REDISCOVERING AGU

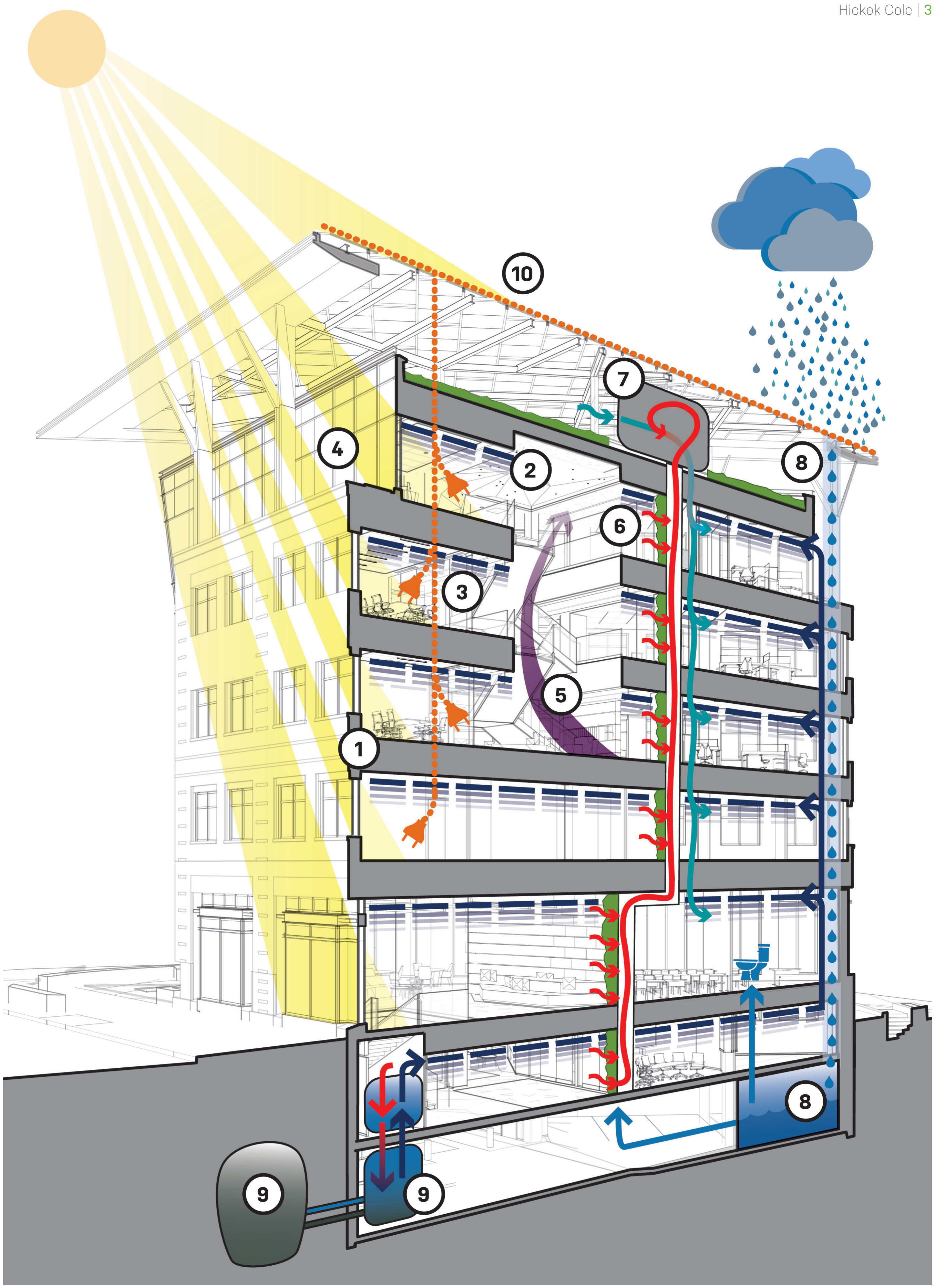
The original American Geophysical Union (AGU) headquarters building was designed to incorporate symbolism representing the Earth and space sciences studied by the organization's more than 60,000 members. Maintaining the integrity of the original design was paramount to AGU, its neighbors, and the local Historic Preservation Board. In approaching the building's renovation, Hickok Cole sought to make both an architectural and environmental statement — situating the building firmly in the conversation around the future of Net Zero Energy development while retaining its original, beloved character.

The result is an iconic design that meets AGU's desire for a statement building that complements the surrounding neighborhood. Two feature elements that amplify the building's urban presence include a new Solar Photovoltaic (PV) array and the extension of the building's signature prow to the street level. Supported on sculptural, zinc-clad columns, the PV array proudly announces the generation of energy, while the new prow leverages the building's architectural language to communicate AGU's goal of connecting with the public.

The building will be a landmark for the city, for the country, and for the struggle to reign in mankind's contribution to climate change via the built environment. The design marks a pivotal moment in the language of architecture—replacing the rectangular penthouse mass used to house a building's heating and cooling systems with a canopy of solar panels. The irony is that this canopy becomes the third part of a tri-partied, classical building composition, allowing buildings to have a base, middle, and top once more.

SUSTAINABLE STRATEGIES

1. Enhance Envelope Insulation
2. Radiant Ceiling Cooling System
3. DC Powered Workspace and Lighting
4. Enhanced Dynamic Glazing System
5. Central Active Stair
6. Hydroponic Phytoremediation Wall
7. Dedicated Outdoor Air System (DOAS) with Exhaust Air Heat Recovery
8. Stormwater Collection and Reuse
9. Municipal Sewer Heat Exchange System
10. Solar Photovoltaic (PV) Array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STRATEGIES BY GOAL

To meet the project's net zero energy goal, the team empoyed a combination of strategies to conserve and generate enough power to meet the building's demands. These strategies have been divided into four categories: reduction, reclamation, absorption, and generation.

REDUCTION

1. ENHANCED ENVELOPE INSULATION

AGU's existing brick envelope is mounted on a concrete masonry unit (CMU) backup wall and separated by an air gap. These exterior walls do not currently contain insulation or an air/weather barrier. To accommodate, six-inch studs were added along the interior of the perimeter wall to provide space to:

- Install eight inches of closed-cell spray-applied insulation to act as an air barrier and help achieve an R-value of 53.
- Anchor the new windows in-line with the insulation, creating a continuous thermal barrier.

2. RADIANT CEILING COOLING SYSTEM

Radiant ceiling systems control temperature through radiation, which is a more efficient way to condition space than forced-air. Decoupling the building conditioning system from the dedicated outdoor air system (DOAS) reduces the overall energy needed to move air through the building since it's now only needed for ventilation, not for space cooling.

3. DC POWERED WORKSPACE AND LIGHTING

The United States electrical grid is wired for alternating current (AC) power distribution. However, most electronics—including computers, appliances, and LED lighting—require direct current (DC) power. To reduce the energy efficiency loss caused by the AC-to-DC power conversion, AGU will use a DC-to-DC energy distribution microgrid that relies on the DC power produced by the building's rooftop PV array.

4. ENHANCED DYNAMIC GLAZING SYSTEM

The existing windows at AGU have been removed and replaced with triple-pane, air-filled, 1-3/4 inch thick dynamic glass windows. The added third pane gives the windows a lower U-value and solar heat gain coefficient that helps to reduce the transmission of heat and cold. This glazing also incorporates an electrochromic film that tints on-demand, taking the place of traditional blinds to reduce glare and heat transmission while allowing natural light in and views out.

5. CENTRAL ACTIVE STAIR

A main feature of the upper floors, the central stair creates connectivity, discourages use of elevators, and helps distribute light throughout the building.

RECLAMATION

6. HYDROPONIC PHYTOREMEDIATION WALL

While this wall looks like a standard green wall or vertical garden, it actually functions as part of the building's ventilation system. In conjunction with the DOAS, the Hydroponic Phytoremediation (HyPhy) wall filters and improves the quality of indoor air, while reducing the amount of outside air needed to support the building. The plants, their roots, and the wall's water filtration system scrubs air of unwanted toxins and volatile organic compounds before recirculating it throughout the building.

7. DEDICATED OUTDOOR AIR SYSTEM (DOAS) WITH EXHAUST AIR HEAT RECOVERY

The DOAS provides a dedicated means for building ventilation. This system both conditions incoming air, and recovers heat from outgoing exhaust to raise the temperature of incoming air for space heating needs.

ABSORPTION

8. STORMWATER COLLECTION AND REUSE

Rainwater captured from the roof and PV array will be collected in a 11,300-gallon cistern located in the building's garage. After filtration and treatment, this greywater will be reused for all flushing fixtures and the irrigation of the green roof and HyPhy wall.

9. MUNICIPAL SEWER HEAT EXCHANGE SYSTEM

The first of its kind in the United States, this system taps into an adjacent 1890s sewer line to maximize the efficiency of the building's mechanical systems. The municipal sewer heat exchange system functions as a heat sink/source, operating by:

- Diverting wastewater to a settling tank located just outside of the building.
- Circulating the now debris-less water into a sewer heat exchanger located in the underground garage.
- Pre-heating or cooling separately piped in radiant fluid before it is recirculated throughout the building.

Fear not, it is a closed loop system, no sewage contamination will take place.

GENERATION

10. SOLAR PHOTOVOLTAIC ARRAY

AGU's solar photovoltaic array includes 720 Sunpower solar panels making up a 250-kilowatt system. Positioned for maximum efficiency, the system includes 24 panels on the vertical, south-facing surface and 696 panels elevated and laid out horizontally above the penthouse roof. The panels are some of the most efficient on the market at just over 22% efficiency.

PROJECT STATISTICS

90%

of construction waste was recycled.

77%

reduction in water demand due to efficient water fixtures and captured rain water.

96%

of existing building materials were reused, including the repurposing of stone, glass and porcelain toilets in first floor terrazzo.

5%

At 96 points, AGU will be in the top 5% of the 110,000+ LEED projects in the world.

100%

AGU is on track to earn 100% of LEED points in the Water Efficiency, Energy & Atmosphere, Innovation in Design, and Regional Priority credit categories.

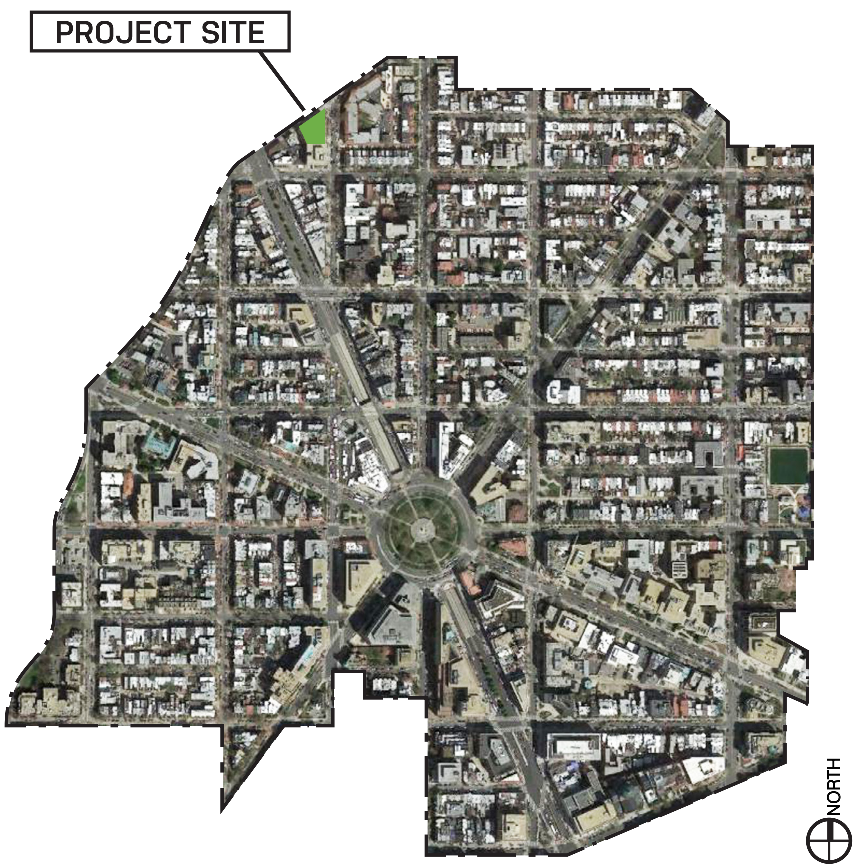
REVIEW PROCESS

HISTORIC PRESERVATION REVIEW BOARD

The AGU building sits at the northern edge of the Dupont Circle Historic District in Washington, DC.

While the building itself is not historic, the addition of the PV array constituted an “alteration to a non-contributing building” and had to be deemed “compatible with the character of the affected district.”[1] Thus, the success of getting to Net Zero Energy rested firmly on obtaining approval for the PV array from the Historic Preservation Office staff and the Historic Preservation Review Board (HPRB). At the initial meeting to discuss the array, the staff made it clear that design of the array had to be extremely refined and well-executed. Their review went through a series of back and forth exchanges about the articulation of the array. Simultaneously, the design team and AGU leadership sought to communicate the goals of the project and to explain the design of the alterations to the neighborhood. Ultimately, the needed approvals from HPRB were obtained.

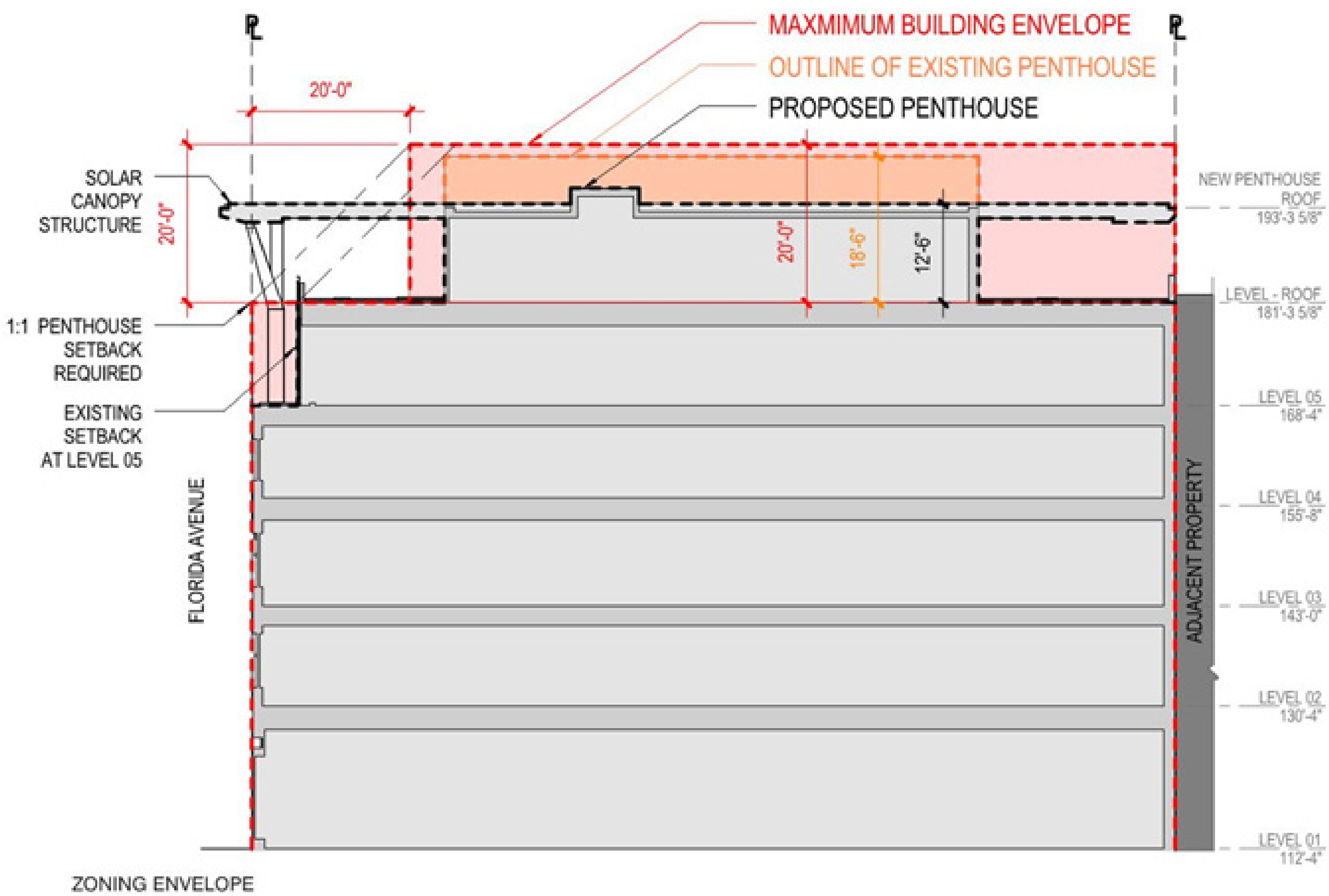
[1] *https://planning.dc.gov/page/minor-work-qualifying-hpo-review*



DUPONT CIRCLE HISTORIC DISTRICT

BOARD OF ZONING ADJUSTMENT

Just prior to the schematic design phase for AGU, the Board of Zoning's (BZA) new zoning regulations came online. For this once-in-a-generation re-write of the zoning laws, the BZA did not address how PV arrays should be reviewed. Lacking any separate set of guidelines, the PV array fell under the rules for penthouses. As such, a 1:1 ratio of height to distance back from the building face was required. This constraint would have ended any effort to get to Net Zero Energy as the project could not afford to lose so much of PV array area. This led to the application for zoning relief from this requirement. In Washington, DC there are strict limits for height of buildings; fortunately AGU was below this limit making the argument for the PV array less problematic to the BZA which was concerned about setting a precedent. After going in front of the BZA twice, unanimous approval was received.



BOARD OF ZONING ADJUSTMENT
Special Exception for Penthouse Setback Requirements

CONNECTING BUILDING AND PEOPLE

HEALTHY WORKPLACE

From the outset, AGU's goal was to create a modern workplace for their hardworking staff. In response, Hickok Cole developed a series of architectural strategies aimed at achieving a healthier and more productive work environment. These strategies include:

- Inserting a two-story, sculptural stair to connect the three staff floors
- Eliminating opaque, perimeter rooms to allow daylight deep into the floor plan
- Placing a hydroponic phytoremediation wall along the main corridor of each floor
- Creating a variety of alternate spaces conducive to getting work done, including the rooftop, member's lounge, staff pantry, glassy and open conference rooms, and small, private "quiet cars"

REUSE

One of the most unique project successes lies in the team's creative and unusual reuse of existing building materials. This effort required the tagging, photographing and cataloging of all interior elements: door, chairs, tables, wall panels, a piece of petrified wood, cabinetry, and even toilets. The team's commitment to reuse resulted in each of these elements being repurposed in the building or connected to a new owner. Even at this stage of construction, the team continues to solicit stories of reuse from sub-contractors working in the field.

One of the most entertaining examples of reuse involves the white chips found in the lobby terrazzo—fragments of the building's toilets floating alongside granite from the lobby walls. This same terrazzo is also being used for the table top in AGU's main conference room.

COMMUNITY ENGAGEMENT

The Dupont Circle area is fortunate to have multiple groups of active citizens who take pride in their neighborhood and enjoy participating in local development decisions. These groups are committed to maintaining the historic character of the neighborhood, and this renovation presented a potentially dramatic change to the local streetscape.

Upon realizing the building would need variances from the current building code, the design and attorney teams began a concerted effort to gain neighborhood support around the project's larger goals. The team decided to tackle this challenge head-on, establishing channels to communicate regularly and transparently with neighbors. To kick-start this effort, AGU invited neighbors into their space for an open house where they could share the plans they had for the buiding. Additionally, a website was created as a means to share updates and major milestone announcements.

A **high-performance building** is one that integrates and optimizes on a life-cycle basis all major high performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.

A **Net Zero Energy** building is one where the total amount of annual energy used is equal to or less than the amount of energy created on-site through the use of innovative technologies and renewable power generation. Achieving this goal allows for the reduction of energy, waste, and water consumption to almost zero, and greatly reduces carbon footprint with the intent of putting excess power back on the grid.

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PROJECT TEAM

Owner: American Geophysical Union

Project Manager: MGAC

Architect: Hickok Cole

Engineer: Interface Engineering

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