

Healing Healthcare Infrastructure: How Retrofits Impact Energy, Carbon, and Cost

**A global analysis of digital and fabric retrofit strategies
for transforming healthcare facilities.**

White Paper

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Executive summary

Healthcare systems face a retrofit trilemma: aging infrastructure, growing sustainability demands, and limited budgets. This paper evaluates retrofit strategies through the lenses of energy use, whole-life carbon, and cost, using simulated data from hospitals worldwide. It finds that digital retrofits outperform traditional insulation, achieving up to 18% energy savings and payback in under five years—providing a strong foundation for developing effective healthcare retrofit strategies.

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Preface

The insights in this whitepaper are built on a robust, physics-based dataset comprising **millions of building performance models** spanning multiple building types, sizes, and global climate zones. This dataset was developed through **EnergyPlus simulations conducted by JLL**, following the ASHRAE modelling standards widely employed by leading design firms for LEED and other green building certifications. These simulations form the analytical backbone of the research and reflect established, industry-standard methodology.

To ensure credibility and sector relevance, **JLL provided independent third-party validation**, integrating detailed input from Schneider Electric offer teams regarding solution capabilities, functional behaviour, and documented performance characteristics. The dataset also captures the **interactive effects between measures**, not just their performance in isolation. These interactions underpin one of the study's core findings: the identification of a **“core retrofit” bundle** that consistently delivers energy, carbon, and cost benefits across diverse climates and hospital building vintages.

The **Impact Building Calculator**—Schneider Electric's online scenario-planning tool—is built on this same modelling foundation. It enables users to explore optimal retrofit strategies using the validated simulation framework applied in this study. While the tool has so far been deployed at only a limited number of customer sites, the **modelling outputs have been cross-referenced against real hospital building data**, demonstrating a promising level of accuracy.

For deeper technical detail—including baseline assumptions, building vintage models, ECCM descriptions, and climate-zone methodologies—please refer to **Appendix A and B**.

1

Retrofitting hospitals for people, planet, and performance

Aging hospitals can no longer meet modern standards, making retrofits a strategic imperative for healthcare systems worldwide.

Key Fact: Healthcare accounts for ~5% of global GHG emissions.

Hospitals are built to heal—but today, many are in urgent need of healing themselves.

Across the globe, healthcare facilities constructed decades ago are now struggling to meet modern standards for energy efficiency, safety, patient experience, and digital integration. Designed for a different era, these aging buildings are increasingly misaligned with the demands of modern care, with significant consequences.

The healthcare sector is still responsible for ~5% of global greenhouse gas emissions,¹ with energy often among the top three non-labour expenses for hospitals. Outdated infrastructure contributes to rising maintenance backlogs, operational vulnerabilities, and risks to both patient and staff safety.

Retrofitting: A strategic imperative

Retrofitting—the process of upgrading existing buildings with new technologies, systems, and design strategies—has emerged as a critical pathway for healthcare transformation. In hospitals, this can include modernizing HVAC systems, integrating smart building technologies, improving insulation and lighting, and reconfiguring spaces to enhance clinical workflows and patient comfort.

Faced with the cumulative pressures of rising patient demands, aging infrastructure, shrinking budgets, and tightening sustainability regulations, healthcare leaders are increasingly turning to digital retrofits as a scalable, cost-effective strategy to modernize operations.

According to the [2025 Hospital Construction Survey by ASHE](#), **61% of healthcare executives reported increased investment in infrastructure upgrades, signalling a strategic shift toward retrofitting existing facilities.** The reasons are clear: retrofits are typically faster to implement, less disruptive to care delivery, more financially viable, and have a significantly lower environmental impact.

This white paper offers a global, data-driven analysis of hospital retrofit strategies, equipping healthcare facility leaders with insights and data to support informed, future-ready decision-making. It evaluates interventions through three critical lenses:

1. Energy reduction
2. Whole-life carbon (WLC)
3. Return on investment (ROI)

These dimensions reflect the most pressing challenges facing healthcare systems today—from volatile energy costs and decarbonization mandates to constrained capital budgets and the imperative to improve patient and staff satisfaction.

1. Health Care Without Harm, *Health care's climate footprint report*.

2

Evaluating retrofit strategies and their impact on energy reduction, WLC, and ROI

Study summary

This study evaluates the energy, carbon, and financial impact of nine commercially available Energy and Carbon Conservation Measures (ECCMs) across seven global hospital locations, each representing distinct climate zones and grid profiles. Using a [standardized hospital prototype](#) and EnergyPlus simulations, the analysis compares digital, physical, and service-based ECCMs—including building management system (BMS) upgrades, occupancy-based controls, and envelope insulation.

The study identifies optimal combinations of ECCMs that deliver up to 18% energy savings, achieve WLC payback in under one year, and ROI in less than five years in most regions. By modeling simulated conditions and operational schedules, the research offers actionable insights for healthcare leaders seeking resilient, sustainable, and cost-effective infrastructure transformation.

ECCMs explained: Definition and scope of analysis

At the heart of our approach are nine commercially available ECCMs. An ECCM refers to any change made to a building, system, or facility that improves its energy efficiency or reduces its carbon footprint without negatively impacting building performance, [see Table 1](#).

To provide further clarity, we categorize each measure into one of the following three types:

- 1. Digital**—Connected systems that monitor, manage, and optimize energy use in real time.
- 2. Fabric**—Upgrades to the building envelope that enhance thermal performance.
- 3. Service-based**—Operational improvements, such as continuous commissioning, that help sustain long-term efficiency gains.

A global simulation across seven climates shows which retrofit strategies deliver the strongest energy, carbon, and financial performance.

Key Fact: Digital retrofits deliver up to **18% energy savings** with payback in under five years.

Table 1

A breakdown of the analyzed ECCMs.

Ref Number	ECCM	Type
1	Building Management System (BMS) tuned to ASHRAE Guideline 36	Digital
2	BMS with Distributed Energy Resource (DER) settings programmed	Digital
3	Occupancy- and daylighting-based zone controls	Digital
4	Improved power factor (PF) correction and harmonic reduction	Digital
5	Continuous commissioning	Service
6	Power management software with connected metering	Digital
7	Power SCADA—energy supply management software	Digital
8	High-efficiency modular Uninterruptible Power Supply (UPS)	Digital
9	Improved envelope insulation (increased R-value)	Fabric

See [Appendix A](#) for detailed descriptions of ECCMs.

Retrofit performance varies widely by climate, making location-specific strategies essential for real impact.

Which geographies and climate zones were modeled?

Healthcare facilities operate differently across climates, with variations in construction methods, mechanical systems, and energy infrastructure. Understanding how ECCMs perform under these diverse conditions is essential for making informed, location-specific decisions. For instance, a hospital in Saudi Arabia—facing a hot, arid climate and a fossil fuel-dominated grid—requires a very different retrofit approach than one in Norway, where the climate is cold, and the grid is largely decarbonized.

To reflect this diversity, our study modeled seven global locations, each representing a unique combination of climate zone and grid carbon intensity, see **Table 2**.

Table 2
Global locations modeled.

Location	Climate Zone	Grid Profile
Singapore	0A (Tropical)	High carbon intensity
Dubai	0B (Hot Arid)	Fossil fuel-dominant
Italy	3A (Warm Temperate)	Moderately decarbonizing
Adelaide	3B (Mediterranean)	Rapidly decarbonizing
New York	4A (Mixed Humid)	Mixed grid
UK	5A (Cool Temperate)	Decarbonizing rapidly
Norway	6A (Cold)	Very low carbon grid

Figure 1 illustrates climate zones across the globe.

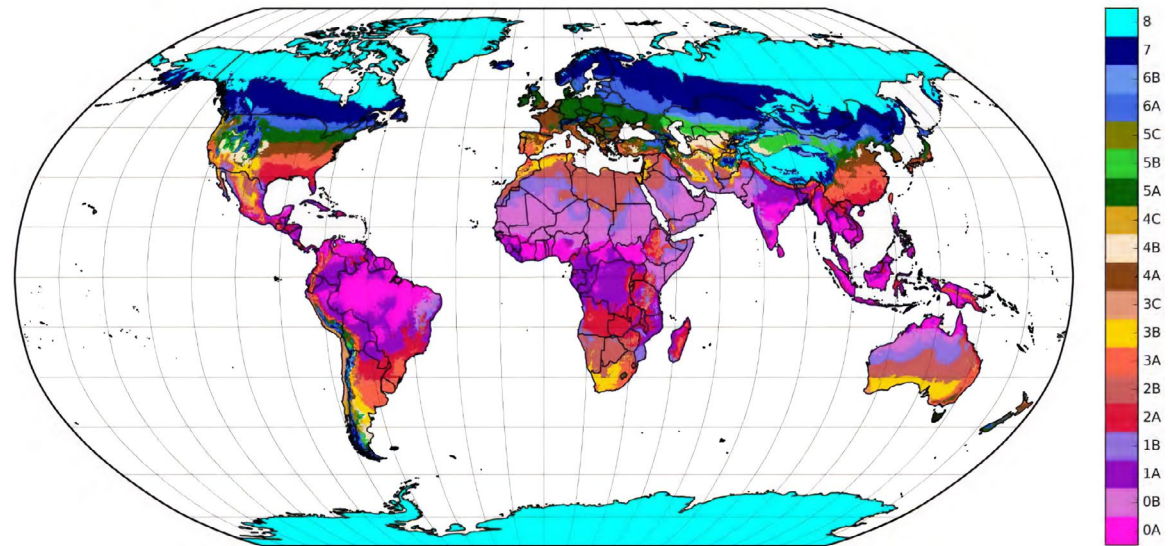


Figure 1
Legend for Climate Zone.
Image courtesy of **ASHRAE**

3

Analysis Part I: Choosing the right retrofit mix to cut energy use

Energy efficiency has evolved from a cost-control measure into a strategic imperative for healthcare facilities. Developing the right roadmap for a more efficient hospital requires a deeper understanding of the competing pressures driving this need, while ensuring uninterrupted delivery of critical care.

Clinical systems dominate hospital energy use everywhere, with heating or cooling loads driving regional differences.

Key Fact: Cooling demand in Singapore drops by 14% with optimized digital controls.



Unpredictable energy costs: Hospitals are among the most energy-intensive buildings, with high demand driven by life-saving equipment and 24/7 operations. Efficiency is no longer just about savings—it’s about building financial resilience amid volatile energy markets.



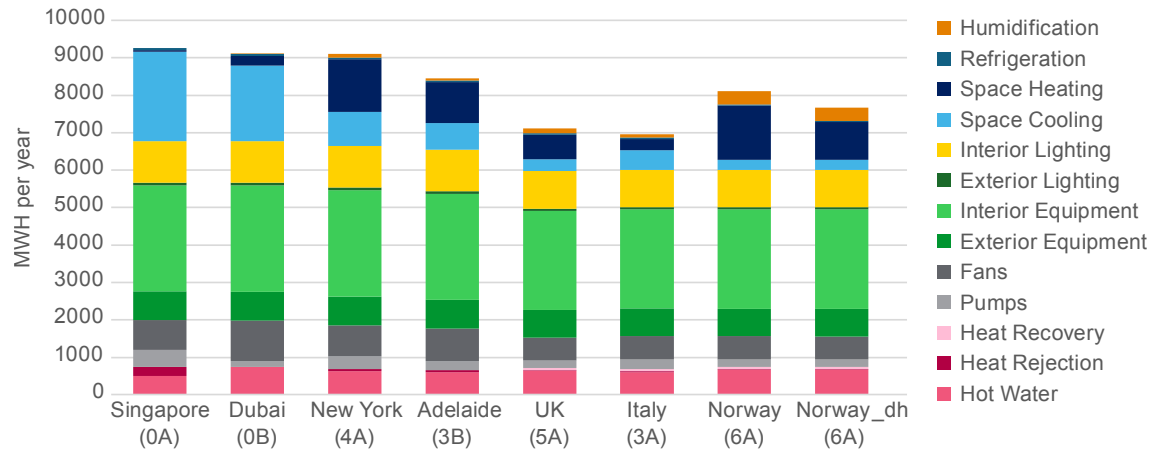
Tightening regulations: Stricter energy performance standards are increasingly linked to funding eligibility, compliance, and public trust. Falling short is no longer just a technical issue—it’s a reputational risk.



The electrification challenge: As healthcare systems shift from fossil fuels to electricity, site-level energy demand can double or even quadruple.² Without proactive efficiency upgrades, this transition risks overwhelming infrastructure and straining budgets.

Understanding baseline energy demand

Figure 2 illustrates baseline energy consumption by end use across the studied regions.



Energy consumption is dominated by two main categories across all climate zones:

- Clinical Systems** (e.g., interior equipment end-uses, including imaging, radiology, computing, and monitoring) consistently dominate energy use. These are essential and non-negotiable.
- Space Conditioning** is the second-largest driver, varying by climate:
 - Cooling dominates in hot climates (Singapore, Dubai)
 - Heating leads in cold regions (Norway)
 - Both are significant in temperate zones (New York, Adelaide)
 - These differences highlight the need for **climate-specific retrofit strategies**.

² Schneider Electric, “The Rise of the All-Electric Hospital”

Stage 1: Assessing the individual impact of ECCMs

Each of the nine ECCMs were modeled independently. An ECCM was deemed viable if it delivered a minimum of 1% annual energy savings.

Digital measures consistently outperform fabric upgrades, with BMS controls and occupancy-based strategies showing the highest value.

Key Fact: UPS resizing often yields <1% savings, making it best timed with equipment replacement.

ECCMs analyzed:

1. BMS upgrade (ASHRAE Guideline 36)
2. BMS with Distributed Energy Resource (DER) settings
3. Occupancy- and daylighting-based zone controls
4. Power factor correction and harmonic reduction
5. Continuous commissioning
6. Power management software with connected metering
7. Power SCADA
8. High-efficiency modular UPS
9. Improved envelope insulation (increased R-value)

Table 3 shows the energy savings achieved per individual ECCM by region.

	Singapore (0A)	Dubai (0B)	Italy (3A)	Adelaide (3B)	New York (4A)	UK (5A)	Norway (6A)	Norway [District Heating] (6A)
1. BMS controls upgrade	1.2%	5.1%	-0.8%	12.4%	11.5%	1.4%	0.9%	-0.3%
2. BMS with DER	0.1%	0.2%	0.2%	0.5%	1.2%	0.2%	0.2%	0.3%
3. Occupancy-based zone controls	1.2%	1.4%	1.7%	1.1%	1.3%	1.4%	1.4%	1.6%
4. Improved PF and harmonics	1.3%	1.2%	1.2%	1.1%	1.1%	1.1%	1.0%	1.2%
5. Continuous commissioning	2.1%	1.6%	1.2%	1.5%	1.7%	1.2%	1.5%	0.9%
6. Power management software	1.6%	1.8%	1.7%	1.8%	1.6%	1.6%	1.3%	1.9%
7. Power SCADA	2.6%	2.4%	2.3%	2.2%	2.1%	2.2%	2.0%	2.4%
8. UPS	0.4%	0.4%	0.5%	0.5%	0.4%	0.4%	0.4%	0.5%
9. Insulation	0.7%	1.3%	-0.6%	4.8%	2.3%	1.0%	2.8%	-1.1%

Table 3

Energy Savings as a percent of whole building energy demand for each ECCM applied in isolation.

This part of the study found that:

- **BMS upgrades** had the highest impact in **Adelaide** and **New York**.
- **UPS resizing** consistently fell below the 1% threshold, so UPS upgrades are best timed with equipment replacement.
- **DER settings for a BMS system** showed limited energy-saving impact outside of one grid location; more advanced DER strategies (e.g., solar, batteries, automated receptacle controls) were outside this study's scope.

Stage 2: Identifying optimal retrofit combinations

Every possible combination of the remaining seven viable ECCMs were modeled to assess cumulative impact. This approach accounts for **interactions between solutions**—for example, envelope upgrades may reduce the incremental benefit of HVAC improvements. Here, solutions were included only if they contributed **≥1% savings when in combination with the other ECCMs**.

Table 4 details the ECCMs that were selected per region and the expected whole building energy demand reduction.

Table 4
The ECCMs that were selected per region and the expected whole-building energy demand reduction.

Location of simulation	Implemented ECCMs	Whole-building energy demand reduction
Singapore (0A)	1, 3, 4, 5, 6, 7	10%
Dubai (0B)	1, 3, 4, 5, 6, 7	13%
Italy (3A)	1, 3, 4, 5, 6, 7	7%
Adelaide (3B)	1, 3, 4, 6, 7	18%
New York (4A)	1, 3, 4, 5, 6, 7	18%
UK (5A)	1, 3, 4, 5, 6, 7	9%
Norway (6A)	1, 3, 4, 6, 7, 9	7%
Norway [District Heating] (6A)	1, 3, 5, 6, 7	8%

Key findings for the optimal retrofit combination for reducing energy use



Finding 1: Common solutions, global relevance

Six ECCMs were selected in nearly **every optimized scenario**:

1. BMS controls upgrade (ASHRAE Guideline 36)
2. Occupancy-based zone controls
3. Power factor and harmonic correction
4. Power monitoring software
5. Power SCADA
6. Continuous commissioning

These form a **core retrofit scenario** for healthcare facilities worldwide.

Pairing occupancy sensors with BMS upgrades more than doubles the savings of BMS alone in many regions.

Key Fact: Combined, they delivered some of the highest savings across all climates.



Finding 2: Digital retrofitting outperforms fabric upgrades

In our analysis, insulation consistently failed to meet the 1% energy savings threshold when combined with other ECCMs. Digital solutions, such as BMS upgrades and occupancy-based controls, outperformed insulation across all climate zones.

Even in cold climates, where insulation traditionally offers the greatest benefit, its impact was marginal when HVAC systems were already optimized. In equipment-intensive buildings like hospitals, added insulation can trap waste heat, increasing cooling demand during moderate and warm periods. In some regions, like Italy, this led to a net increase in energy use.

[See Appendix C for more details on this finding.](#)



Finding 3: The power of pairing: Occupancy + BMS controls

When combined, occupancy-based controls and BMS upgrades delivered synergistic benefits—especially in non-critical zones. In many cases, this pairing more than doubled the energy savings of BMS upgrades alone.

Regional insights: How climate shapes retrofit impact

While many ECCMs proved effective across geographies, their performance varied depending on local climate conditions. This section highlights the most considerable regional differences revealed through our modelling.

1. Cooling-dominated climates: Singapore & Dubai



In hot, humid regions like Singapore and Dubai, where air conditioning and ventilation are the primary energy drivers, the most impactful ECCMs were in optimizing the BMS to focus on:

- Improving HVAC system performance
- Enhancing fan efficiency
- Deploying occupancy-based zone controls

Singapore achieved a remarkable 14% (343.5 MWh) annual reduction in cooling demand, showcasing the power of targeted interventions in high-temperature environments.

2. Heating-dominated climates: Norway & New York



In regions such as Norway and New York, where heating loads dominate energy consumption, the most effective measures included:

- Advanced BMS upgrades to fine-tune heating system performance reducing natural gas usage by as much as 40% in the New York case.
- Power monitoring and control systems reducing electrical demand by more than 5% in both cases.

New York delivered one of the most impressive results: an **80% reduction in total heating energy consumption** from the BMS-related combination of ECCMs.

3. Balanced climate performance: Adelaide



Adelaide emerged as a standout performer, achieving the **highest overall energy savings**—approximately **18%**— due to the strong performance of ECCMs.

Key results included:

- 44% reduction in cooling energy consumption (308 MWh/year)
- 89% reduction in heating energy consumption (975 MWh/year)
- 8% increase in fan energy (66 MWh/year), due to enhanced airflow control

Climate conditions dramatically shift where energy savings come from—cooling in hot regions, heating in cold ones.

Key Fact: In New York, optimized BMS controls cut 80% of total heating energy consumption.

4. The interplay of controls and climate: Italy & Norway



In **Italy** and **Norway**, upgrading water control loops in the BMS programming without adding zone-level occupancy sensors led to **increased overall energy consumption**. Why? Because:

- Fan energy demand rose
- Heating and cooling reductions were minimal
- Critical hospital zones have strict air change and temperature requirements, limiting optimization potential.

However, when **occupancy-based zone controls** were added for **non-critical areas**, they more than offset these energy demands. This combination proved highly effective in these regions. By introducing **controls for smaller zones within the larger floorplate**, facilities can unlock significant savings without compromising care delivery.

These findings underscore the importance of tailoring retrofit strategies to local climate and operational realities—proving that precision, not just ambition, drives meaningful energy savings in healthcare facilities worldwide.

4

Analysis Part II: Calculating the whole-life carbon impact of the core retrofit scenario

Reducing energy use is vital for decarbonizing healthcare facilities, but it only addresses part of the climate impact. To make informed decisions, it's essential to evaluate whole-life carbon—including both operational emissions (Scopes 1 and 2 from energy use during occupancy) and embodied emissions (scope 3 from the manufacturing, transport, and installation of materials).

Scopes of emissions:

- **Scope 1:** Direct emissions from on-site fuel use (e.g., natural gas for heating)
- **Scope 2:** Indirect emissions from purchased electricity
- **Scope 3:** Indirect emissions from materials and construction processes (embodied or “upfront” carbon)

Effective retrofit strategies must address all three scopes to achieve meaningful decarbonization.

Not all energy savings are equal

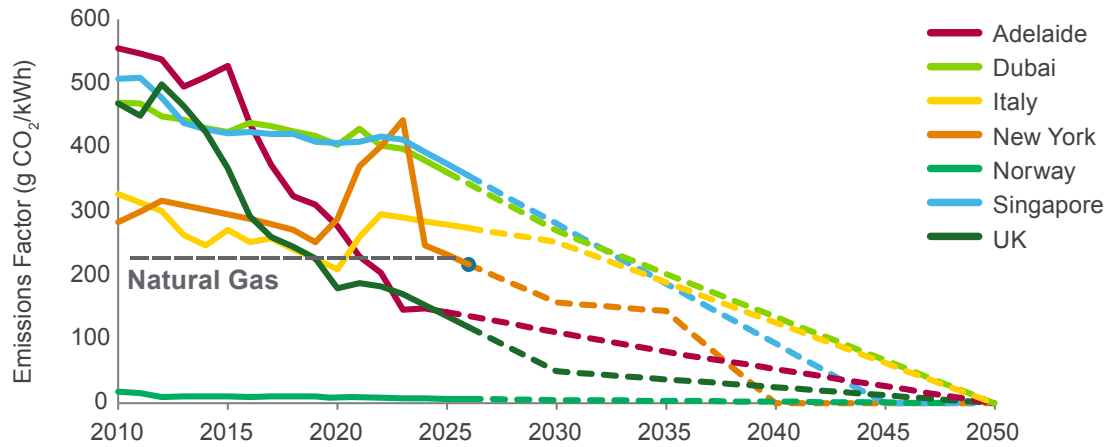
Reducing energy use is essential for decarbonizing hospitals—but not all energy savings have equal climate impact. The carbon reduction from saving 1 kWh of natural gas differs from saving 1 kWh of grid electricity, which varies by region based on grid cleanliness.

In regions with high grid emissions, cutting electricity use has a greater impact. In cleaner-grid areas, reducing natural gas becomes more critical. **Figure 3** shows current and projected grid emission factors by region, aligned with global decarbonization goals—key for evaluating the long-term climate benefits of retrofit strategies.

Digital retrofits offer far faster carbon payback than insulation due to lower embodied emissions and strong operational savings.

Key Fact: Core retrofits achieve carbon payback in under one year in most regions.

Figure 3
Greenhouse gas emission factors of the electrical grid in each studied location.



Energy savings by energy source

Earlier, we presented the energy-demand impact of individual ECCMs. **Table 5** now breaks down those savings by **energy source**—electricity (white) and natural gas (light gray)—to better understand their contribution to reduced emissions.

Table 5
Energy savings as a percent of whole building energy demand by form of energy when ECCMs are applied in isolation.

	Singapore (0A)	Dubai (0B)	Italy (3A)	Adelaide (3B)	New York (4A)	UK (5A)	Norway (6A)	Norway [District Heating] (6A)
1. BMS controls upgrade	1.1%	2.8%	-1.1%	0.8%	-1.0%	-0.2%	-0.4%	-0.4%
	1.6%	15.1%	0.0%	41.9%	40.8%	5.6%	3.3%	-0.1%
2. BMS with DER	0.1%	0.1%	0.3%	0.3%	0.8%	0.3%	0.4%	0.4%
	0.0%	0.3%	0.0%	1.3%	2.3%	0.0%	0.0%	0.0%
3. Occupancy-based zone controls	1.4%	1.6%	2.1%	1.7%	1.9%	1.9%	2.0%	2.0%
	0.0%	0.0%	0.4%	-0.3%	0.0%	-0.2%	0.5%	0.1%
4. Improved PF and harmonics	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
5. Continuous commissioning	2.4%	1.8%	1.4%	1.2%	1.3%	1.2%	1.1%	1.1%
	0.1%	0.7%	0.7%	2.2%	2.4%	1.4%	2.2%	0.0%
6. Power management software	1.8%	2.1%	2.3%	2.4%	2.3%	2.4%	2.4%	2.4%
	-0.2%	0.1%	-0.6%	0.0%	-0.1%	-0.5%	-0.6%	0.0%
7. Power SCADA	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
8. UPS	0.4%	0.5%	0.6%	0.6%	0.5%	0.6%	0.6%	0.6%
	0.1%	0.2%	0.0%	0.1%	0.0%	-0.1%	-0.1%	0.0%
9. Insulation	0.8%	1.3%	-1.1%	1.9%	0.6%	-1.7%	-1.4%	-1.4%
	0.1%	1.6%	1.2%	12.4%	6.3%	7.7%	10.6%	0.0%



Key Insight: Energy-efficiency measures can create trade-offs between electricity and gas consumption. Understanding these interactions is critical for accurate carbon modeling and informed decision-making.

For example, power management software reduces unnecessary power use by electrical equipment. However, this also eliminates the waste heat that is produced, which can slightly increase the demand for supplemental heating from the HVAC system—particularly in colder climates.

Conversely, optimizing a BMS to meet ASHRAE Guideline 36 often increases fan energy use and requires additional monitoring hardware, both of which raise electricity consumption. In cooling-dominated climates, these increases are typically offset by overall HVAC efficiency gains, resulting in net electrical savings. In heating-dominated climates, electricity demand may rise, but the associated carbon impact is often outweighed by significant reductions in natural gas use.

Digital ECCMs deliver rapid carbon returns, especially in regions with high grid emissions or high heating loads.

Key Fact: Dubai's core retrofit scenario achieves ROC in 0.06 years (just a few weeks).

Return on Carbon: Measuring climate payback

To assess the climate effectiveness of retrofit strategies, we calculated the Return on Carbon (ROC)—the number of years it takes for operational carbon savings to offset the embodied carbon across core retrofit scenarios, **see Table 6:**

- BMS controls upgrade (ASHRAE Guideline 36)
- Occupancy-based zone controls
- Power factor and harmonic correction
- Power monitoring software
- Power SCADA
- Continuous commissioning

Location of simulation	Core Retrofit Scenario ROC	Insulation ROC
Singapore (0A)	0.07	10.4
Dubai (0B)	0.06	5.09
Italy (3A)	0.17	n/a – never achieved
Adelaide (3B)	0.08	2.48
New York (4A)	0.06	5.07
UK (5A)	0.25	7.63
Norway (6A)	0.47	3.26

Table 6

Calculated years to achieve ROC for retrofit investments by location.

From a WLC perspective, **physical envelope upgrades** (e.g., insulation) carry approximately **three times the upfront carbon burden** compared to digital or service-based interventions. In warmer climates where HVAC demand is driven primarily by cooling, insulation offers limited climate benefit. Its effectiveness is largely confined to **cold regions** where heating is dominant, and the grid is already clean, such as Norway. However, even in these cases, switching to **district heating** significantly reduces the need for insulation, as the embodied carbon of the material outweighs its operational savings.



Key takeaways

1. **Whole-life carbon analysis** is essential for evaluating the true climate impact of retrofit strategies.
2. **Digital retrofits outperform physical upgrades** in most regions, offering faster carbon payback and lower embodied emissions.
3. **Insulation is not a one-size-fits-all solution**—its effectiveness depends heavily on climate and grid decarbonization status.
4. **Optimized combinations of digital ECCMs deliver rapid carbon returns**, often within the first year of implementation.

5

Analysis Part III: Evaluating Cost and ROI

Digital retrofits deliver strong financial returns across all regions, even under budget constraints.

Key Fact: ROI is under 10 years everywhere, and often under 5 years.

While global climate responsibility is a powerful motivator, the reality is that retrofit decisions in healthcare often come down to one key factor: **financial ROI**. ROI was determined using simple payback, comparing upfront capital costs to annual utility bill savings. The analysis focused on the **core retrofit scenario**, see **Table 7**.

Key financial insights

- **ROI for the core retrofit scenario was under 10 years in all regions**, with more than half achieving payback in **under 5 years**.
- The **primary cost driver** was the distributed room sensor network. When removed, ROI dropped to **under 2 years** in all regions except **Norway** and **New York**, where it was approximately **3 years**.
 - However, removing the sensor network led to a **~25% increase in energy and carbon use**, highlighting the trade-off between short-term cost savings and long-term environmental impact.

Location of simulation	Core Retrofit ROI (Financial)
Singapore (0A)	3.64 years
Dubai (0B)	4.17 years
Italy (3A)	5.32 years
Adelaide (3B)	3.39 years
New York (4A)	7.99 years
UK (5A)	4.75 years
Norway (6A)	9.60 years

Table 7

Calculated ROI for retrofit scenario.

Digital retrofits deliver more than financial returns—they redefine resilience for healthcare facilities. While ROI under 10 years is compelling, the true value lies in improved patient experience, streamlined operations, and future-proof infrastructure.

6

Conclusion

As healthcare systems face aging facilities, rising energy costs, and ambitious sustainability targets, retrofitting is no longer optional—it's a strategic imperative. Our analysis shows that digital retrofit strategies consistently outperform traditional fabric upgrades in energy savings and carbon reduction. For example:

- **Up to 18% energy savings** with ROI under 5 years in most regions.
- **Whole-life carbon payback in under a year** for our core retrofit scenario—compared to over a decade for insulation in some climates.

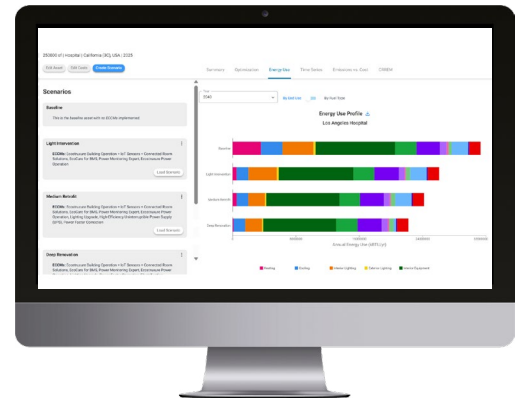
To build a resilient, sustainable healthcare sector, we must start by transforming the infrastructure we already have.



To help organizations act decisively, Schneider Electric™ offers the **Impact Building Calculator**—a scenario-planning tool that enables rapid assessment of ECCMs.*

With millions of modeled building performance datasets, it helps users:

- **Evaluate ROI and carbon impact** across multiple retrofit scenarios.
- **Align with regulatory pathways** like NYC Local Law 97 and CRREM.
- **Prioritize actions** based on cost, compliance, and decarbonization goals.



Explore how digital retrofits can help you meet energy, carbon, and compliance goals by completing our [online form](#) or connecting with your local Schneider Electric account executive.

*Please note – The Impact Building Calculator is currently only available in: **NAM, Europe, Australia, UAE, Saudi Arabia, Singapore, and Hong Kong.**

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Efrie Escott, AIA, LEED BD+C, LCACP, LFA, Schneider Electric: Efrie promotes strategies to accelerate the decarbonization of the built environment as the Decarbonization Technical Leader for Schneider Electric's Digital Energy Division. With a career focused on climate action in the built environment, Efrie has developed tools, authored international standards, published peer-reviewed research, and lectured internationally to reduce carbon emissions radically.



Rashmi Baliga, LEED BD+C, JLL: Rashmi is a Project Manager within JLL's Sustainability Consulting team. She leverages state-of-the-art simulation, data management, and data visualization tools to develop comprehensive strategies to meet her clients' sustainability and decarbonization goals. Rashmi is passionate about bringing transformative change to the built environment through big-picture thinking and identifying relationships across different facets of sustainability.

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Resources



White Paper

[The Rise of the All-Electric Hospital: Analyzing the Impact of Electrifying an 800 bed acute-care Hospital](#)



Solutions eGuide

[Digitalization & Electrification: Solution Enabling the Healthcare Facility ahead of its time](#)

Appendix A

Energy Carbon Conservation Measures (ECCM)	Description
1a. BMS Controls Programmed to ASHRAE Guideline 36 compliance for VAV controls	<ul style="list-style-type: none"> The VAV systems have additional sensors and control capability to meet ASHRAE Standard 36. The additional capabilities of the VAV systems include: <ul style="list-style-type: none"> Increased variability of VAV box airflow (minimum airflow: 30%). Supply air temperature reset: When OA exceeds 21 °C (70 °F), supply air temperature is 12 °C (54 °F). When OA is lower than 16 °C (60 °F), the supply air temperature is 18 °C (65 °F). The supply air setpoint is ramped linearly. Zonal and system-level CO₂ monitoring for enhanced DCV strategies.
1b. Chilled and Hot Water Controls Updated	<ul style="list-style-type: none"> Controls use Outdoor Air-based HW temperature reset. When the OA is higher than 10 °C (50 °F), the hot water is set to 65.55°C (150 °F). When the OA is lower than -6.67 °C (20 °F), the hot water is set to 82.2 °C (180 °F). Otherwise, the setpoint is ramped linearly. Controls use Outdoor Air-based CHW temperature reset. When the OA exceeds 26.7 °C (80 °F), the chilled water is set to 6.7 °C (44 °F). When the OA is lower than 15.6 °C (60 °F), the hot water is set to 12.2 °C (54 °F). Otherwise, the setpoint is ramped linearly.
2. Load-Shifting/ Demand Response Connectivity	<ul style="list-style-type: none"> Buildings are equipped with BMS controls and an automated control sequence to shed load during periods of high hourly emissions on the electrical grid. Peak grid events are estimated to occur an average of once weekly during the cooling season. The events are modeled for a four-hour period between 12:00pm and 4:00pm. <ul style="list-style-type: none"> For the USA and Europe, this is modeled in June, July, and August. For Australia, this is modeled in January, February, and March. For the Middle East, this is modeled in June, July, and August. For Singapore, this is modeled in May, June, and July. Load can be shed by adjusting setpoints for systems automatically: <ul style="list-style-type: none"> Public spaces, office spaces, corridors, and nurse station thermostat cooling setpoints adjusted upwards by 2.8 °C (5 °F). Lighting levels in public spaces, office spaces, corridors, dining, and nurse stations reduced by 20%. Non-emergency plug loads reduced by 10%.
3a. Occupancy-based Lighting Controls	<ul style="list-style-type: none"> This ECCM models a modern BMS control system (EcoStruxure and Connected Room Solutions) with occupancy-based sensors (SpaceLogic™) to adjust lighting setpoints. The lights are turned off if the occupancy sensor detects that no one is in the room. The lighting schedule does not exceed the occupancy schedule. This applies to nurse stations, dining areas, kitchen, and offices. No setbacks are applied to patient care areas, operating rooms, ER, etc.
3b. Occupancy-based Temperature Controls	<ul style="list-style-type: none"> This ECCM models Schneider Electric's BMS control system (EcoStruxure and Connected Room Solutions) with occupancy-based sensors (SpaceLogic) to adjust thermostat setpoints. With occupancy, the heating setpoint is 21 °C, and the cooling is 22 °C. When unoccupied, the heating setpoint is 16 °C, and the cooling setpoint is 24 °C. <ul style="list-style-type: none"> This applies to nurse stations, dining areas, kitchen, and offices. No setbacks are applied to patient care areas, operating rooms, ER, etc.

Table 8
ECCM descriptions.

Energy Carbon Conservation Measures (ECCM)	Description
3c. Daylighting-based Lighting Controls	<ul style="list-style-type: none"> ● All lighting systems in perimeter public daylit zones or from skylights include daylight dimming control capability. Sensors are located 4.5m from the perimeter. The system is modeled as continuous dimming with a minimum input power of 10% and a minimum light output fraction of 20%. <ul style="list-style-type: none"> - Daylight dimming incorporated into the Modern BMS control system (EcoStruxure). Daylight dimming is modeled in perimeter public spaces per code requirements.
4. Harmonic & Power Factor Correction	<ul style="list-style-type: none"> ● Buildings are equipped with high-efficiency transformers with PowerLogic™ Accusine EVC+ power and harmonic factor correction. Power factor is estimated to improve from 0.855 to 0.96. ● Power factor correction does not impact site kWh consumption and is therefore not included in energy model results. The impact on source energy accounts for the emissions reduction. ● Harmonic factor correction reduces hourly power consumption by 1.5% on average for connected equipment.
5. Continuous Commissioning	<ul style="list-style-type: none"> ● Buildings have a commissioning process where Schneider smart building systems (Building Advisor, Power Monitoring Expert, PowerLogic meters, Power, and Asset Advisor EcoCare services) are utilized to monitor equipment performance and identify deficiencies to be addressed continuously. ● This measure is estimated by anticipating this continuous commissioning process will increase equipment performance over the lifetime of the building: <ul style="list-style-type: none"> - Chiller and boiler efficiency improved by 5%. - Fan power static pressure reduced by 0.05"-0.15" based on fan type. - Pump efficiency improved by 5%.
6. Submetering Connected to Power Monitoring Software	<ul style="list-style-type: none"> ● Buildings are equipped with submeters connected to EcoStruxure Power Operation. The submetering allows building operators to monitor individual loads and identify areas of energy waste. ● This measure simulates reductions in plug loads (receptacle loads, elevators/escalators, etc.) by 5% due to improved monitoring and energy management. The plug load reduction is estimated using automated control methodology from the Pacific Northwest National Laboratory².
7. Power SCADA	<ul style="list-style-type: none"> ● Power operation is monitored, allowing for manual adjustments to operations to optimize power management through identification of unused capacity and avoidance of unplanned downtime. ● Estimated 3% annual electricity savings based on manual operational adjustments.
8. Uninterrupted Power Supply (UPS)	<ul style="list-style-type: none"> ● UPS system is resized based on measured loading to optimize efficiency. ● UPS is assumed to be used for critical electrical equipment in ORs, laboratories, imaging, and radiology. ● This ECCM does not include any building-integrated data centers.

² Source?

Appendix B Simulated buildings in healthcare

In healthcare, the building type that better represents the majority of facilities of interest in the segment is the Acute Care Hospital, a facility that provides short-term and active treatment for patients with severe injuries, sudden illnesses, urgent medical conditions, and those recovering from surgery. In addition to these services, Acute Care hospitals typically include areas for outpatient services, such as consults, day surgeries, and other treatments that do not require patient admission.

To provide patients with the above services, a traditional acute care hospital will include the following building spaces, which have been modelled in the Impact Building Calculator, as listed in **Table 9**.

Space Types	Total Area (m ²)	Total Area (ft ²)
Emergency Department	1,626	17,499
Intensive Care Unit (ICU)	1,545	16,628
Administrative and Support ¹	5,340	57,471
Back of House Circulation and Support ²	7,646	82,289
Patient Room	1,895	20,395
Offices	641	6,899
Dining	697	7,501
Kitchen	929	9,998
Allied Health	488	5,252
Imaging	488	5,252
Lab	530	5,704
Operating Room	613	6,597

Table 9
Typical building spaces and clinical spaces in an Acute Care Hospital, as modelled in the calculator.

1. Administrative and Support includes nurse stations, pharmacy, outpatient intake and treatment.

2. Back of House Circulation and Support includes corridors, stairs, mechanical rooms, and other service spaces in the basement area.

The two building prototypes simulated for healthcare include a pre-2004 urban tower-style hospital and a 2004-2009 mid-rise hospital, with assumptions listed in **Table 10**.

Prototype Assumptions	Pre-2004 Urban Tower	2004-2009 Mid-rise
Building Area	564,400 ft ² / 52,435 m ²	241,410 ft ² / 22,428 m ²
Number of Floors	16	6
Window to Wall Ratio	16%	16%
Building Construction	Concrete mass with location-based code-required insulation	Steel-framed walls with location-based code-required insulation
Mechanical Systems	<ul style="list-style-type: none"> Hot water system with gas boilers Chilled water system with water-cooled chillers and open cooling tower Floor-by-floor VAV AHUs with hot water reheat and steam humidifiers Gas-fired central service water heaters 	

Table 10
Prototype assumptions for the Pre-2004 Urban Tower and 2004-2009 mid-rise vintage.

Regional Modifications

Additional adjustments were made to reflect regional differences:

Singapore:

- Used fan coil units with hydronic coils served by water-cooled chillers
- Ventilation provided by a Dedicated Outside Air System (DOAS)
- Demand Control Ventilation (DCV) included in the 2010 baseline, excluded in 2004
- Airside energy recovery excluded due to low regional adoption

Dubai:

- 2004 prototype uses air-cooled chillers instead of water-cooled
- 2010 prototype uses a district cooling system

Nordic Region:

Two heating energy supply options modeled:

- On-site natural gas system (same as other regions)
- District heating system (denoted “dh” in results)

Key Assumptions

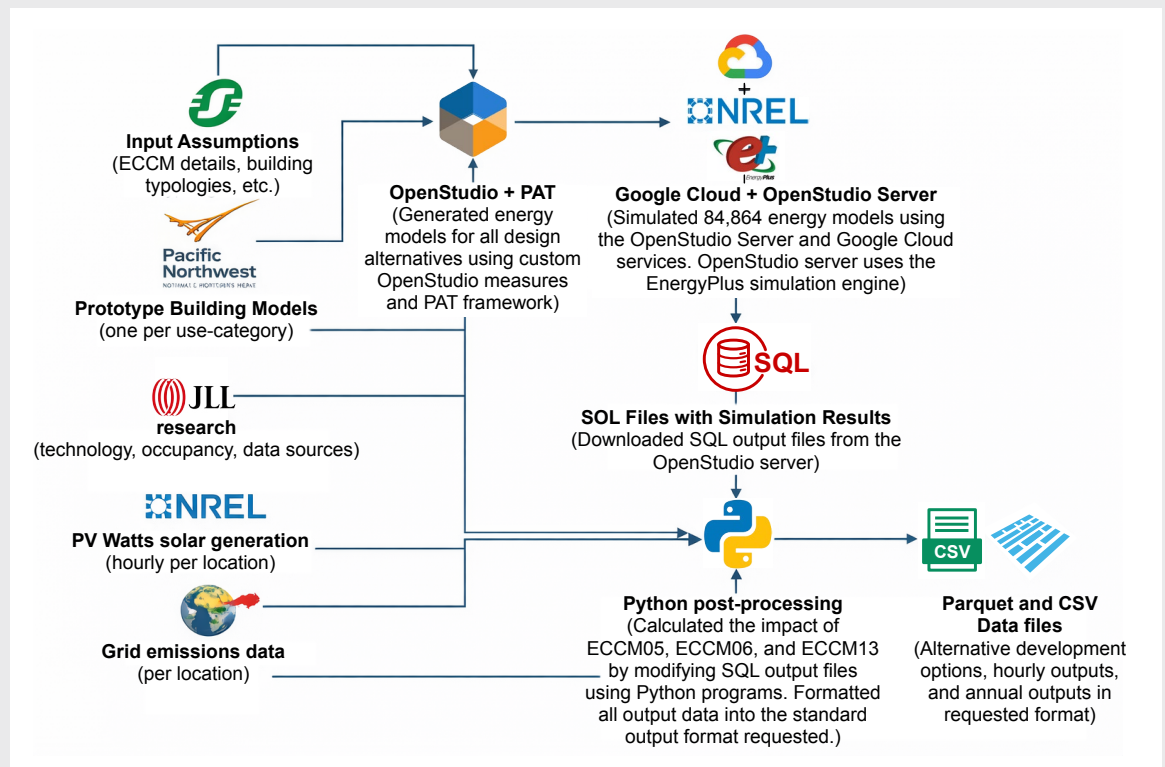
To ensure comparability and relevance, the study was based on the following assumptions:

- **Retrofit scope:** Retrofits are applied to existing buildings without major structural alterations.
- **Energy and carbon data:** Energy prices and carbon factors reflect current regional averages.
- **Operational schedules:** Building usage patterns are modeled on typical hospital operations.
- **Financial modeling:** Includes capital costs, energy savings, and maintenance over a 30-year lifecycle.

These assumptions ensure the findings are grounded in practical realities while offering strategic insights for healthcare decision-makers.

EnergyPlus simulations were leveraged to perform energy modelling and operational energy to carbon calculations, utilizing the hospital prototype (see **Figure 4** for a diagram of the modelling workflow).

Figure 4
Workflow for parametric energy modeling and operational energy to carbon calculations.

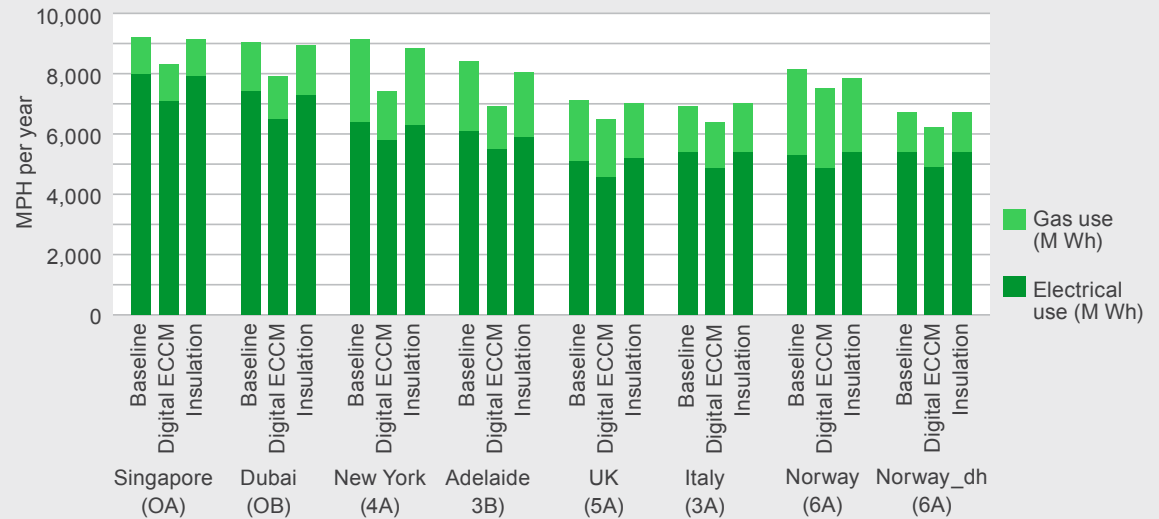


Appendix C

Why isn't insulation an important part of the solution?

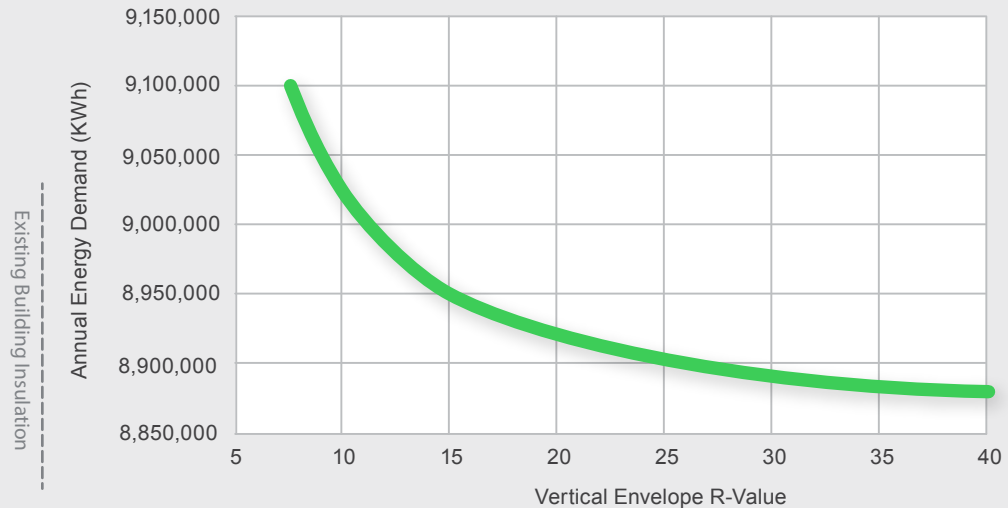
The performance of insulation was not included in any of the optimized conditions, as the insulation rarely saved sufficient energy to surpass the 1% threshold when applied in combination with any other ECCM. When comparing the digital solutions against the fabric upgrades, the digital solutions save more energy than an upgrade to the building envelope in every climate zone, as shown in **Figure 5**.

Figure 5
Comparing the energy demand of digital ECCM against the baseline case and energy saved by adding insulation.



While insulation is an important part of a building's performance in new buildings, there are significant diminishing returns to adding insulation to an existing envelope for most building types in most climate zones. This remains true in extremely cold climates that are completely heating-dominated, as shown in **Figure 6**. Therefore, while it may reduce energy demand by as much as 5% (in Adelaide) as a stand-alone measure, when paired with digital energy efficiency improvements that are already optimizing the HVAC system, the insulation provides minimal additional savings.

Figure 6
Annual energy demand in prototype hospital in Climate Zone 7A with varying levels of insulation. Vertical line shows the code-required insulation in the baseline building.



For equipment load intensive buildings, where the majority of the energy footprint is created by internal loads, adding insulation works to trap in the waste heat from the equipment, leading to a trade-off between the energy savings in cold weather against the need for additional cooling energy on more moderate and hot days, as shown in **Figure 7**. **This is even more pronounced in cooling-dominated climates, such as Italy, where adding insulation increases energy demand by 1% due to the increased cooling requirements in the warmer months.**

Figure 7
Annual energy demand in prototype hospital in Climate Zone 4A with varying levels of insulation. Vertical line shows the code-required insulation in the baseline building.

