

Limitations of Environmental Assessment Methods for Bioclimatic Building Design

A Multi-Case Study of LEED Certified Construction in Vancouver, Canada (49.3°N, 123.1°W)

The Leadership in Energy and Environmental Design (LEED) assessment standard has been integrated into Vancouver building policy as a strategy to bring sustainable design to the mainstream, reduce carbon emissions associated with the construction sector, and communicate a measure of environmental quality to the property market. There is a tendency in the literature and the industry to use a LEED score as a proxy for high performance construction, obscuring the processes and priorities that informed the building design, and potential differences in the energy performance of buildings with the same rating. Despite the dominance and influence of the LEED framework, there is limited evidence to suggest that LEED rated buildings are using less energy than conventional buildings. Standards of this nature have also been criticised for their lack of focus on performance-based targets, and inability to cater to site-specific characteristics.

In contrast to the LEED framework, bioclimatic design proposes to minimize environmental impact and energy demand by catering to site-specific conditions. Bioclimatic design is gaining increasing attention in the literature for its ability to achieve up to 75% energy savings compared to conventional buildings. The aim of this research is to understand (a) the interaction between the LEED framework and the bioclimatic design approach, (b) how project-level and contextual dynamics influence the energy performance of buildings, and (c) incentives and barriers for bioclimatic integration. The findings of this study are based on a comparative case study of three LEED-certified buildings, which include the Vancouver Convention Centre (VCC), the University of British Columbia Centre for Interactive Research on Sustainability (CIRS), and the Marguerite Ford Apartments (MFA).

Although LEED acknowledged some aspects of bioclimatic design, the framework does not allocate points for how design components, systems, and strategies are integrated or contextual considerations; factors which are indicative of energy performance. The nature of the collaborative approach of the project, client priorities, building operators and users, and design team approach to engaging with LEED are some of the identified dynamics that are important for determining post-occupancy performance. The extent to which energy performance is prioritized within the design approach is also dependent on the political and socio-economic context in which these projects are situated. This study challenges the use of LEED as a tool to support a transition to a sustainable building industry, and suggests that environmental assessment should focus on both performance-based energy use intensity targets, and the integrative approach of the design process itself. This study concludes that transformation of the building sector will require a paradigm shift on many levels, including cultural values and patterns of consumption, workforce education, government policy, the nature of the global economy, and the environmental approach of industry professionals.

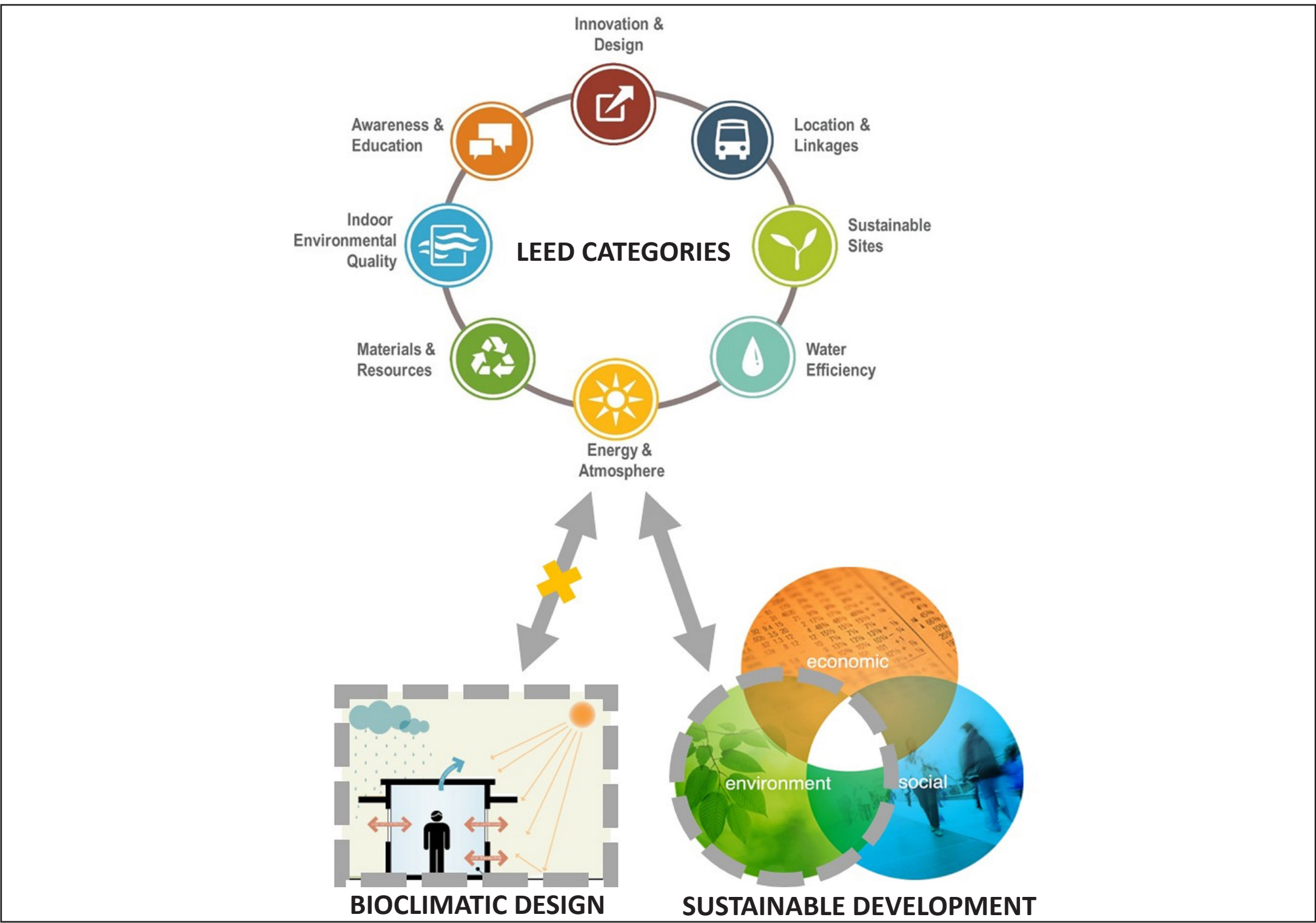
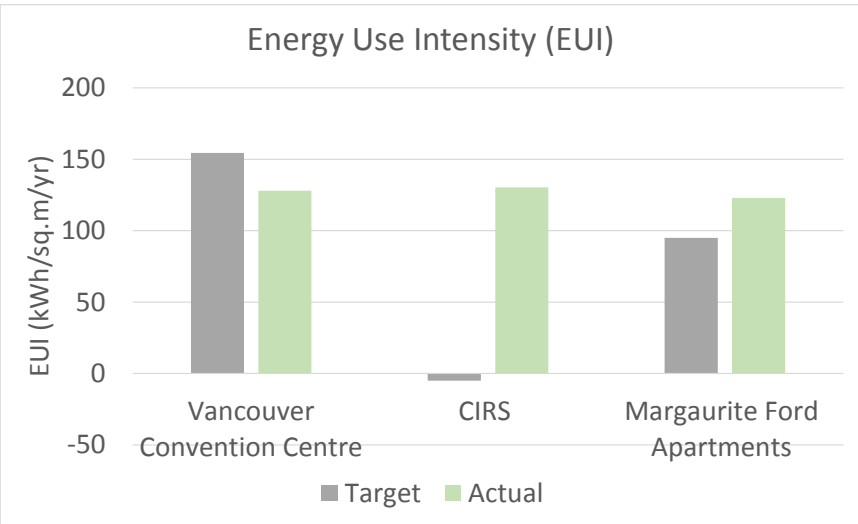


Diagram picturing the relationship between LEED assessment, sustainable development, and bioclimatic design. LEED is criticized in the literature for only assessing environmental aspects of sustainability, and for its inability to cater to site-specific conditions.

Context



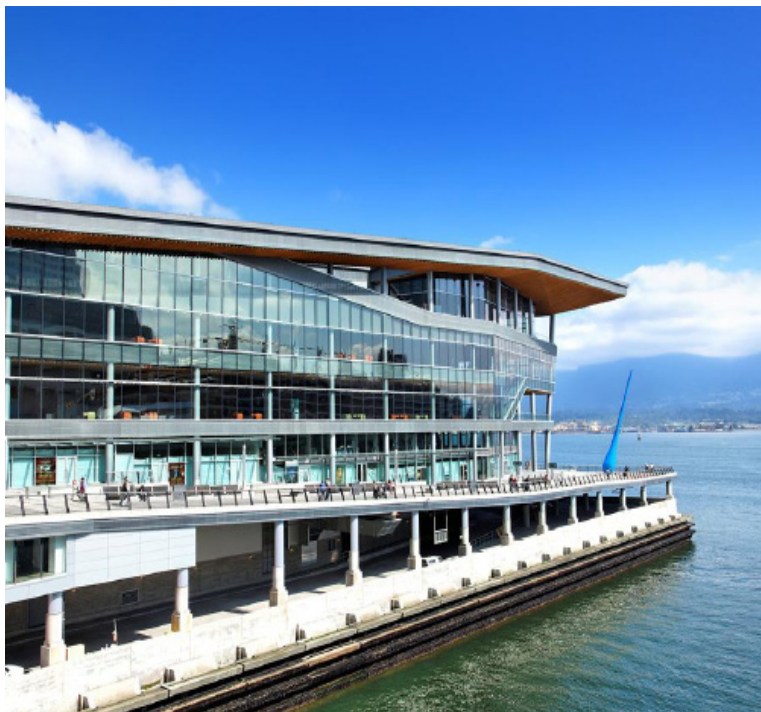
Map of Vancouver, British Columbia, Canada highlighting the location of each case study site.



EUI target, and post-occupancy energy performance for the VCC, CIRS, and MFA buildings



The south facade of the CIRS building.  
Photo by the University of British Columbia

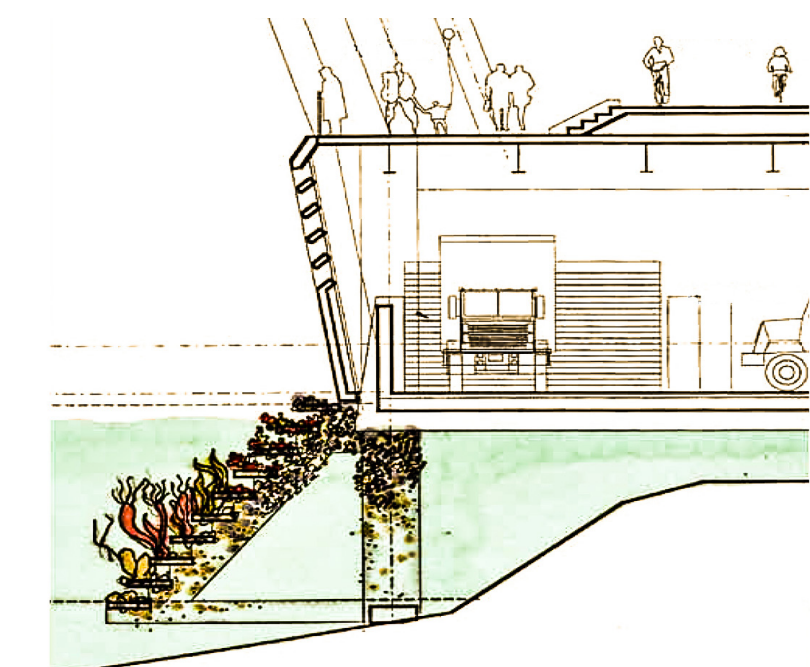


The east facade of the VCC building  
Photo by South West Forest

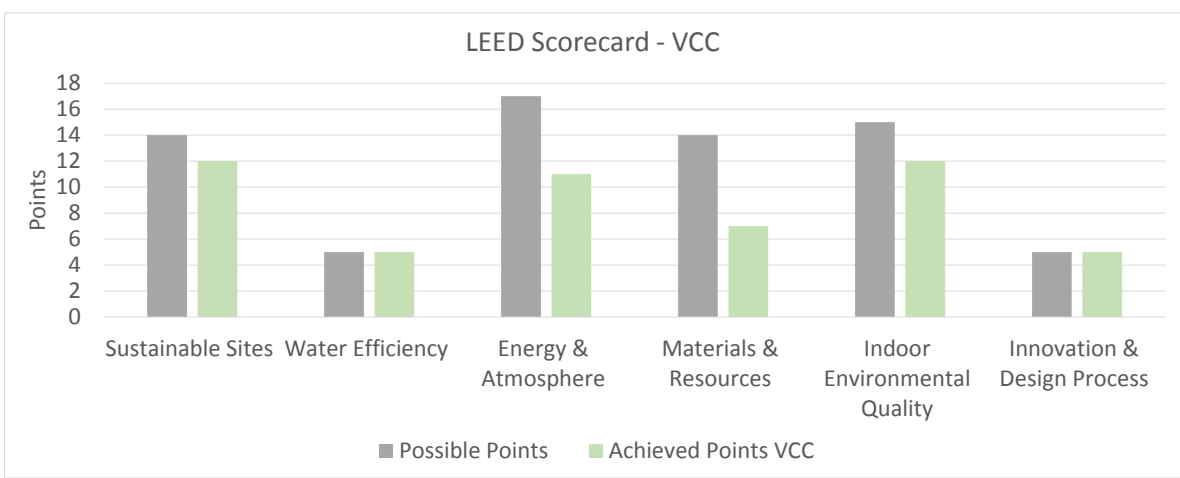


The north-east and south-east facades of MFA  
Photo by The Changing City

Vancouver Convention Centre

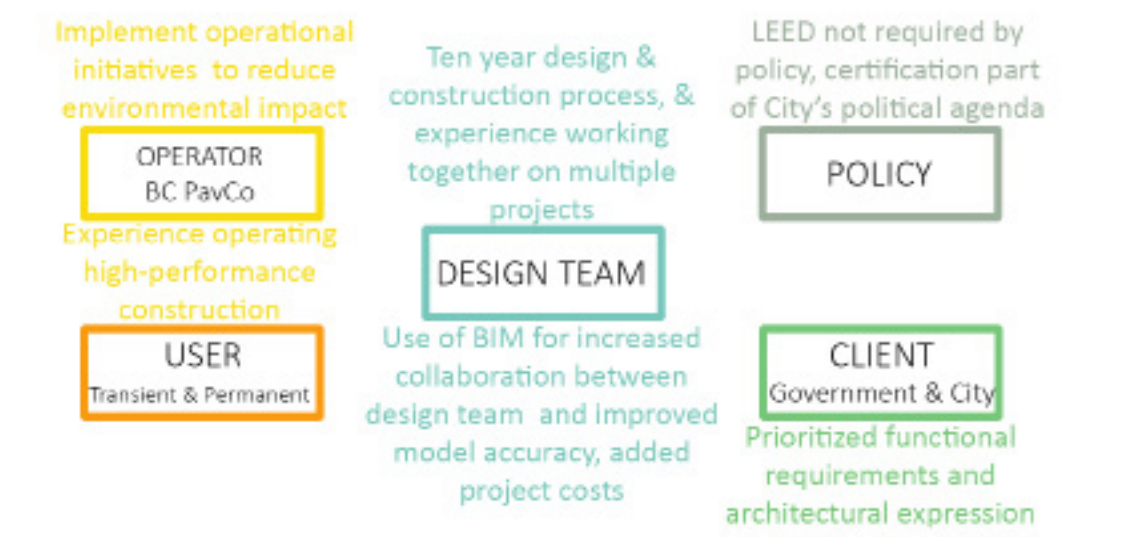


Section of the marine shelf, loading dock, and pedestrian level of the VCC. Sketch by MCMP Architects



LEED scorecard for the VCC. The project has achieved LEED Platinum certification

The LEED score in Energy and Atmosphere is the lowest of all cases, although it is the only project whose actual EUI is lower than the target EUI. LEED score in this category is reflective of lack of integration of renewables. High score in Sustainable sites largely reflective of building context and federal fisheries policy rather than design decisions to reduce environmental impact. The Indoor Environmental Quality score acknowledges the team's commitment to occupant comfort by allocating points for thermal comfort compliance and modelling. Significant socio-economic benefits provided by building are not acknowledged by LEED scorecard. Care of design team to understand how design strategies were interacting to influence overall performance and functionality is not acknowledged. Design components including the green roof and extensive glazing that fit with the project priorities of communicating sustainability commitment and preserving views have been selected in favour of solutions that reduce EUI.

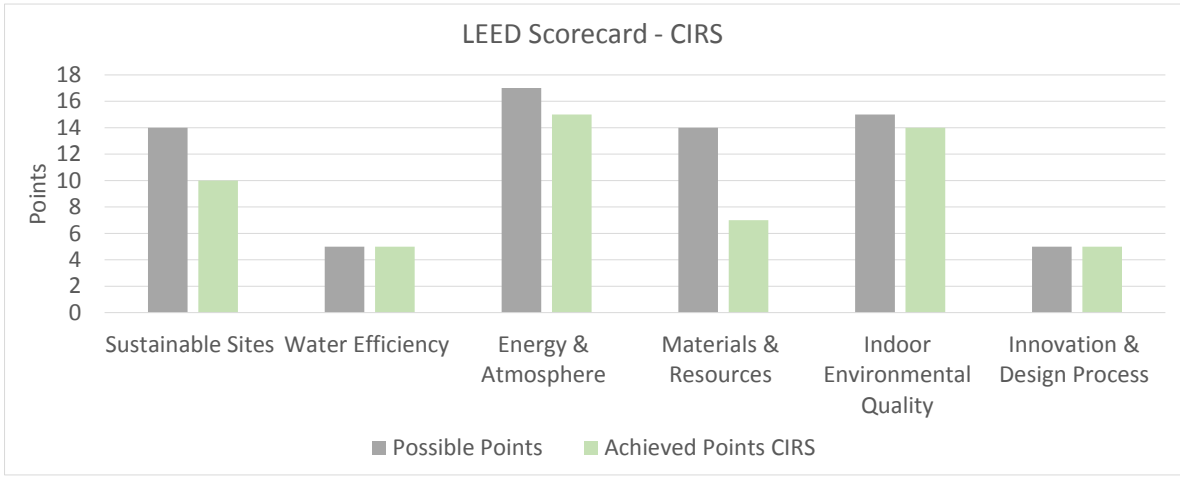


Assemblage of actors, forces and dynamics which influence the post-occupancy energy performance of the VCC

Centre for Interactive Research on Sustainability

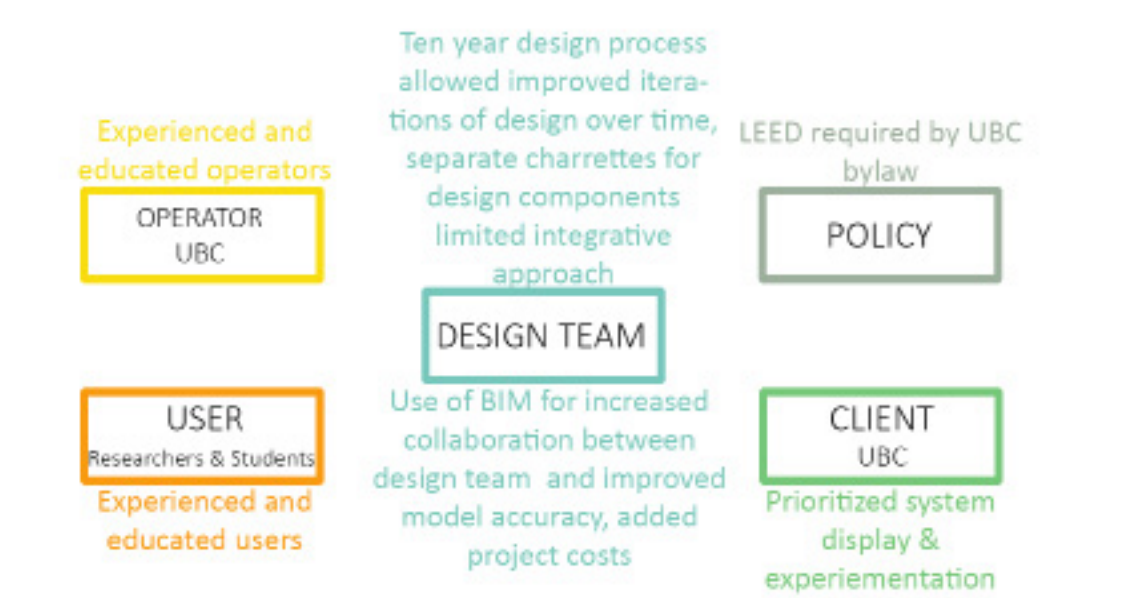


Rendering of CIRS by P+W Vancouver



LEED scorecard for CIRS. The project has achieved LEED Platinum certification

CIRS has achieved the highest score in Energy and Atmosphere of all cases, but has the highest post occupancy EUI of all cases. LEED score in this category is reflective of the net-zero EUI target, and extensive integration of renewables, which was achieved through grants from Sustainable Development Technology Canada. UBC's commitment to reaching the net-zero target and reducing the performance gap is not acknowledged by LEED. The Indoor Environmental Quality score reflects the team's commitment to thermal comfort compliance and monitoring and daylighting performance of the building. The design team expressed utilization of a bioclimatic approach, and they have incorporated multiple passive strategies; however, there was limited focus on how multiple complex systems were interacting, which contributes to the performance gap.

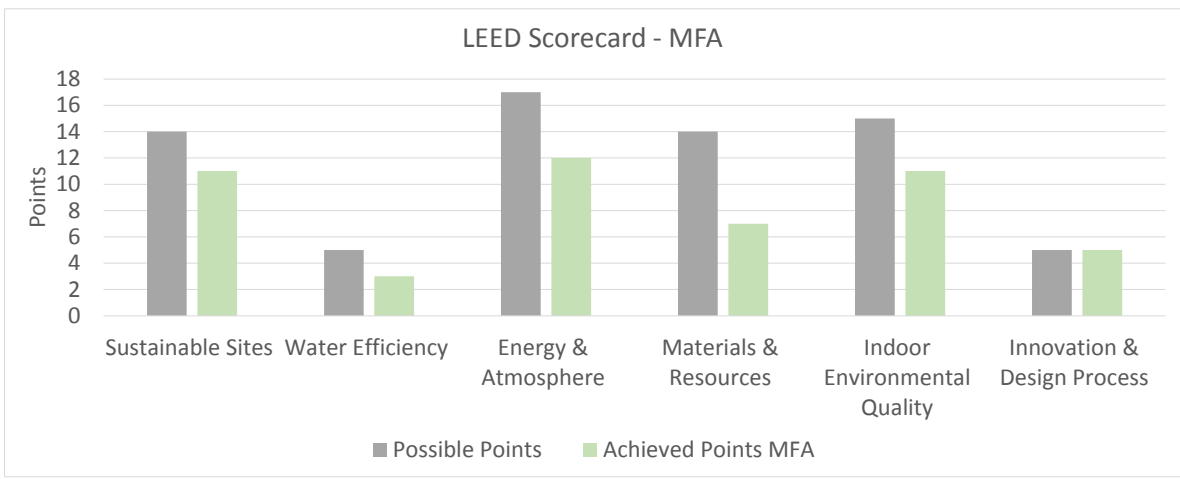


Assemblage of actors, forces and dynamics which influence the post-occupancy energy performance of CIRS

Marguerite Ford Apartments

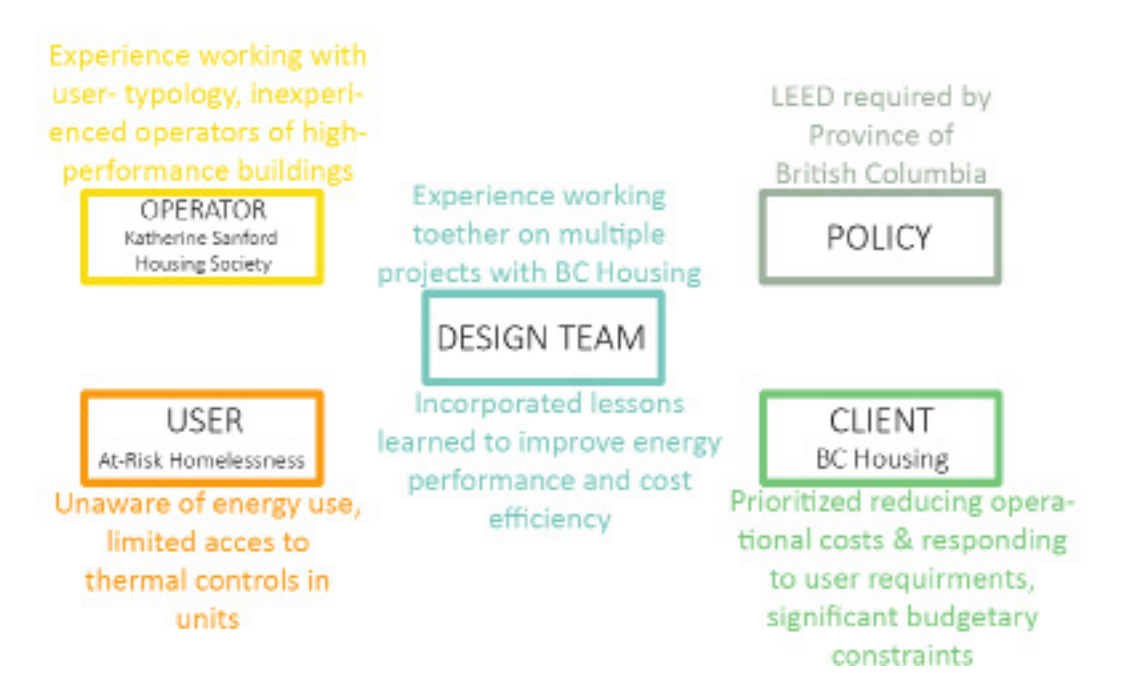


Rendering of the east view of MFA by DYS Architects



LEED scorecard for MFA. The project has achieved LEED gold certification

The EUI of MFA is the lowest of all projects, but this achievement is not reflected by the LEED score. The design team was challenged by the Indoor Environmental Quality Category; was difficult to achieve high score in this category and simultaneously respond to the needs of the unique client. Numerous social benefits provided by the project not acknowledged by LEED. The design team has utilized a user-based design approach that is built around addressing the social and health concerns of its occupants as well as optimizing livability and comfort. The building design maximized the lot size in order to achieve as many units as possible. As a result, the orientation of the building was predetermined. What the design team was then left with, was to focus on the performance of the building envelope in order to limit heat losses and undesirable solar gains. There was a strong understanding and consideration of the trade-off of passive strategies, and those that were selected were the best fit for the user and the client. The integrated, user-based approach is not reflected in the LEED score



Assemblage of actors, forces and dynamics which influence the post-occupancy energy performance of MFA