

DIALOG®

CANADIAN CONSULTING ENGINEERING AWARDS 2021



EDMONTON CONVENTION CENTRE ATRIUM RENOVATION

CENTRE OF CONNECTION

The Edmonton Convention Centre (ECC) is the city's premier event venue and a focal point in Edmonton's river valley. Since 1983, the Centre hosts over half a million guests annually and generates over \$30 million in economic impact for the city each year. Its variety of rooms, banquet halls, and flexible event spaces are attractive for meetings and events of all sizes from around the world. The spectacular atrium is the entry point for visitors, and connects the Centre's event spaces with the greater Downtown Edmonton community.

When the 35-year old glazing that encloses the iconic atrium needed replacement, the project team saw it as an opportunity to do much more than just replace glazing panels.

The ECC prides itself on going above and beyond to help event planners to lower the environmental impact of their events. The Centre has set ambitious sustainability goals, and this atrium renewal was a chance to help them reach those goals while making a statement about sustainability in the community.

DIALOG's solution includes a higher performance building envelope, modernized lighting system, structural upgrades, and Canada's largest building-integrated photovoltaic system with a Morse code poem embedded to enjoy.

PROJECT TEAM

DIALOG

Structural Engineering, Mechanical Engineering, Electrical Engineering, Architecture

CITY OF EDMONTON

Owner/Client

HOWELL-MAYHEW ENGINEERING

Solar Photovoltaic Engineering

MORRISON HERSHFIELD

Building Science Engineering

BIRD CONSTRUCTION

Construction Manager



INNOVATIVE AND DISTINCT

More than just a glazing replacement, the revitalization of the Edmonton Convention Centre's (ECC) atrium saw the addition of a building integrated solar photovoltaic system, updated atrium lighting, energy analysis, enhanced structural system, and higher performance building envelope.

The installation of a building integrated solar PV system is the most visible and ambitious update. The 35-year old glazing was leaking and had poor thermal performance. A modern system was necessary, and the project team pushed the envelope to showcase the ECC as a beacon of sustainability in Edmonton's river valley.

Given the atrium's expansive area and southern azimuth, the opportunity to integrate solar PV glass was introduced to the client. Working closely with the manufacturer, custom-sized solar photovoltaic Insulated Glazing Units (IGUs) were manufactured, with monocrystalline cells sandwiched between panes. The custom sizes were made to fit within the existing glazing framing system, resulting in over 18 different types of IGUs.

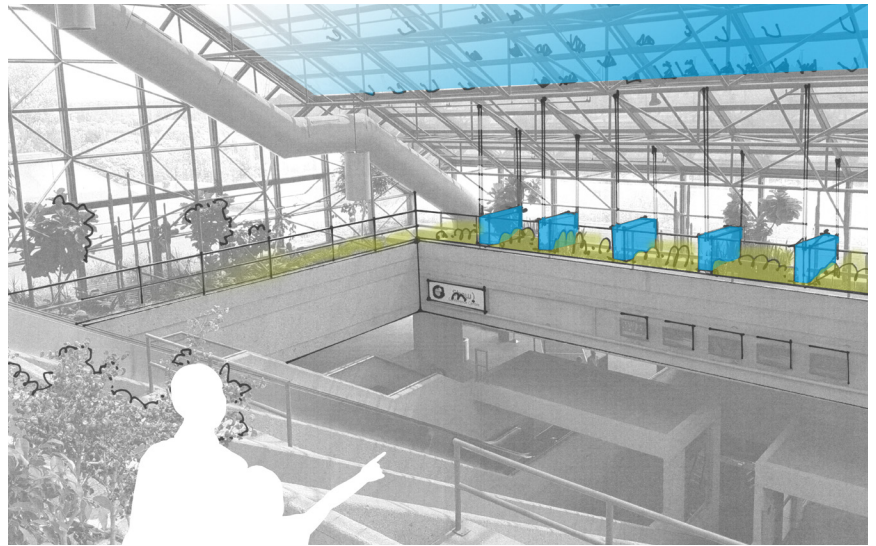
The solar PV system provides an opportunity to educate visitors about sustainability. The 170 kW system utilizes a string inverter topology. Instead of hiding them, the inverters are mounted in plain sight among the indoor foliage. Their prominence helps build the narrative of sustainability, while showcasing all the components necessary to harness energy from the sun.

Lighting-wise, the antiquated 400 Watt high pressure sodium fixtures were replaced with modern, efficient LED downlights. The fixtures are located above escalators and stairs, making maintenance access very difficult. Innovative remote driver systems are provided for the new LED lights, which allows maintenance activities to be done at ground level.

The new envelope performance was analyzed with respect to energy, water management, and thermal comfort; as well as evaluating the substantial photovoltaic array on the south facing glass. This included creation of an early stage energy model to evaluate the impact of various glazing options, value of embodied energy

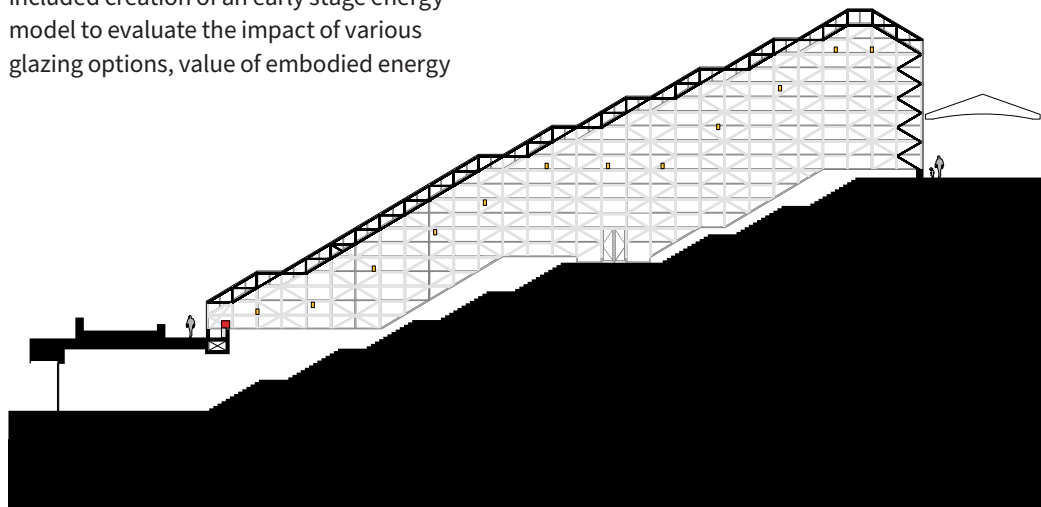
in the original aluminum frame, and net GHG savings. In addition, the existing natural ventilation operable windows were refurbished, allowing building operators to more easily ventilate the space with fresh air.

A study of the anticipated snow loading due to the new glazing's reduced heat loss was commissioned. The study included building massing effects, prevalent wind direction, snow melt through the roof and current climatic data to determine if any reduction in snow loading was permitted below the values prescribed through the codes. This innovative approach rationalized using reduced snow loads in the analysis, greatly reducing the extent of structural strengthening required. A successful structural intervention, in this case, was one that was elegantly subtle and allowed the updated glazing and solar PV system to remain as the focal point.



Inverters on display

The Edmonton Convention Centre's atrium follows the slope of Edmonton's river valley. The south facing roof provides a perfect opportunity to harness energy from the sun.



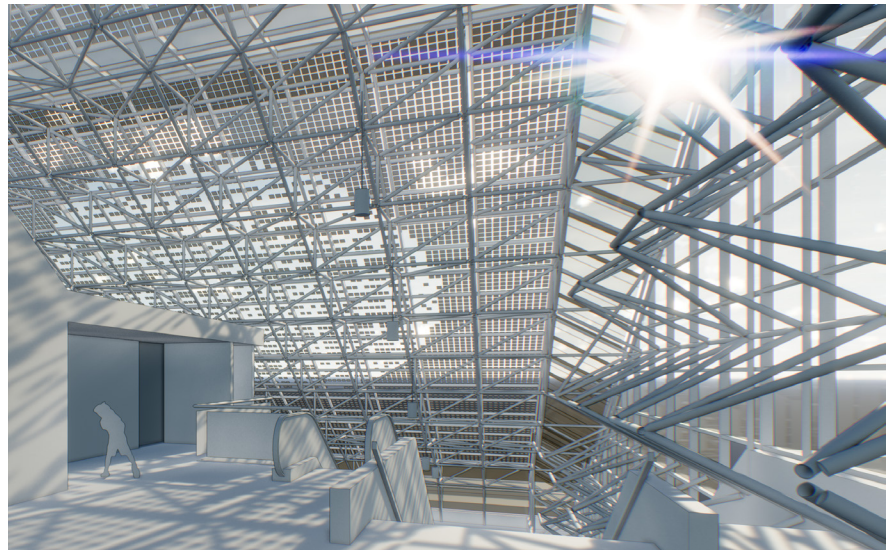
COMPLEX UPGRADES

The main objective of the project was to replace the ECC atrium's existing glazing, and the overall scope to achieve this includes the integration of the solar photovoltaic system, along with the complex structural and electrical and systems to support that.

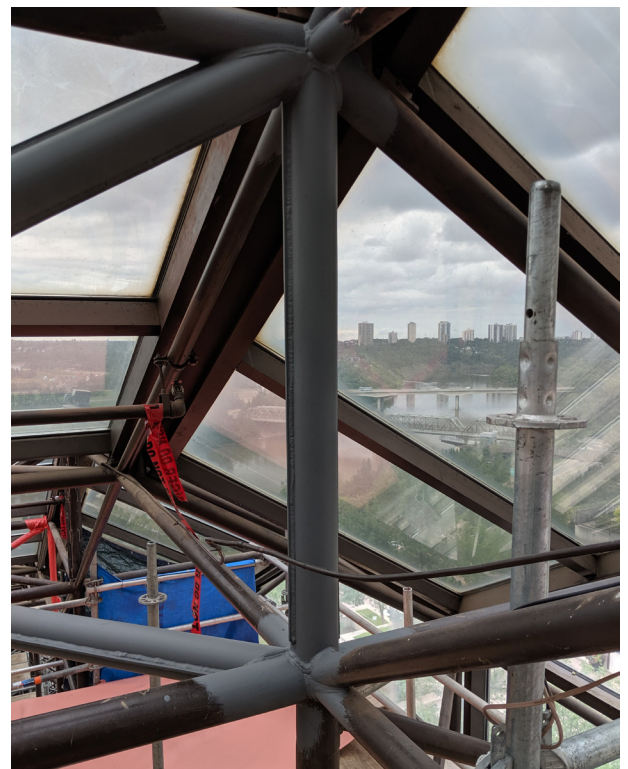
The selection of the glazing was an intensive iterative process that included six different glazing options. There were many factors to be considered in glazing selection including U-value, visual transmittance, shading coefficient, color, and overall system weight. The overall cooling load for the space had to be equal or lower than existing to avoid costly mechanical system upgrades. Another significant factor was retaining enough light transmittance for the atrium's impressive plant collection. This required a full daylight illuminance study. This combination of factors led to the selection of a double paned assembly since triple glazing could not be structurally supported.

The new insulated glazing units are heavier than the existing, and their enhanced energy performance reduces heat loss through the glass. This results in the potential for increased snow accumulation on the roof. This change in loading necessitated a full structural analysis of the steel space frame and the design of steel "jacketing" around the existing round hollow steel truss sections. These strengthening members were carefully detailed to tie-in neatly with the existing structure while providing sufficient structural capacity to support the increased loads. An analysis model of the atrium space frame structure was created to assess the effects of this loading increase.

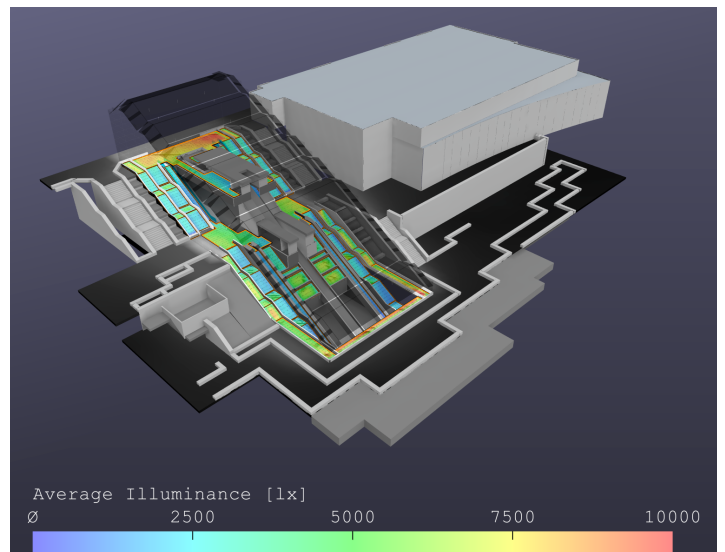
Careful coordination was required to design the electrical wireways for DC cabling. Electrical inspectors were consulted early in the design phase to determine the safest way to run the high-voltage DC cabling through the structure. Enhanced safety measures were taken, such as arc-fault and ground protection, additional bonding, and grommited wireways. These safety measures mitigate the risk of electrifying the glazing frame in the event of a fault.



▲ Preliminary 3D renderings were generated to help visualize the effect of the new PV glazing.



► A structural solution that strengthened the existing structure and integrated with the new electrical system was found to be both a fiscally and socially responsible approach.



► A full daylight illuminance study was performed to determine if the new glazing system would retain enough light quality for the atrium's impressive plant collection.



BALANCING ENERGY, ECONOMICS AND DELIGHT

"Not only does the installation help position Edmonton as an attractive destination for sustainable events, it encouraged us, our clients and our guests to set loftier goals that support the future of our industry and environment"

-Melissa Radu, ECC Sustainability Manager

The renovation strikes a balance between energy, economics, and delight. The ECC benefits from lower operating costs due to the high performance envelope and active electricity generation. It is estimated that the envelope upgrades alone reduce heating and cooling costs by about 10%.

The atrium is now brighter than ever. The existing glazing was significantly tinted with a visible light transmittance of only 18%. Older glazing systems relied on darker tinting to lower solar heat gains, but newer, advanced glazing selectively controls the infrared spectrum without the dark tinting. The new glazing units bring the visible light transmittance up to 25%, even with opaque PV cells covering approximately half of the surface.

While a partial replacement of the steel roof structure was contemplated early in the design phase, an approach that retained and strengthened the existing structure was found to be both a fiscally and socially responsible approach. This

strategy reduced structural demolition and allowed for phased construction, keeping this important community hub accessible throughout the project.

Operationally, the solar PV array generates approximately 200 megawatt-hours of electricity per year, reducing the annual electricity costs by approximately \$20,000. Visually, the system has a delightful surprise for visitors to the Centre and surrounding river valley. An 'oculus' appears in the heart of the atrium, allowing a clearer outlook to the picturesque river valley with a poem inscribed. The poem is composed by a former Edmonton poet laureate, E.D. Blodgett, and is displayed in Morse code using PV cells. This elegant collaboration between art and engineering invites a sense of curiosity and connection to the surroundings. While filling the oculus with a solid array of PV cells would have had a greater economic impact, the social impact of incorporating art helped balance initiatives.



The poem is legible from left to right within the atrium, but the visual appeal extends outside and across the valley.

The Morse code is an excerpt from *Gifts of a River* by former Edmonton poet laureate E. D. Blodgett:

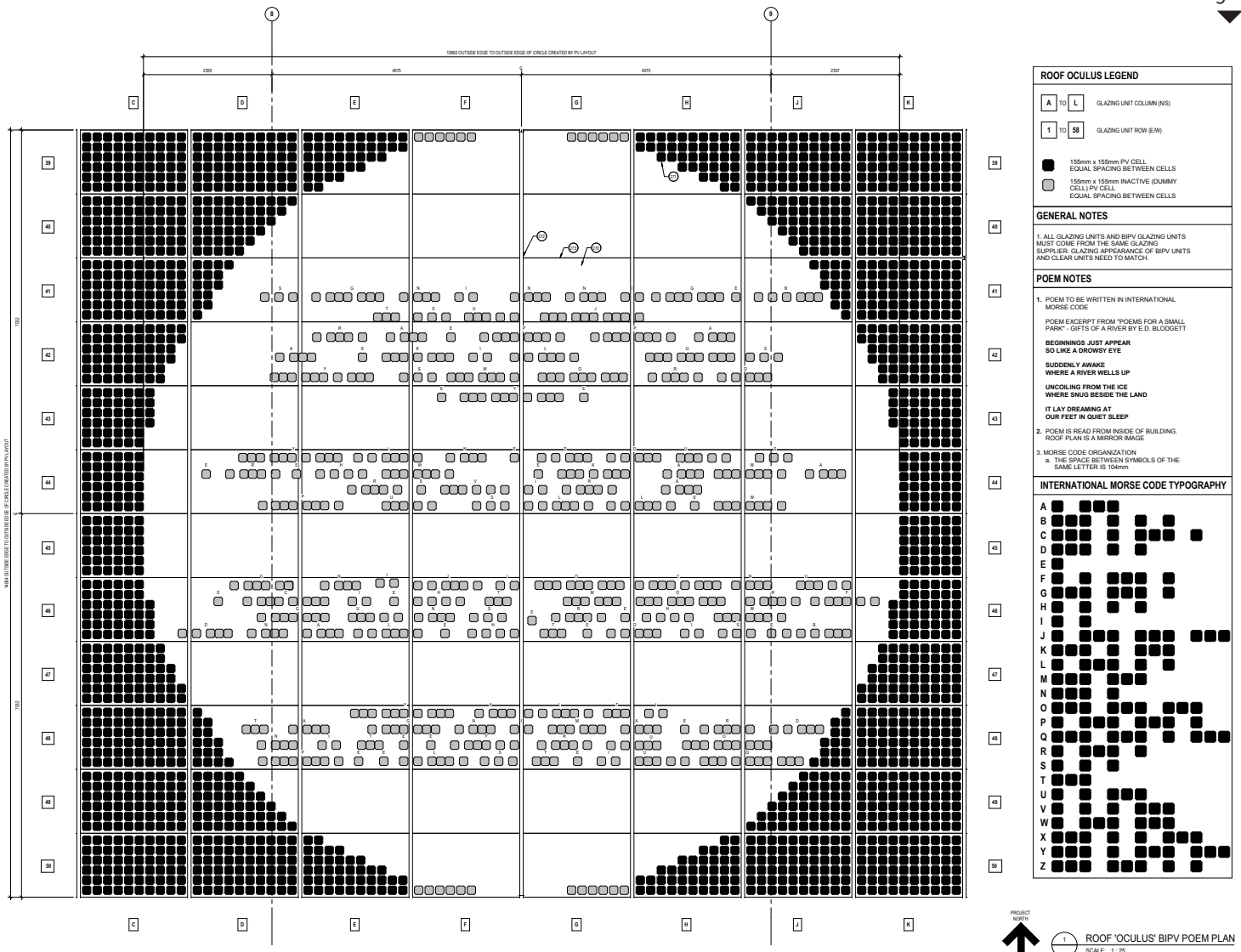
beginnings just appear
so like a drowsy eye

suddenly awake
where a river wells up

uncoiling from the ice
where snug beside the land

it lay dreaming at
our feet in quiet sleep

Roof Oculus BIPV Poem Plan from final construction drawings.



ENVIRONMENTALLY RESPONSIBLE

Harnessing energy from the sun to offset some of ECC's electrical usage was an opportunity not to be missed. It is estimated that the solar PV array will generate more than 200 megawatt-hours of electricity each year, reducing anticipated greenhouse gas emissions by over 150 tonnes. While the solar PV system is the most visible sustainable initiative, the ECC is so large that this only offsets approximately 3% of their annual electricity usage.

Bigger benefits are hiding in plain sight. When the solar PV system is combined with the improved thermal performance of the envelope and the LED lighting, the

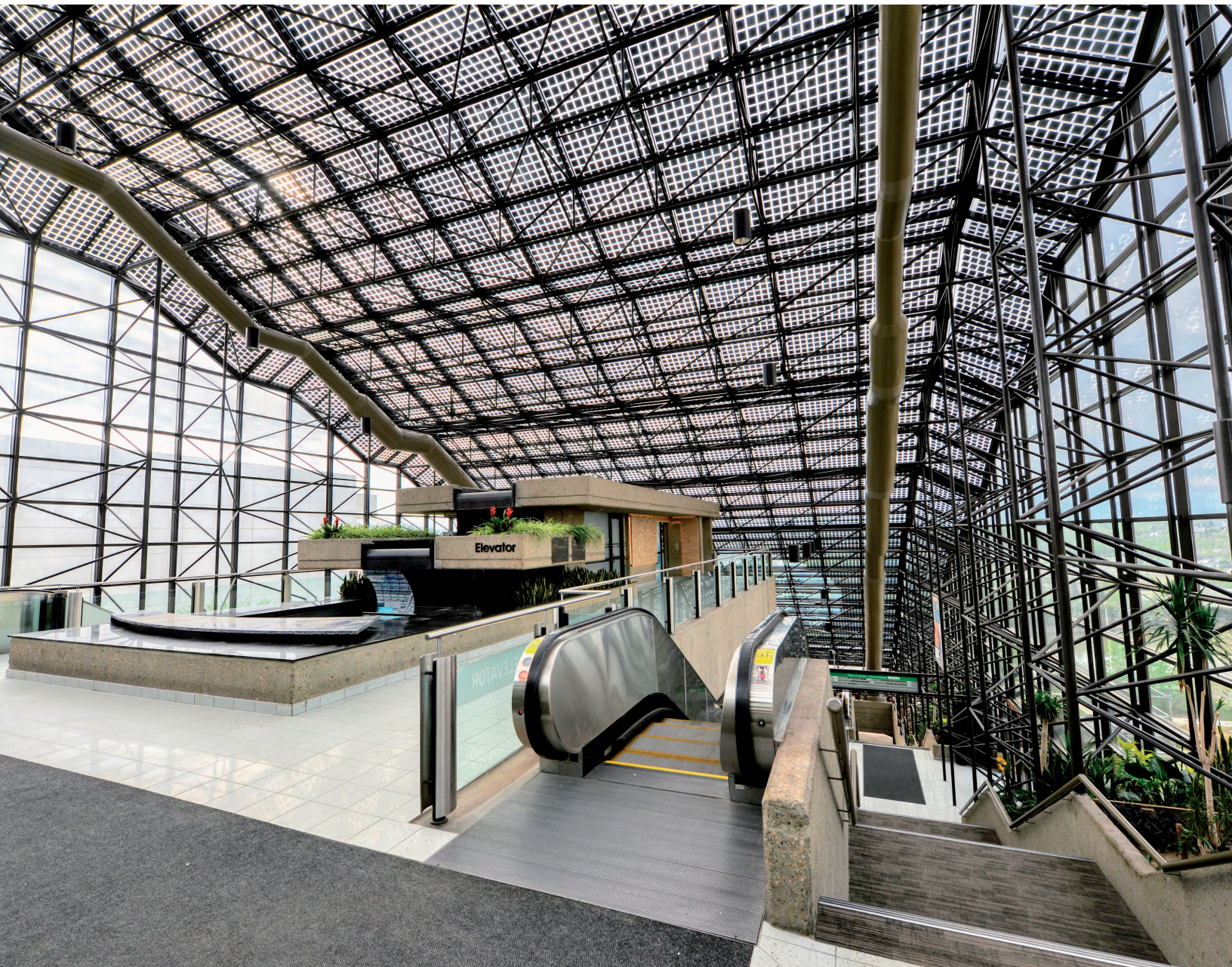
overall renovation is expected to reduce energy consumption for the facility by 20%, and to reduce green house gas emissions by 263 tonnes. This lowers operating costs for the facility (potentially reducing public funding requirements) and works towards a zero-carbon future—all while maintaining the iconic stature of the atrium in the river valley.

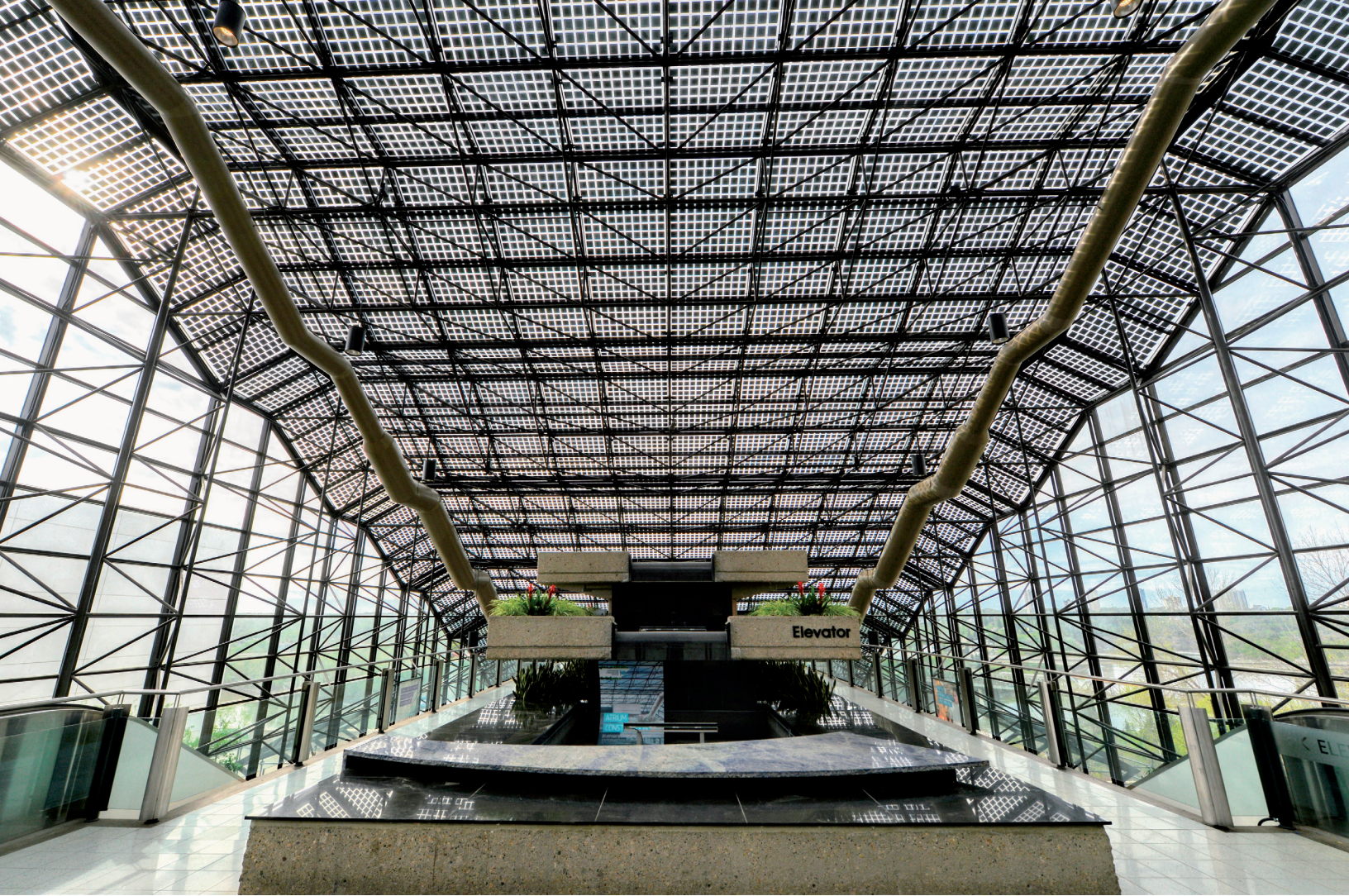
While a partial replacement of the steel roof structure was contemplated early in the design phase, an approach that retained and utilized the existing structures was favoured as a more sustainable approach. This strategy reduced structural demolition and new

materials used, and allowed for phased construction that kept this important community facility accessible throughout the project.

"With the sheer size of our building, it should be no surprise that the largest percentage of our greenhouse gas footprint comes from the procurement of energy—nearly 70% of our total emissions. Generating renewable electricity onsite, while also becoming more energy efficient, is one of the best ways to make real progress towards slashing emissions."

-Melissa Radu, ECC Sustainability Manager





EXCEEDING EXPECTATIONS

The existing Edmonton Convention Centre is an iconic structure in the heart of Edmonton and the river valley network. The welcoming atrium is a connective gateway between the bustle of downtown and the calm of the river valley. It's the entrance for events hosted at the ECC, and a publicly accessible space for all to enjoy. Maintaining this prominence while repairing and rejuvenating the atrium was the client's primary objective.

Knowing that the ECC is recognized for its leadership in sustainability in the meetings and conventions industry, the project team suggested that a highly visual solar PV system is an opportunity to prominently showcase their sustainable ambitions while helping ECC achieve them.

Lighting upgrades increased the quality and quantity of light in the atrium, making

the space more enjoyable during the day and night. Replacement of the glass with high performance insulated glazing units significantly reduced heating and cooling loads in the building. Structural systems are intimately linked with the architectural and building envelope requirements, and the electrical systems are elegantly integrated with the structural strengthening.

The integrated engineering and architectural teams kept sustainability and aesthetics top of mind while designing an integrated solution.

The artful incorporation of a Morse code poem into the building integrated solar PV system creates a sense of wonder and connection to the surroundings. All of these design elements, when combined, successfully met and exceeded the client's expectations for this renovation.

"Across the world, event organizers are asking to host their events in cities and venues that can showcase this type of environmental accountability. Our sustainability program and solar roof now set us apart as the ideal location for organizers and businesses who also wish to reduce the environmental footprint of their events."

-Melissa Radu, ECC Sustainability Manager