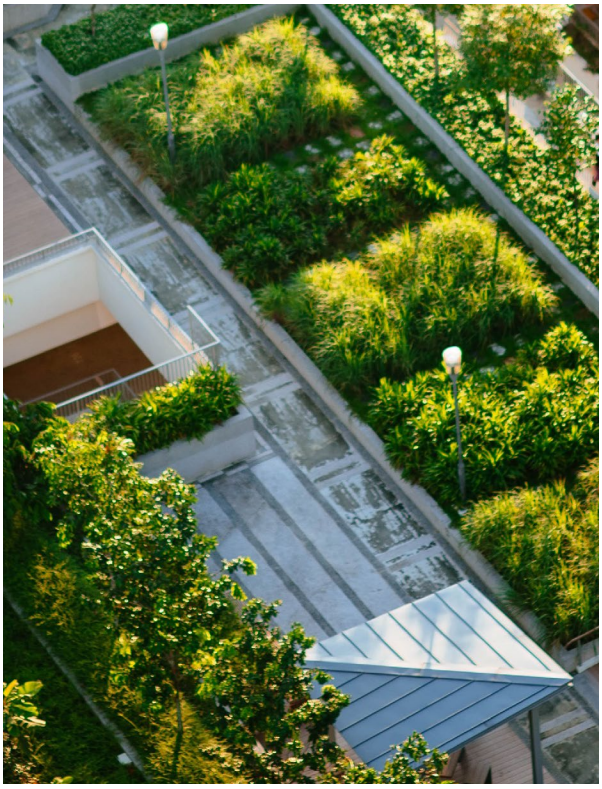


LOW CARBON RESILIENCE CASE STUDY: CHRISTUS SPOHN HOSPITAL, CORPUS CHRISTI, TEXAS

LCR and Health Infrastructure

The Christus Spohn Hospital case study provides an example of a low carbon resilience (LCR) approach to construction and operation of a major health facility. It illustrates building elements that can be used to align emissions reductions and adaptation goals, and how strategic planning in this regard have contributed to one building's design, construction and operation. This case study provides an existing example of how LCR can be used to reduce emissions and strengthen both building and community resilience to climate change impacts.

> "Since buildings typically last 60+ years, it is important to consider projected climate change impacts when assessing their design and performance ... [and] minimize the emissions a building will contribute over its lifespan.

Background

Climate change is causing environmental, social, health, and economic problems for Canadians that are projected to intensify over the coming decades. Adaptation to climate impacts is essential because global temperatures have already risen and will continue to increase to some extent, even if we were to eliminate all GHG emissions today.[1] The success of global emissions reduction efforts (mitigation) will determine the severity of future climate impacts, which will continue to escalate if we do not reduce global emissions by around 80%, the goal of Canada's Mid-Century Strategy.[2] Low carbon resilience (LCR) is a lens designed to achieve strategic and systemic integration of climate change adaptation and mitigation, which have largely been planned separately to date.[3] Continuing to do so is inefficient in terms of resource expenditure and risks building in vulnerabilities, adding to emissions and missing transformative co-benefits. Integrating the two at all levels of policy, planning and practice via LCR approaches[4] will help align climate action goals and advance the transition toward a more energy efficient, resilient, and sustainable future.

Christus Spohn Hospital

The LCR approach can be applied to most fields of practice, including building design. Since buildings typically last 60+ years, it is important to consider projected climate change impacts when assessing their design and performance.[5] It is equally important to minimize the emissions a building will contribute over its lifespan. The Christus Spohn Hospital case study provides an example of a building with consideration for climate change incorporated into all aspects of its design and function.

Part of the largest hospital system in South Texas,[6] Christus Spohn comprises three facilities with a total of 1,056 patient beds[7] and a new 42,000-square-foot family health centre.[8] A 10-story patient care tower will open in 2019,[9] adding 200 new beds.[10] The

hospital is one of several pilot projects being used to refine the "RELi resilience standard" for designing buildings, communities and neighbourhoods.[11] The U.S. Green Building Council, which was responsible for development of the widely recognized Leadership in Energy and Environmental Design (LEED) standard, is refining the RELi program to provide a prescriptive roadmap to guide architects, city planners, developers and governments to advance designs that are better adapted to projected climate changes, and capable of withstanding increased incidences of hurricanes, storms, drought, heatwaves and other types of disruptions.[12] The RELi standard also promotes climate change mitigation by incorporating elements of the LEED criteria related to energy and greenhouse gases (GHGs).[13]

The city of Corpus Christi, Texas is vulnerable to many of the impacts of climate change, which are expected to increase the costs, challenges and risks related to droughts, extreme heat and severe weather events.[14] Corpus Christi is particularly vulnerable to climate change-related increases in flooding and damage due to sea-level rise,[15] as well as an increase in the number and severity of hurricanes.[16] Innovative planning and design at Christus Spohn Hospital, which successfully withstood Hurricane Harvey in 2017[17] and is substantially reducing its building and operating emissions,[18] demonstrates that LCR can be mainstreamed into building design and operation.

Adaptation Design Elements

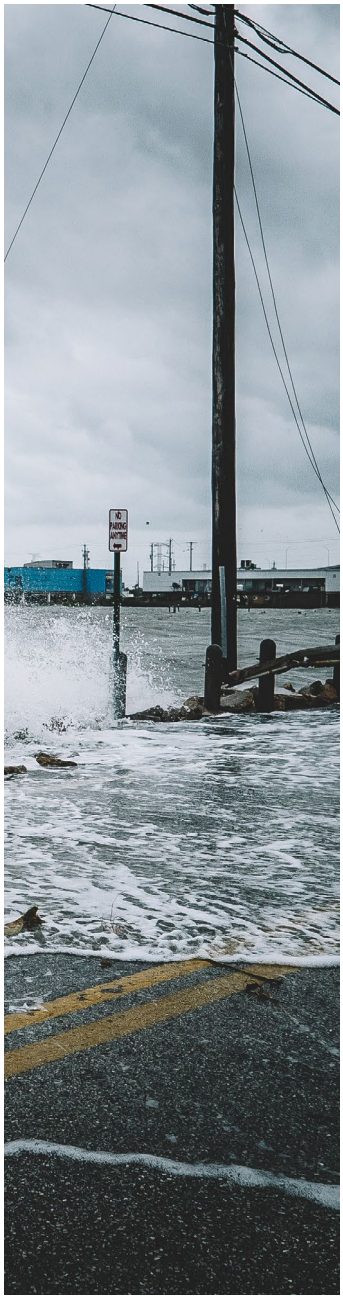
The RELi rating system takes a holistic approach to climate change resiliency, incorporating it into design, hazard reduction, materials and construction techniques,[19] thus ensuring that Christus Spohn Hospital is prepared for hazards and emergencies, such as loss of power or excess heat, that could compromise building function.[20] The structure has a hurricane-resistant exterior and oversized roof drains, rain gardens and green roofs to manage stormwater.[21] The hospital was placed in a 500-year floodplain, a substantially more cautious approach than the 100-year floodplain standard.[22] Reflective rooftops and strategic sun shading ensure that the facility is designed to stay cool even if the HVAC system is compromised.[23] In case of emergency, hospital protocol mandates maintenance of a four-day supply of food and water and generators that can provide power for five days.[24] The building features combined heat and power systems designed to improve efficiency during normal operations and continued operation during disasters.[25] During Hurricane Sandy, these types of systems were used to ensure that a number of public facilities, including hospitals, stayed operational.[26]

The hospital's designers recognize the building's potential to fulfil a unique function in the community, positioning it to operate as a regional command centre and refuge during natural disasters and other emergencies.[27] The project therefore goes beyond adapting a single building to the changing climate by contributing to resilience for the surrounding community.

Mitigation Design Elements

Although the RELi standard is principally focused on resilience, it also promotes climate mitigation by recognizing the energy and sustainability-related elements of LEED certification. The standard has minimum performance requirements in the "energy efficiency" and "atmospheric impacts" categories and awards credits for achieving energy optimization, carbon neutrality and net zero energy flows.[28] Christus Spohn Hospital has undertaken energy efficiency measures that will have a significant impact on its emissions. In 2017, the hospital was recognized for these initiatives,

"The building features combined heat and power systems designed to improve efficiency during normal operations and continued operation during disasters.



including its part in a switch to LED lighting expected to save half a million kilowatt-hours of electricity annually.[29]

Some elements of the building's design serve a dual role in increasing climate resilience and reducing emissions, such as its green roof and building cooling techniques. Green roofs reduce overall energy consumption by providing insulation and reducing demand for heating, cooling and stormwater management.[30] Green infrastructure has additional benefits for mitigation through its capacity to sequester carbon;[31] for instance, a single tree can capture several tons of carbon over its lifetime.[32]

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LCR Co-benefits

The hospital's nature-based elements, like its green roofs and rain gardens, have benefits beyond their contributions to adaptation and mitigation. Naturalizing urban spaces provides habitat for pollinators and other species and contributes to the presence of nature corridors that are important for species mobility.[33] Human exposure to nature reduces stress, improves health and increases overall wellbeing.[34] Strategically integrating adaptation and mitigation can also be more cost-efficient; for instance, nature-based solutions tend to be cheaper to install, operate, maintain, and replace than traditional hard infrastructure approaches.[35]

Additional Opportunities for LCR Building Design

Other elements of building design and construction can also benefit from the application of LCR. Siting and location are essential components in reducing a building's vulnerability and energy requirements. Building siting (e.g., near transit stations), facilities (e.g., bike parking) and neighbourhood design (e.g., sidewalk width) facilitates user access via low carbon modes of transportation. The availability of multiple modes of transportation and robust transportation networks (e.g., street grids that provide multiple routes) can enhance efficiency of evacuation during emergencies. Shelter-in-place strategies that allow building users to remain on site during extreme weather events are especially important for vulnerable populations, reduce transportation-related GHG emissions, and even provide safety benefits by reducing the number of cars on the road. These design choices can have significant consequences; during Hurricane Rita in 2005, evacuations contributed to more than 100 deaths.[36]

The capacity to design buildings to actively adapt to changing conditions throughout their lifespan is emerging.[37] For instance, modular, prefabricated components can be reconfigured to suit changing conditions and demands on the building. Designing buildings to be more flexible may become an increasingly important component of ensuring they can adapt to a changing climate.[38] Increased flexibility can also minimize other environmental impacts, and benefit energy and resource-use efficiencies, by avoiding or delaying demolition and reconstruction.[39] "Long life, loose-fit" is a type of design approach that emphasizes using durable materials to ensure structures last while simultaneously maintaining flexibility in function and use of the building.[40]

Concluding Remarks

This case study demonstrates ways that LCR approaches are beginning to take shape in the public sector. Buildings currently being constructed and retrofitted will contribute to GHG emissions over their lifespans and will also need to withstand decades of climate changes. The LCR approach can help strategically address these challenges while providing multiple co-benefits.

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