 and into 2025 as windows were replaced; that overall energy intensity decreased due to increased efficiency of thermal energy management (namely greater waste heat recovery and more efficient heat rejection); and that electricity consumption increased during the mechanical upgrades due to the addition of full cooling and a shift to providing the remaining heating needs from electricity (heat recovery chillers and electric boilers).



	2020	2021	2022	2023	2024	July 2024 to June 2025
Total EUI	380	414	358	326	284	281
PV EUI	0	0	0	0	0	8
Gas EUI	243	264	125	52	38	23
Elec EUI	136	150	234	274	246	250

Figure 2: HFH Energy Use Intensity over time (ekWh/m2/year). Source: Providence Health Care.



	2020	2021	2022	2023	2024	July 2024 to June 2025
GHGI	45	49	25	12	10	7

Figure 3: HFH Emissions Intensity (GHGI) over time (kgCO2e/m2/year). Source: Providence Health Care.

Summary - Solutions Implemented

Thermal Gradient Header (TGH) Technology

- A single-pipe system that integrates heating and cooling systems by redistributing thermal energy within the building, treating heat as a reusable resource rather than waste.
- Enabled recovery and reuse of waste heat generated from cooling processes, reducing overall energy demand.
- Eliminated the need for large tanks typically required for heat recovery, saving significant mechanical room space.

Heat Recovery Chillers and Boilers

- Installation of heat recovery chillers that capture waste heat for domestic hot water and space heating.
- Addition of electric boilers to complement condensing boilers, allowing for lower supply temperatures (down to ~140°F), improving overall system efficiency.

Exhaust Air Heat Recovery and Heat Rejection

- The previous glycol runaround heat recovery was replaced with new exhaust air heat recovery units with greater potential to capture waste heat; the TGH enables them to reject heat as well, reducing the need for other heat rejection equipment
- These units were made with aluminum to reduce the weight and avoid structural upgrade work.

Advanced HVAC Controls

- Implemented demand-controlled ventilation and occupancy-based scheduling.

Building Envelope Upgrades (Post Award)

- Replacement of original 1954 single-pane windows with triple-glazed, argon-filled high-efficiency windows.
- Significantly improved thermal insulation, reduced drafts, and enhanced indoor comfort.
- Comprehensive asbestos and lead paint abatement measures were incorporated during window replacements to ensure safety.

Renewable Energy Integration (Post Award)

- Installation of a rooftop solar photovoltaic (PV) system with 30 panels (200+ kW capacity).
- The solar array provides approximately 20% of the hospital's peak electricity demands, tracked via real-time monitoring.

> **"Providence Health Care proactively invests in building infrastructure projects to provide high quality spaces for our clients and staff.**
>
> **For the Holy Family Hospital Project, the aim was to renew older HVAC systems, provide cooling to address current climate concerns, while taking our environmental impacts into consideration by reducing Carbon Emissions and Energy Consumption."**

Anthony Munster, Providence Executive Director, Projects, Planning and Facilities Management

Results and Recognition

The HFH retrofit delivered significant environmental, financial, and comfort benefits:

- **Carbon Reduction:** Achieved a verified 75% reduction in carbon emissions within two years—the highest percentage globally among peer projects (2021–2023) according to the IFHE Global Healthcare Challenge. Additional measures have since pushed carbon emissions reduction to 85%.
- **Energy Savings:** Lowered energy use intensity and utility costs substantially, with the rooftop solar PV system offsetting approximately 20% of the hospital's peak electricity demand and about 7% of annual electricity consumption.
- **Patient and Staff Comfort:** Improved indoor air quality, thermal comfort, and access to mechanical cooling for patients and staff.
- **Funding and Incentives:** Combined capital replacement budgets with generous energy efficiency incentives to support project implementation.

Key Success Factors

The Holy Family Hospital retrofit succeeded thanks to strong leadership, close collaboration, and innovative solutions. Executive Director Tony Monster championed ambitious carbon reduction goals and secured the funding needed to deliver them, signaling the project's importance across the organization.

An integrated team of engineers, contractors, facility operators, and health authority staff worked together from planning through commissioning, ensuring seamless execution with minimal disruption to patient care. Thermenex's patented Thermal Gradient Header (TGH) technology provided a compact, flexible solution for heat recovery and energy management, while incentives from BC Hydro and other programs strengthened the financial case.

The phased approach and a commitment to continuous improvement led to additional upgrades—such as solar panels and high-efficiency windows—further enhancing performance and sustainability.

Table 1: Summary of Results Acheived

Metric	Before (2020)	After (July 2024 - June 2025)	Impact
Gas Energy Use Intensity (ekWh/m2/year)	243	23	90% reduction due to waste heat recovery and fuel switching
Electrical Energy Use Intensity (ekWh/m2/year)	136	250	83% increase due to adding more cooling and fuel switching of heating
Electrical Energy from PV Generation (kWh/m2/year)	0	8	Production until June 2025 was 3% of site annual electricity and is predicted to result in about 7% of total site electricity per year
Total Energy Use Intensity (ekWh/m2/year)	380	281	28% reduction despite additional cooling, due to increased efficiency
Carbon Emissions (tCO2e/year)	507	77	85% reduction, or 430 tons CO2e, which is equivalent to removing 94 passenger vehicles from the road
Solar PV Production (MWh)	0	89	Production until June 2025 was 3% of site annual electricity and is predicted to result in about 7% of total site electricity per year
Window Thermal Performance	Single-pane, poor insulation	Triple-pane, argon filled	Dramatic thermal efficiency gain

Source: Providence Health Care 2025.

> **"As president of the International Federation of Healthcare Engineering (IFHE), and a proud Canadian, I was so pleased to witness a Canadian health care organisation achieve 75% reduction in carbon emission and receive a world record honour in IFHE's 2024 Carbon Challenge.**
>
> **My personal congratulations to Vancouver's Holy Family Hospital for achieving the world's largest building carbon emission reduction percentage between 2021 and 2023. No doubt their achievements will inspire the wider global health community to escalate their carbon emissions reduction initiatives in service of a healthier planet."**
>
> Steve Rees, Certified Facility Manager and Past President, International Federation of Healthcare Engineering (IFHE)

Lessons Learned

- Early engagement of contractors and operators was critical to success, especially with an innovative system like the TGH.
- Preserving space for future mechanical upgrades in original building design facilitated smoother retrofits.
- Treating thermal energy as a resource opens new pathways for integrated heating and cooling solutions.
- Careful phasing and communication are necessary to manage retrofits in operational health care environments.
- Combining building envelope improvements with mechanical and renewable energy upgrades maximizes carbon reduction and co-benefits.

Conclusion

The Holy Family Hospital retrofit sets a global benchmark for deep carbon reduction in health care. It shows that even aging facilities can be transformed into climate leaders. With determined leadership, cutting-edge technology, and a coordinated multi-year approach, hospitals can dramatically cut emissions, enhance occupant comfort, and maintain operational integrity—offering a replicable model for health care institutions striving toward net-zero goals.

References

1. Providence Health Care. Climate Change Accountability Report 2024. Energy and Environmental Sustainability team, British Columbia, Canada. 2025. Available from https://bcgreencare.ca/wp-content/uploads/2025/06/Climate-Change-Accountability-Report-2024-Providence-Health-Care.pdf
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3. Energy and Carbon Data provided by Providence Health Care based upon utility data, PV generation dashboard and calculation to convert units [Accessed October 24th 2025]

**Cover image courtesy of Providence Health Care (2025)*

About Us: *The Canadian Coalition for Green Health Care is Canada's leading network dedicated to advancing environmental sustainability in the health sector. Guided by our vision of a sustainable, resilient, and equitable health system for all, we mobilize change-makers, build capacity, and deliver practical tools and strategies that drive meaningful action. This fact sheet has been developed as part of the Coalition's "Preparing Canada's Health Care Buildings for Net-Zero" project, made possible with an investment from the Government of Canada's Low Carbon Economy Implementation Readiness Fund.*

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The Canadian Coalition for Green Health Care
Coalition canadienne pour un système de santé écologique

PREPARING CANADA'S HEALTH CARE BUILDINGS FOR NET-ZERO

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