

NET ZERO HEROES

ASHRAE LowDown Showdown

2018 Building Performing Analysis Conference and SimBuild

Building Type: Museum
(including retail space and full service restaurant)

Total Floor Area: 65,547 ft²

Location: Denver, Colorado

Total Energy Usage

897,726 kBtu

Site EUI

13.7 kBtu/ft²

Annual Water Usage

150,000 gal

Annual Electricity Cost

0.002 \$USD/ft²

Annual Water Costs

0.02 \$USD/ft²

Total Annual Costs

1,460 \$USD

CPSF

483 \$USD/ft²

Total Energy Generation

927,565 kBtu

Net Zero Energy

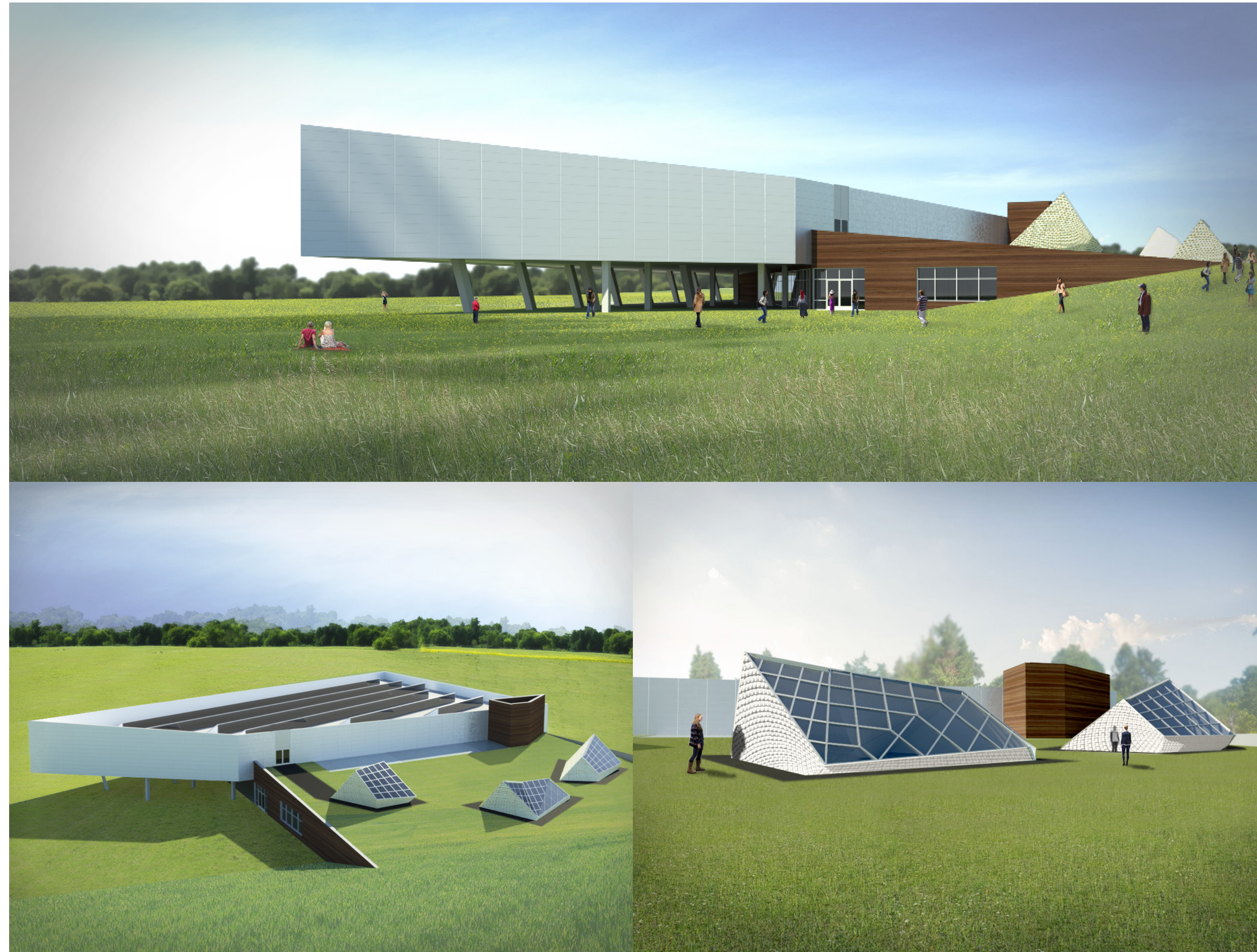
29,839 kBtu

Carbon Equivalent

-0.738 tons CO₂

Team

Captain/Energy/Engineer Noble Lilliestierna PE, LEED AP BD+C	Architect Bennie McMullen MBA, LEED AP BD+C, AIA
Energy/Engineer Jeff Turovskiy EIT	Designer Ivette Ruiz
Energy/Engineer Kaitlin Page PE, LC	Designer Monique Kowalik LEED GA
Coach/Fan Adam Downey	Architect Takeshi Aratake
Energy/Engineer Ashor Chirackal	Architect Jim Boyer

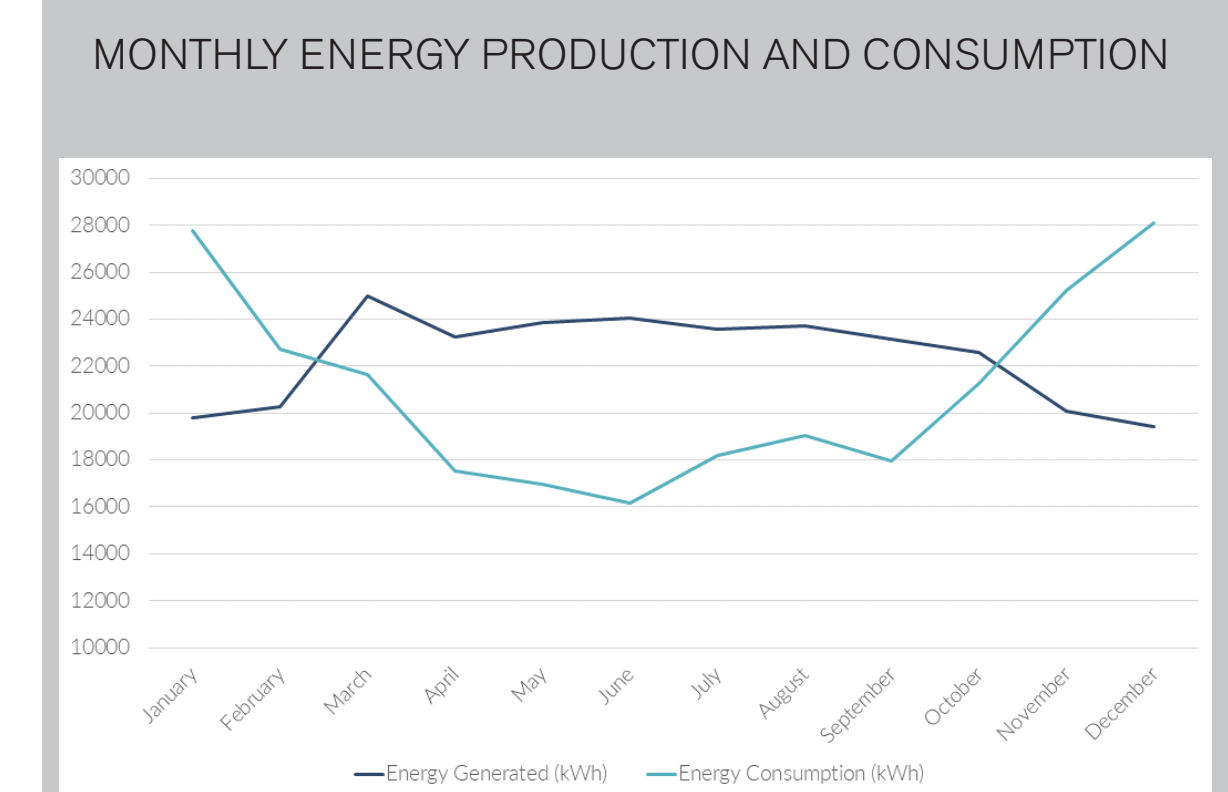
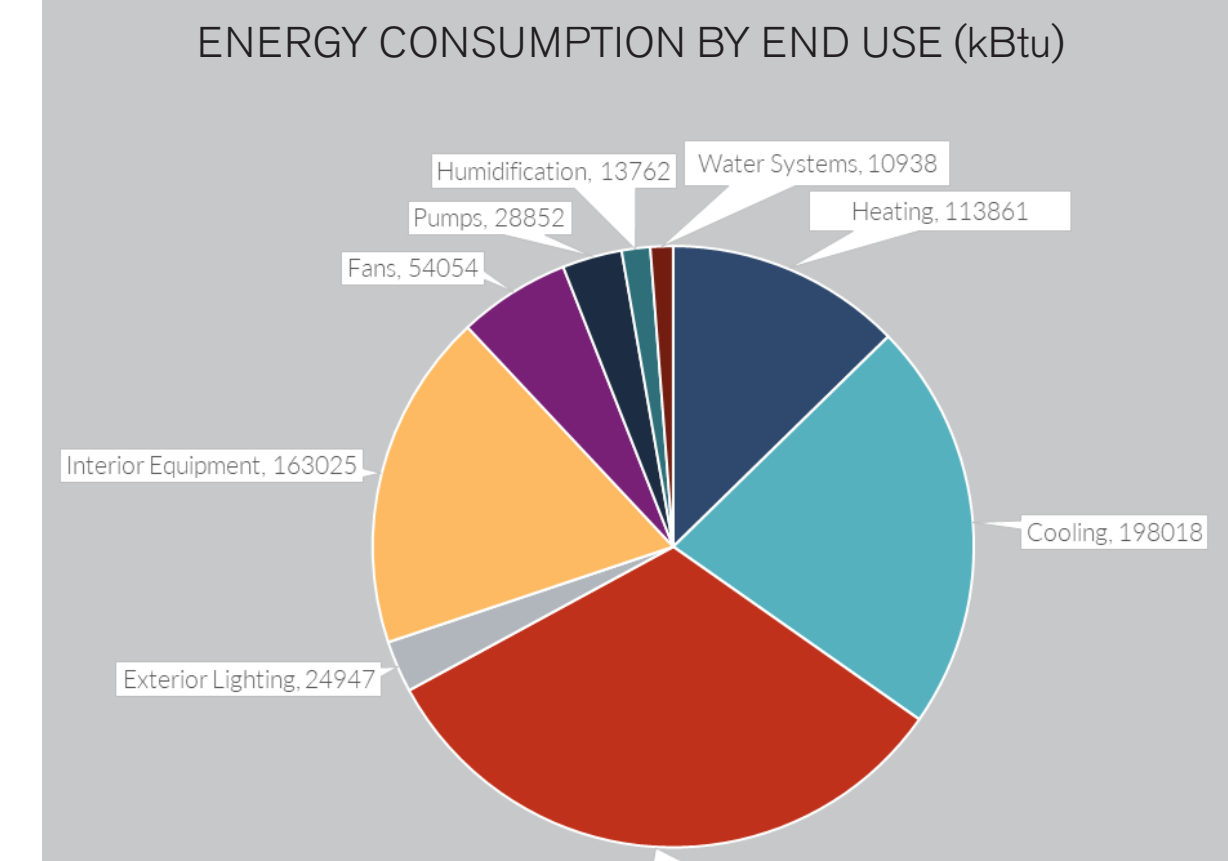
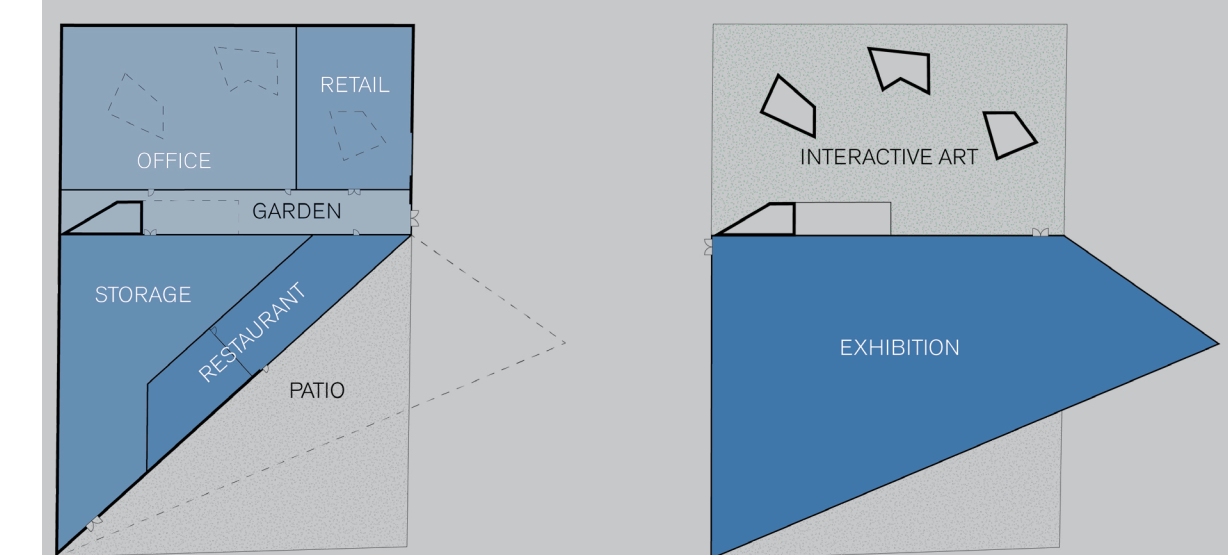
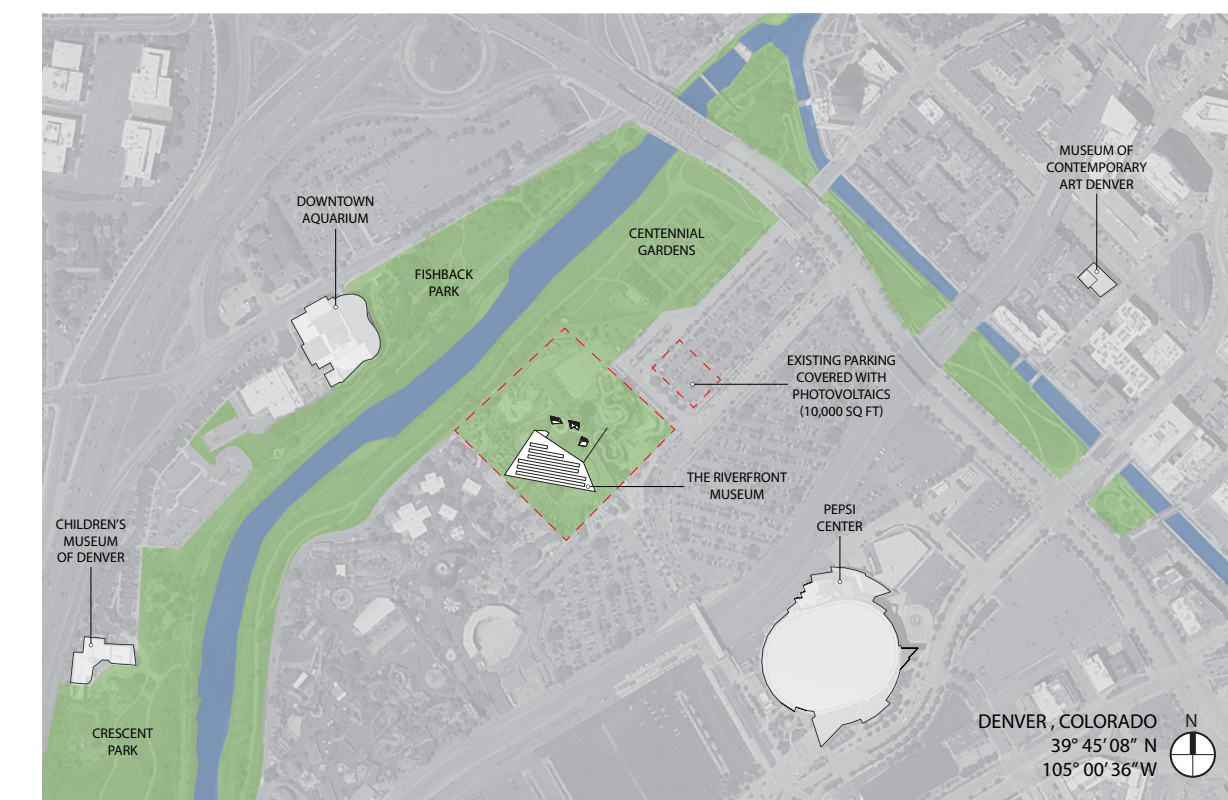
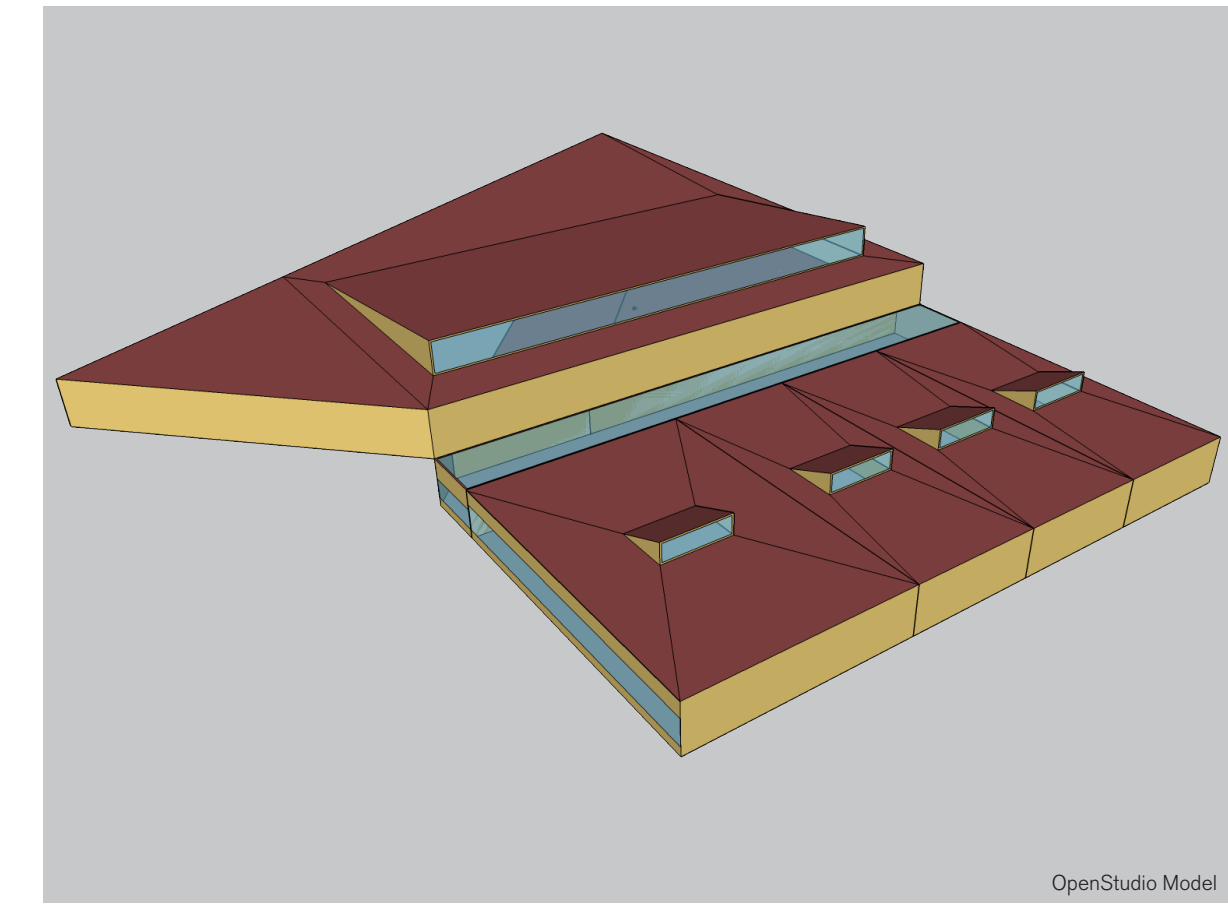
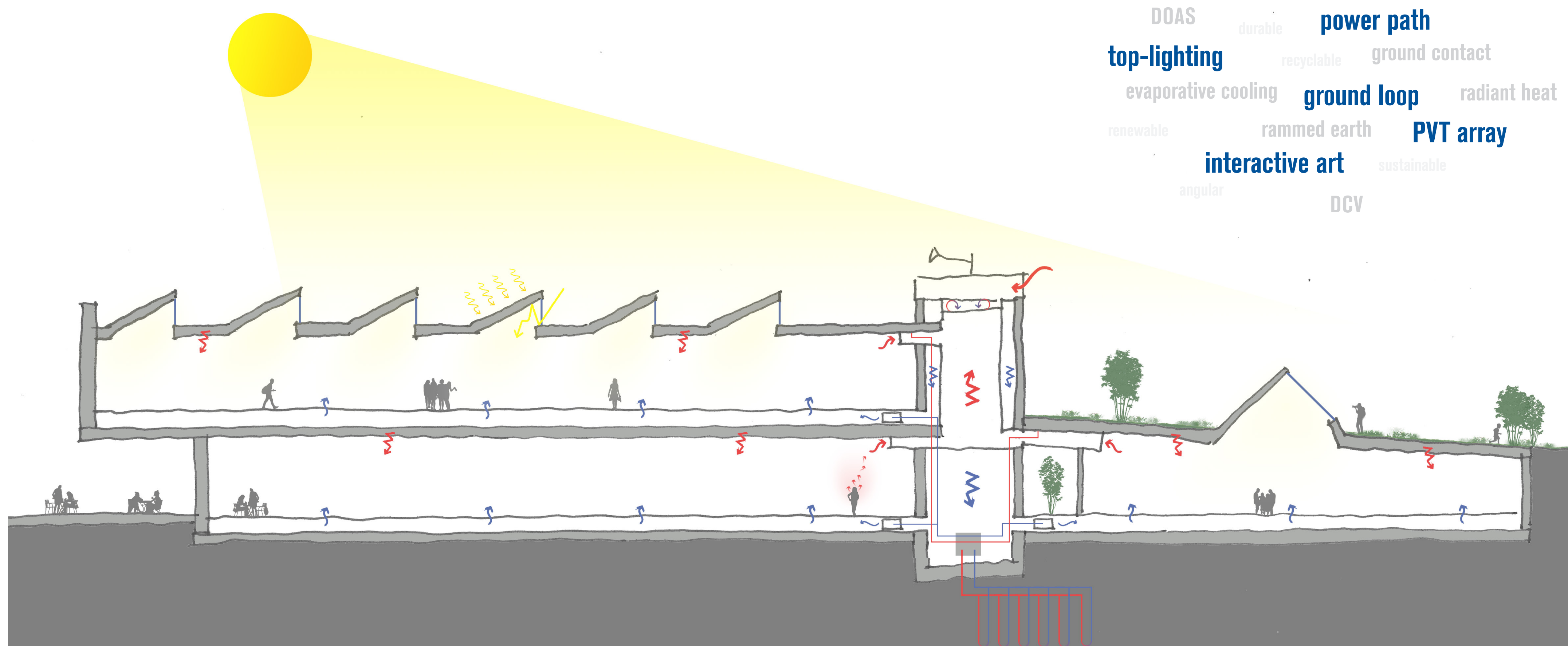


Model Description

The Net Zero Heroes, a team of engineers, architects, energy modelers, and designers, have joined to design the Denver Riverfront Museum. The energy modeling tool of choice was OpenStudio and, together with other tools like AGI32, Autodesk CFD, and System Advisor Model, the Heroes designed a net zero museum with an EUI of 13.7 kBtu/sf, less than one third the energy consumption of a typical museum.

Energy Savings Strategies

The Net Zero Heroes began with the end in mind; a target EUI of 13.98 kBtu/sf as determined by the power generated by 10,000 sf of PV. Passive architectural strategies, such as burying half the building, north-facing top-lighting, and rammed earth walls helped reduce the energy needs. Dedicated outdoor air systems tied to displacement ventilation distribution meet the ventilation and humidification requirements of the spaces using indirect evaporative cooling, sensible air-to-air heat exchangers, and ultrasonic duct humidifiers. A vertical ground loop heat pump system supplies radiant ceiling heating and zone level water-air heat pumps to handle the sensible loads. Service hot water needs are entirely met by using hybrid PVT panels instead of plain PV panels. To engage and educate visitors, the surfaces of the light wells are covered with an interactive art display powered by energy-generating floor tiles.



DOAS durable power path
top-lighting recyclable ground contact
evaporative cooling ground loop radiant heat
renewable rammed earth PVT array
interactive art sustainable
angular DCV