Better Buildings
U.S. DEPARTMENT OF ENERGY

PNC Net-Zero Energy Branch

Success in retail energy design

Fort Lauderdale, Fl.

Better Buildings
U.S. DEPARTMENT OF ENERGY

The Team

CJL ENGINEERING

Turner

GMS

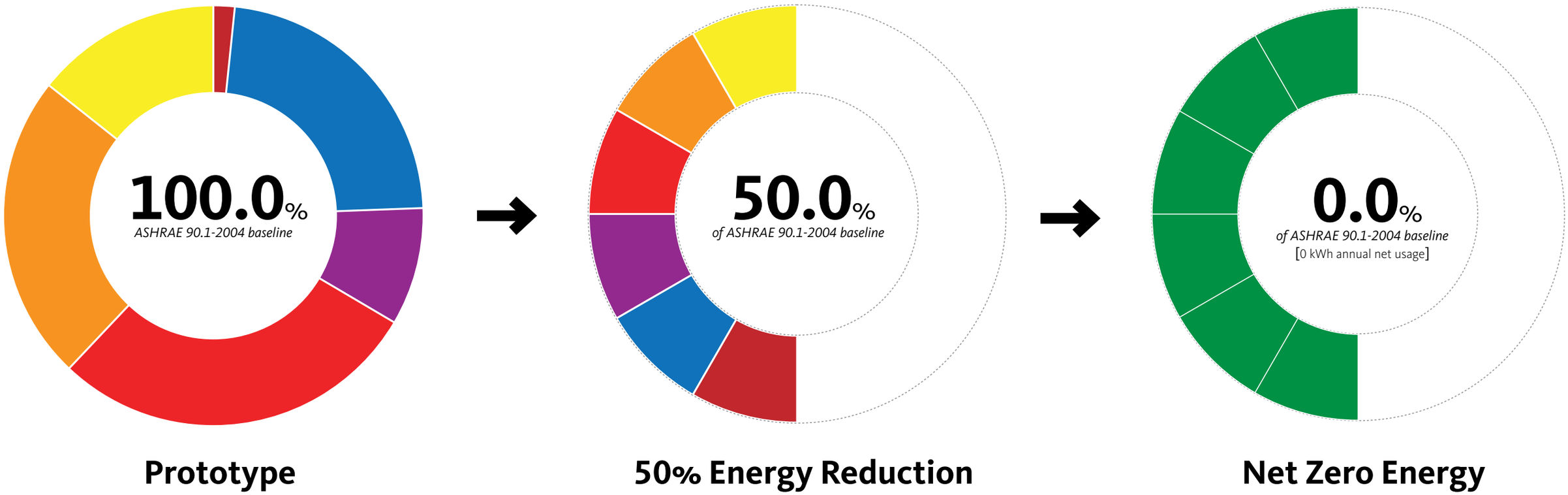
BOHLER ENGINEERING

TERRA TECTONICS design group, inc.

PNC BANK

Gensler

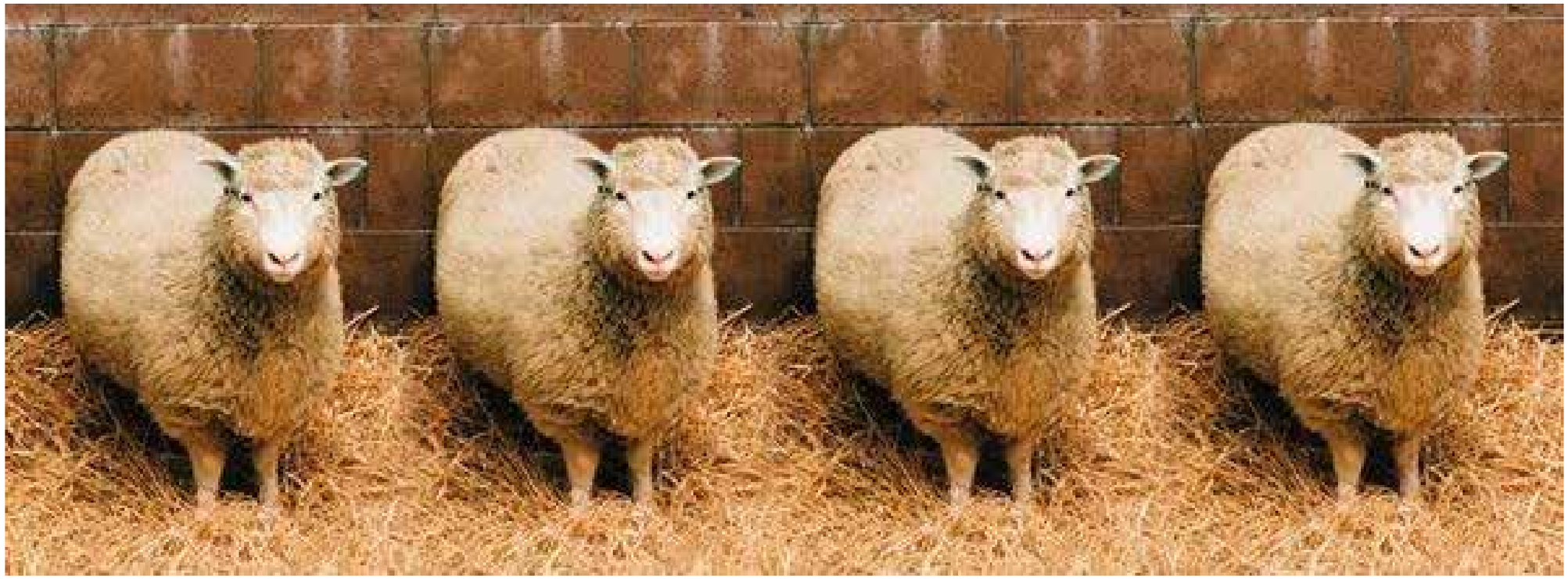
Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965



What do we mean by "net-zero"?

U.S. Department of Energy Commercial Buildings Initiative:

- 50% better performance than ASHRAE 90.1 2004
- On-site renewables only
- Net-zero annual energy consumption



Why is retail an opportunity?

Retail rollout architecture is based on a one to many model for efficiency - which also applies to energy. Gains in efficiency for the prototype extend to the entire retail rollout portfolio.

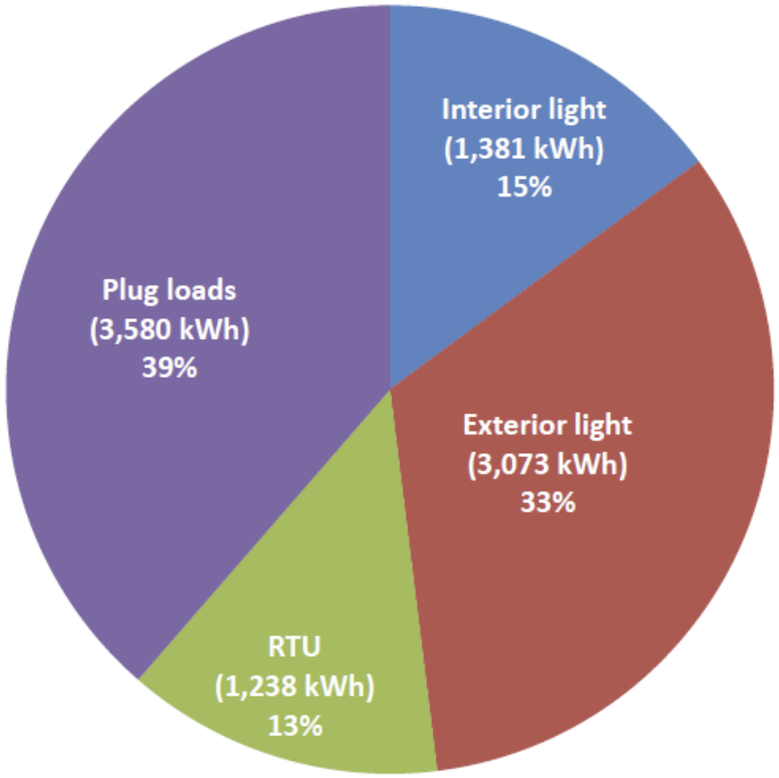
Part I: In the Lab

Establishing baseline

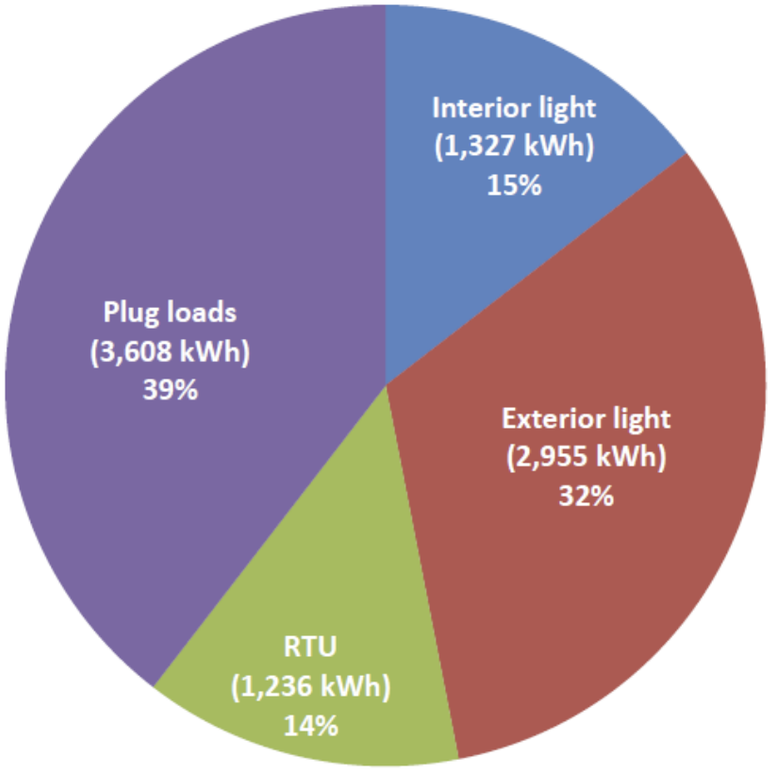
Original PNC prototype

~4,000 sf
6 Tellers Stations, 4 Customer rooms, Attached drive-thru
SIP + Stick-built Construction
Designed for Zone 2 & 3 CBECS climate (North East)

December 2009
(total 9,273 kWh)

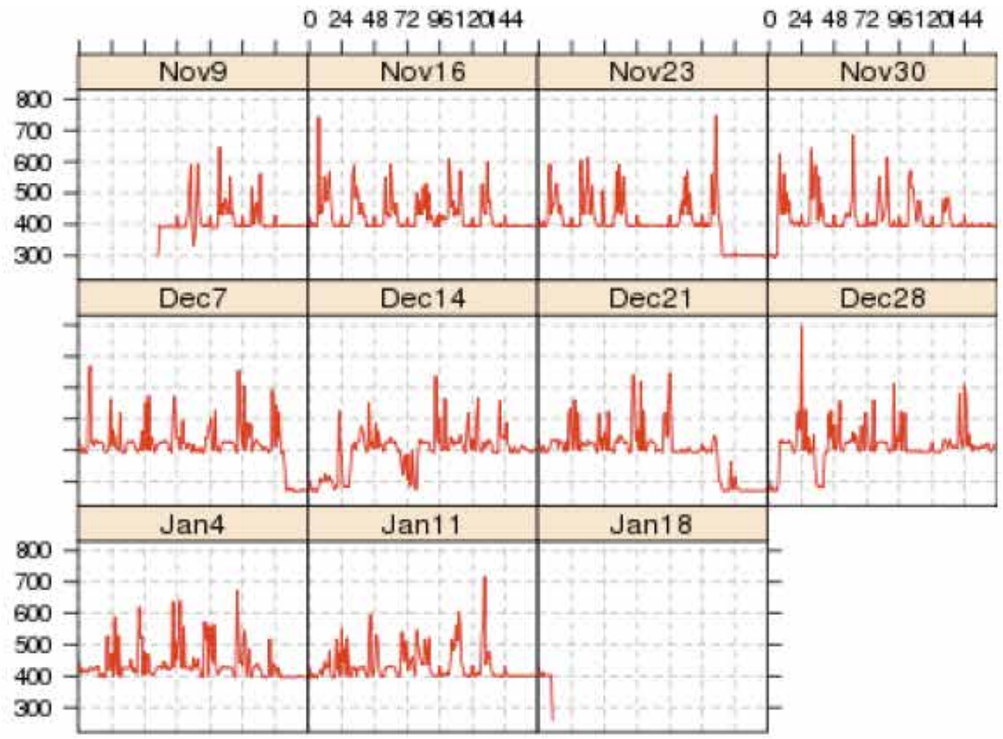


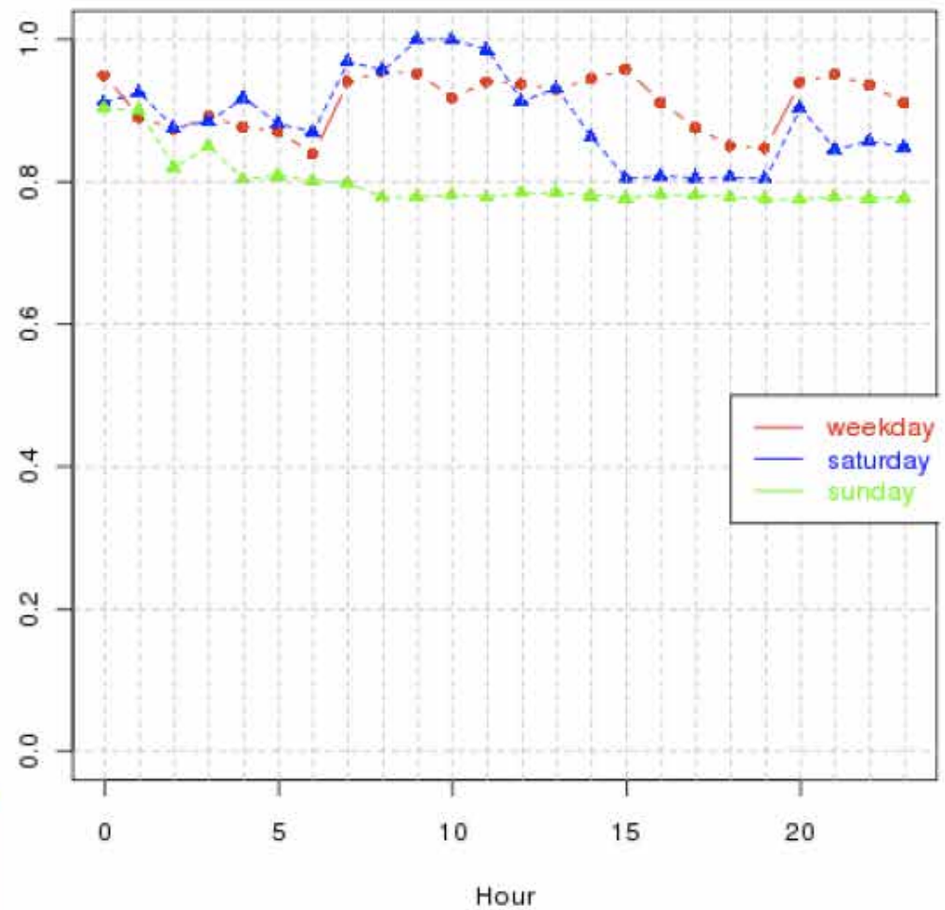
January 2010
(total 9,127 kWh)



Original Prototype Energy Profile

The ASHRAE 90.1 2004 baseline was calibrated based on electrical panel and individual plug-load metering of an existing, prototypical branch in Richland, PA.



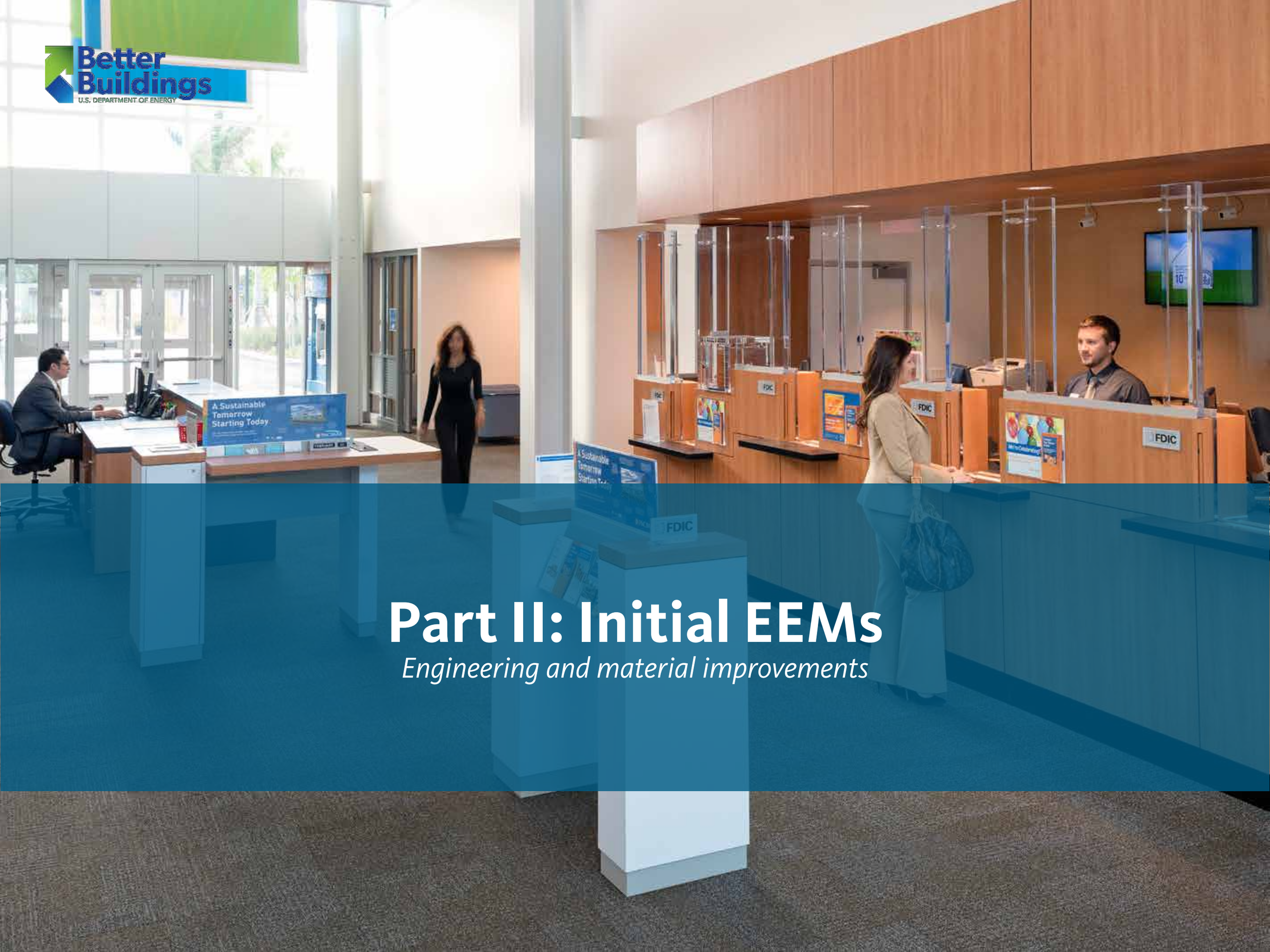


Aggregated from 7 plug loggers:

- Lobby TV, internet station (CPU/monitor/fan),

Plug-load detail

Detailed energy profiles were analyzed by the team to understand in detail how loads varied by hour according to actual branch use.



Part II: Initial EEMs

Engineering and material improvements

Envelope

Interior lighting
specified lighting within the building envelope

Exterior lighting
decorative exterior lighting and site lighting

Plug Loads
bank appliances, ATMs, computers, servers, monitors, printers, TVs, cameras, etc.

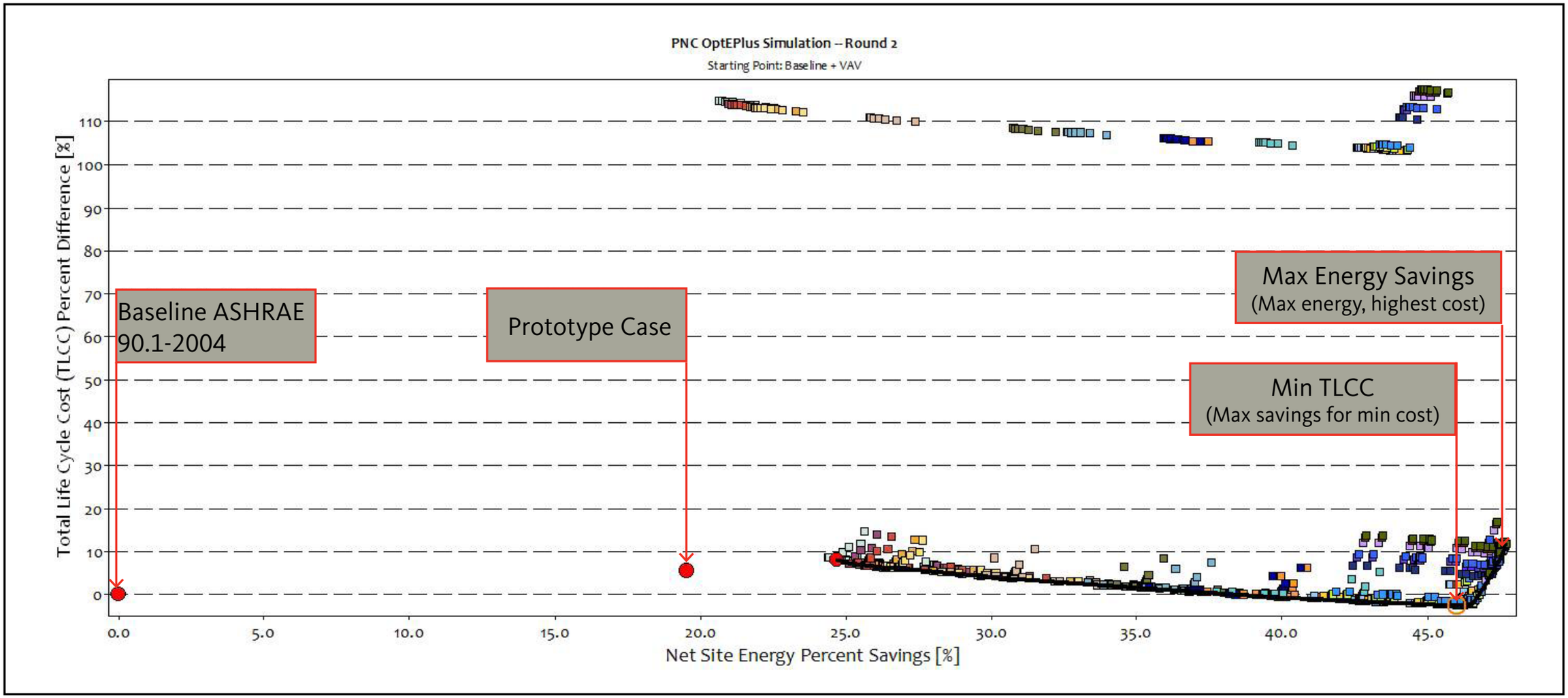
Fans
building air supply and exhaust

Cooling
hvac cooling system

Water
service water heater

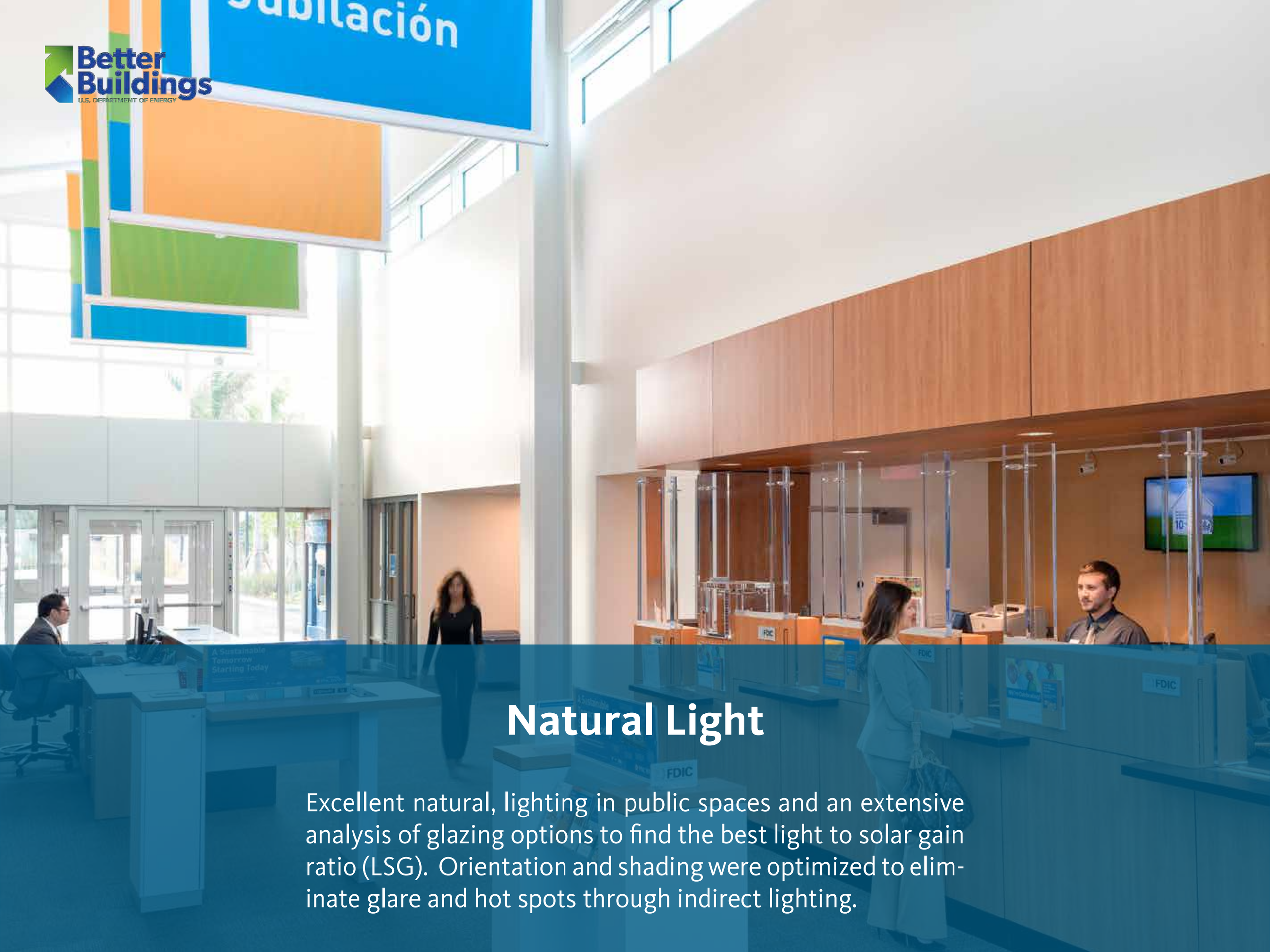
Initial Energy Efficiency Measures (EEMs)

Energy reduction through improvement of typical systems and materials.



Envelope Construction

Improved envelope efficiency by comparing Total Life Cycle Costs (TLCC) vs. net site energy percentage savings to identify the most energy efficient wall construction for the money.

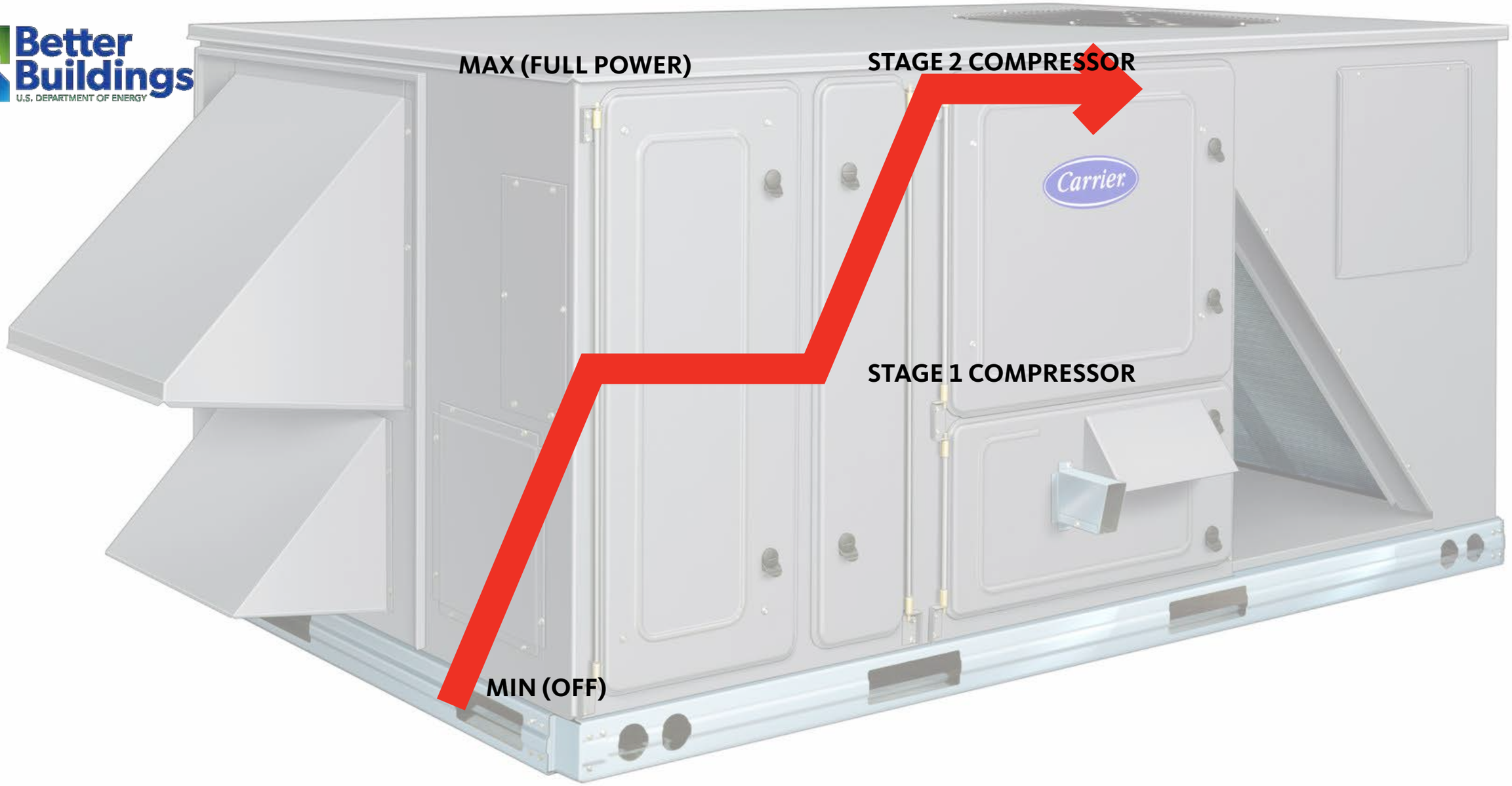


Natural Light

Excellent natural, lighting in public spaces and an extensive analysis of glazing options to find the best light to solar gain ratio (LSG). Orientation and shading were optimized to eliminate glare and hot spots through indirect lighting.

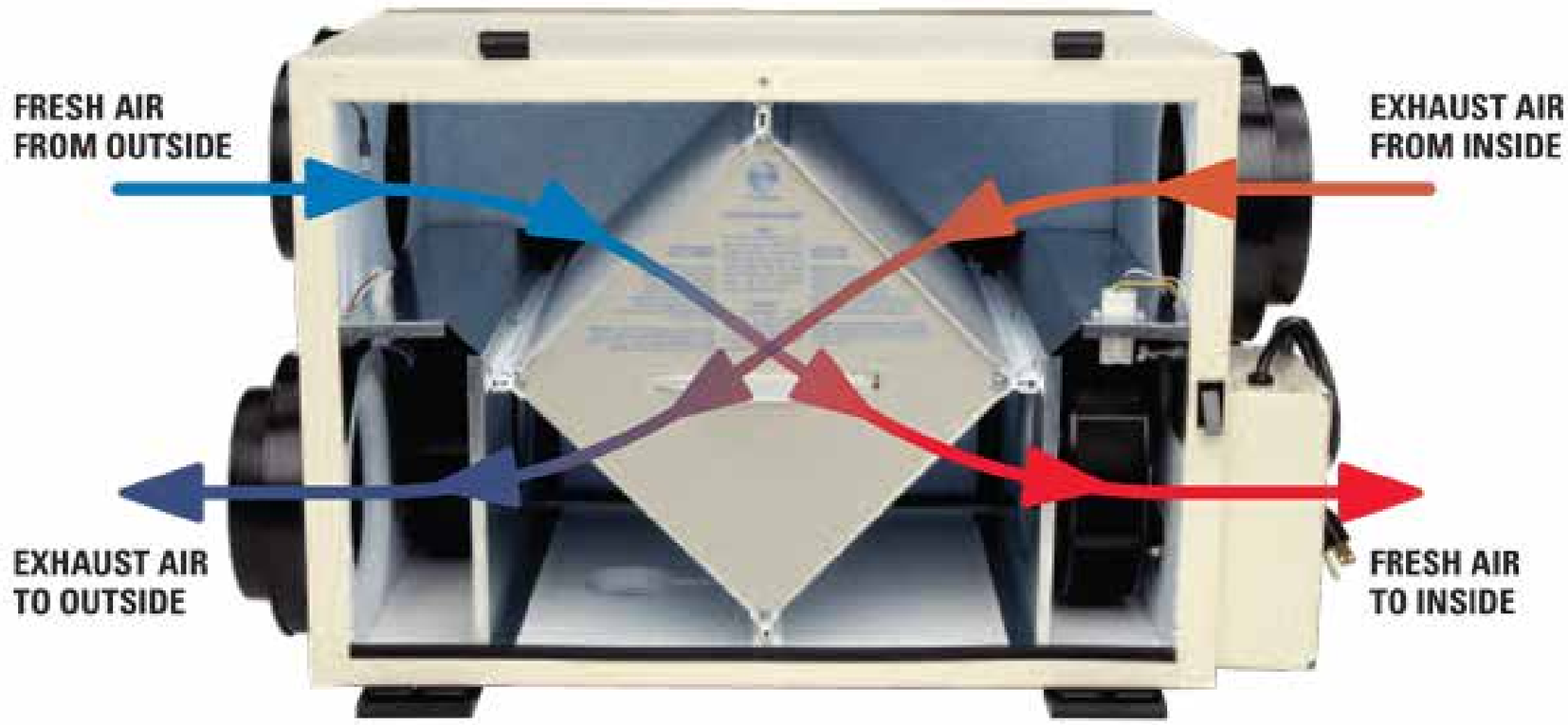
Artificial Light

All public facing interior and exterior lighting converted to LED fixtures with excellent color rendering indexes (CRIs). T8 fixtures are used in utility rooms for cost efficiency. Daylight and occupancy sensors are used for daylight harvesting.



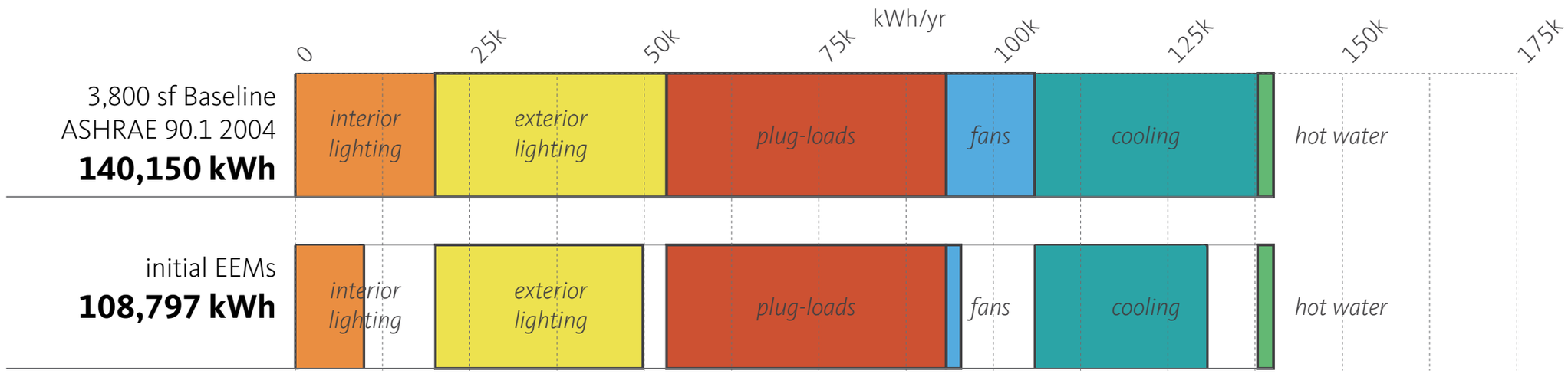
Cooling and Fans

HVAC unit capacity was reduced after metering revealed that the standard unit was “short-cycling” - an inefficient process where the 2nd stage compressor is used in only short intervals. A cost-effective adaptive fan unit was selected over VAV.



Energy Recovery Ventilator

An Energy Recovery Ventilator (ERV) uses exhaust air to cool air coming into the RTU to reduce cooling loads.

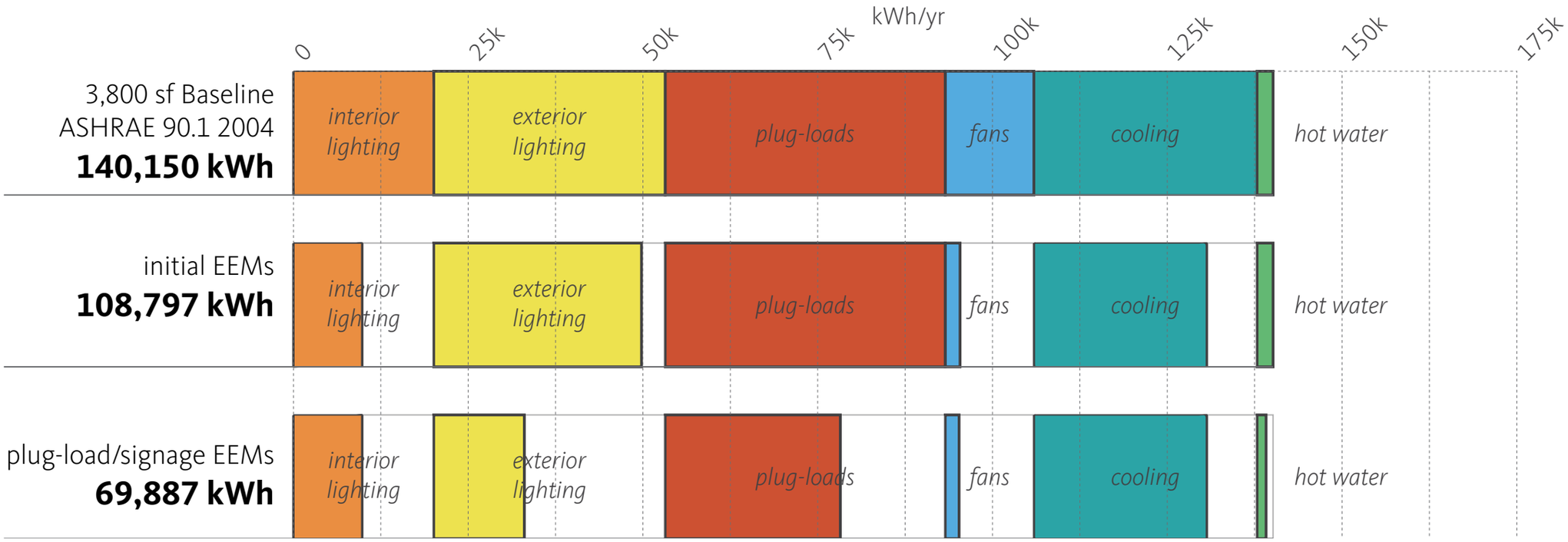


Initial Evaluation

The initial evaluation indicated a **25.8%** overall reduction from baseline consumption and helped to identify exterior lighting and plug loads as targets for further reduction.

Opportunities: Plugs & Signage

The biggest outliers from our initial evaluation were plug-loads and signage energy consumption. Plug-loads were evaluated for automatic/programmable solutions. Signage vendors were engaged to upgrade their technology to LEDs.

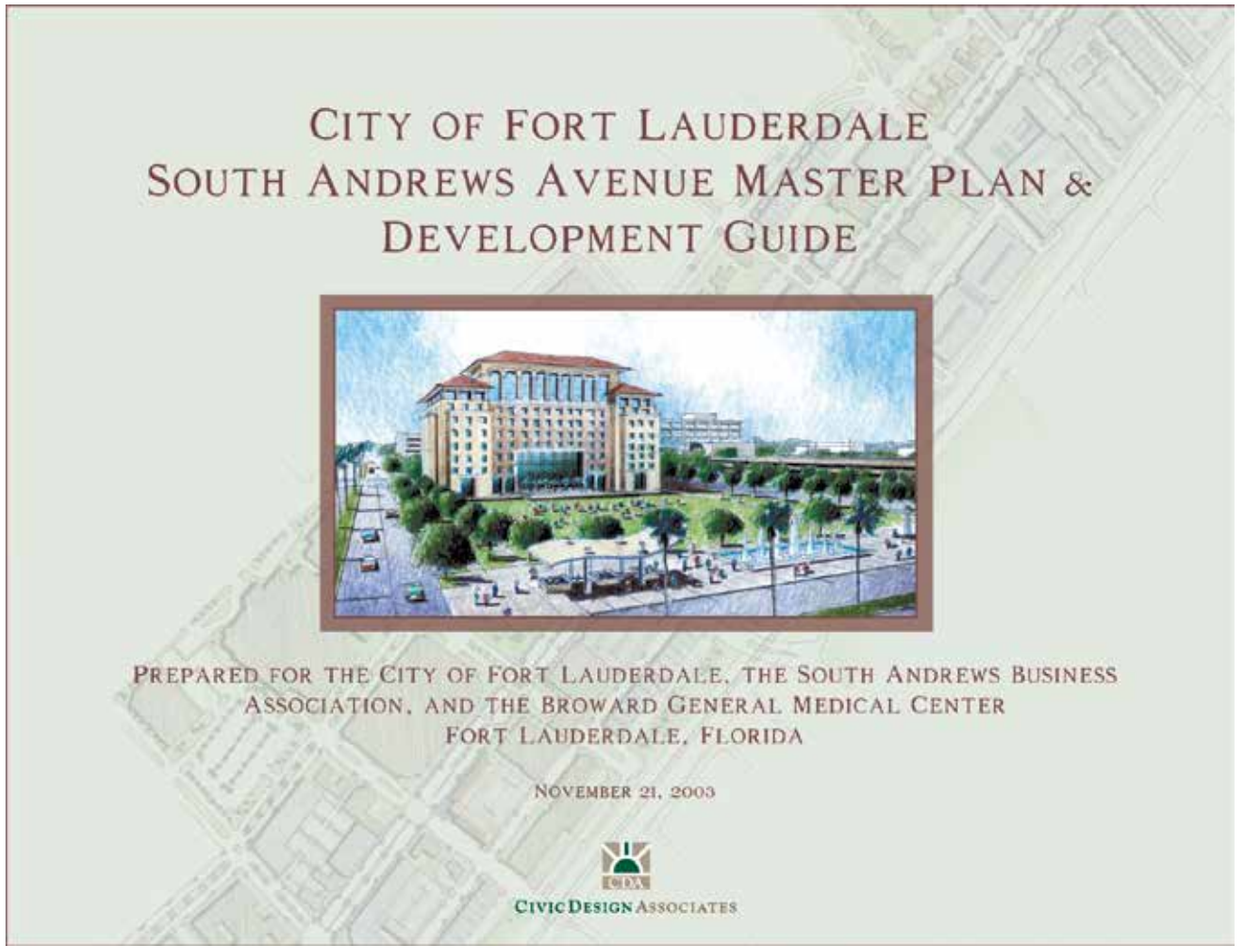


Additional Reductions

With signage, plug-load (and water heater) reductions the model indicated we would be able to achieve a 50.7% overall reduction achieving our target reduction of 50%.

Part III: Reality Strikes

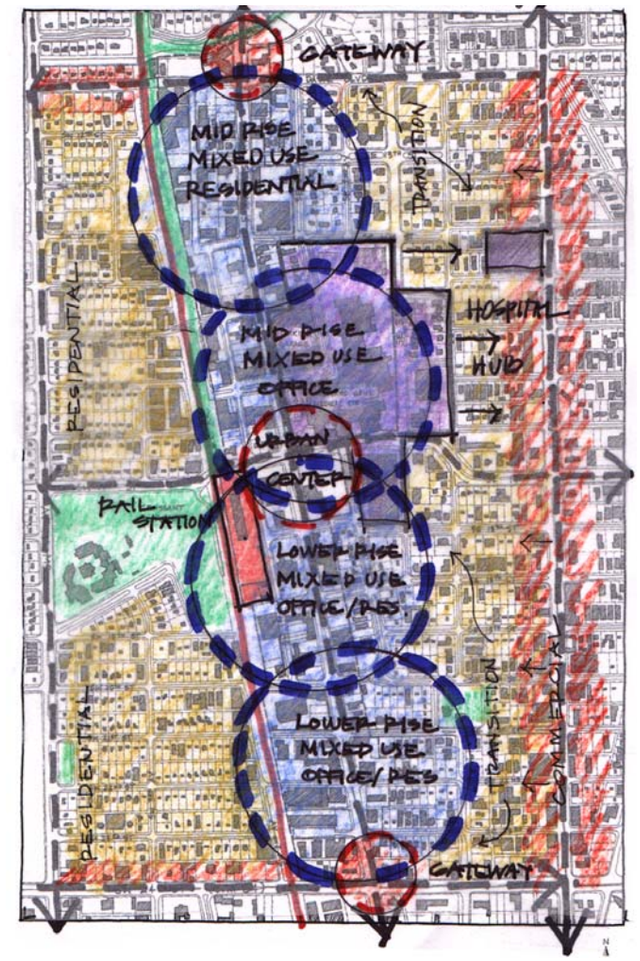
Model application in the real world



"Design engages and encourages **pedestrian interaction**."

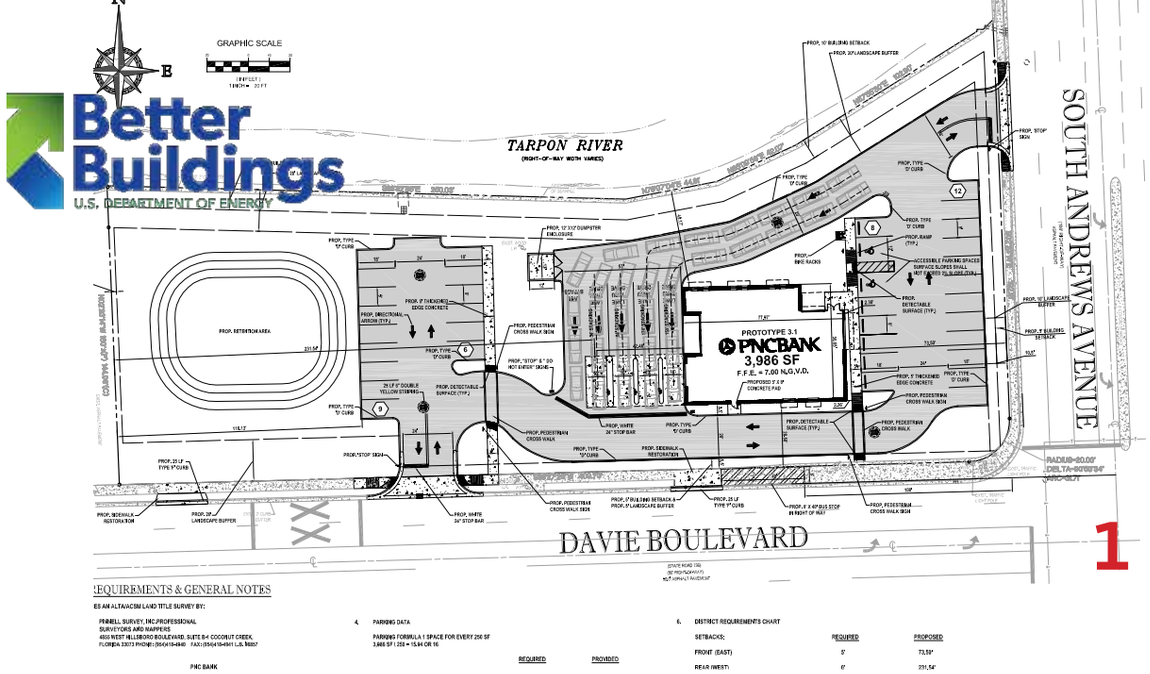
"Building should be of high quality with **minimal setbacks**, oriented to provide light and air at the street level."

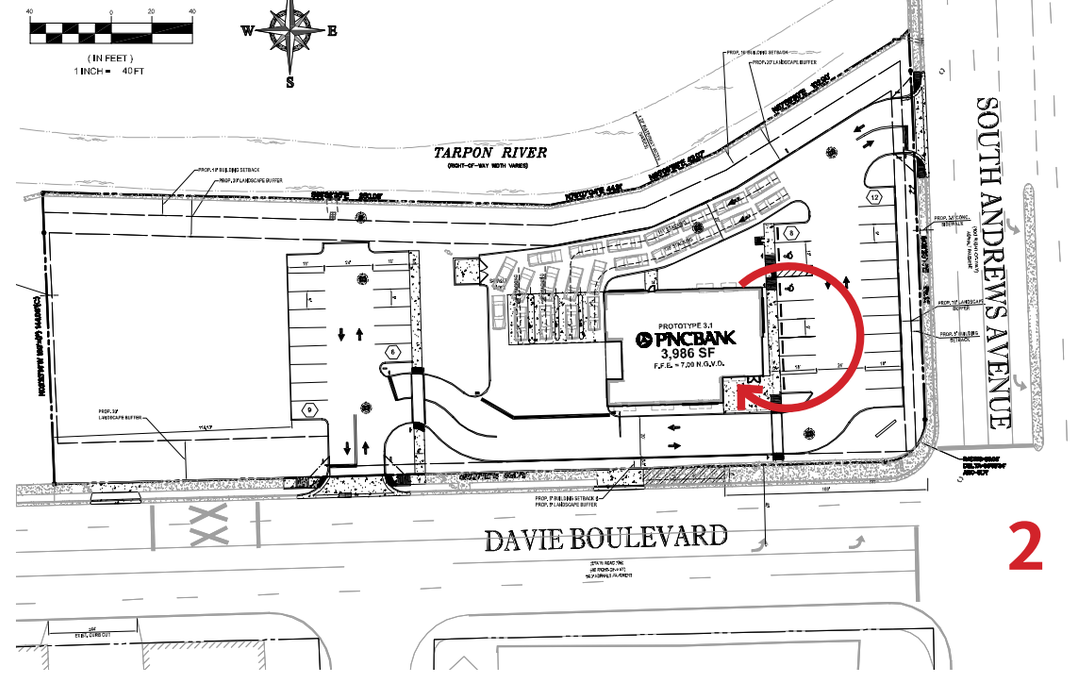
"The **'fifth façade' [roof]** of a building is treated as **part of the total design.**"

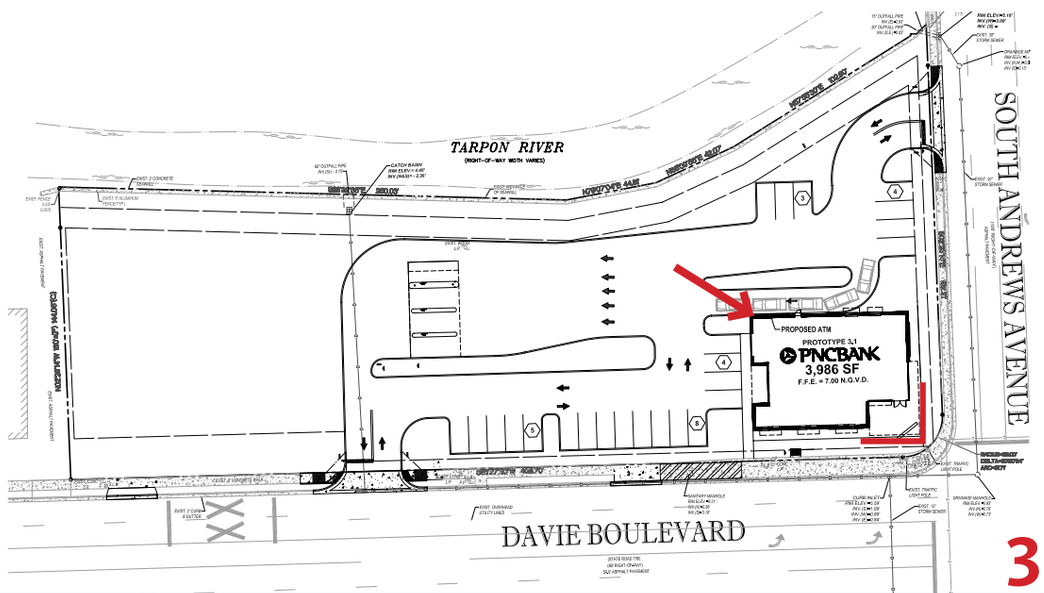


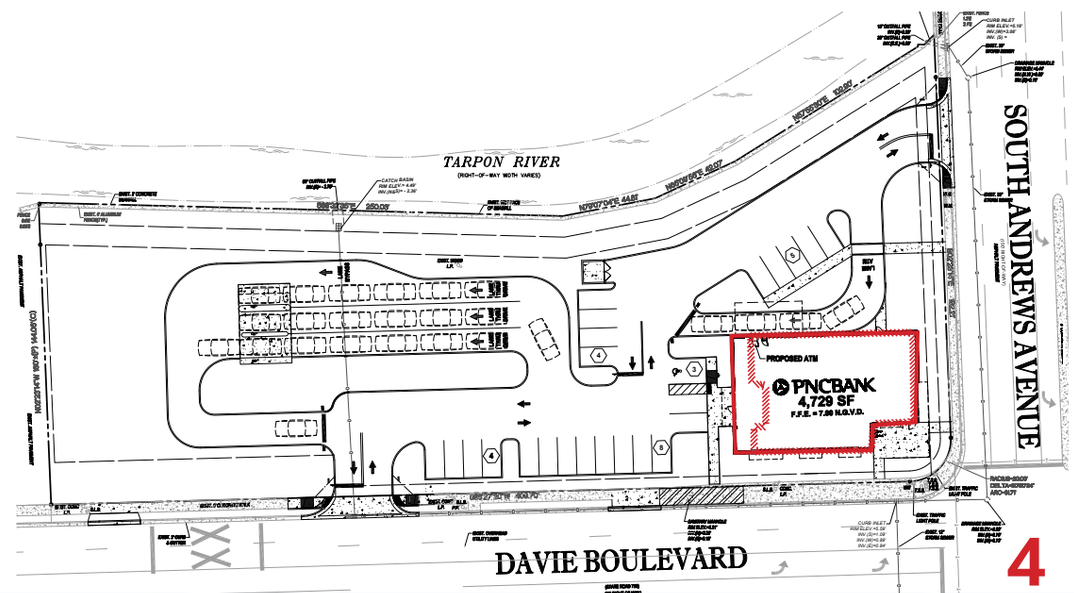
Site and Master Plan

The selected site for the project was designated as a "gateway" site for the newly adopted South Andrews Ave. Master Plan. There were several changes required to comply with the Plan and support the local business district.



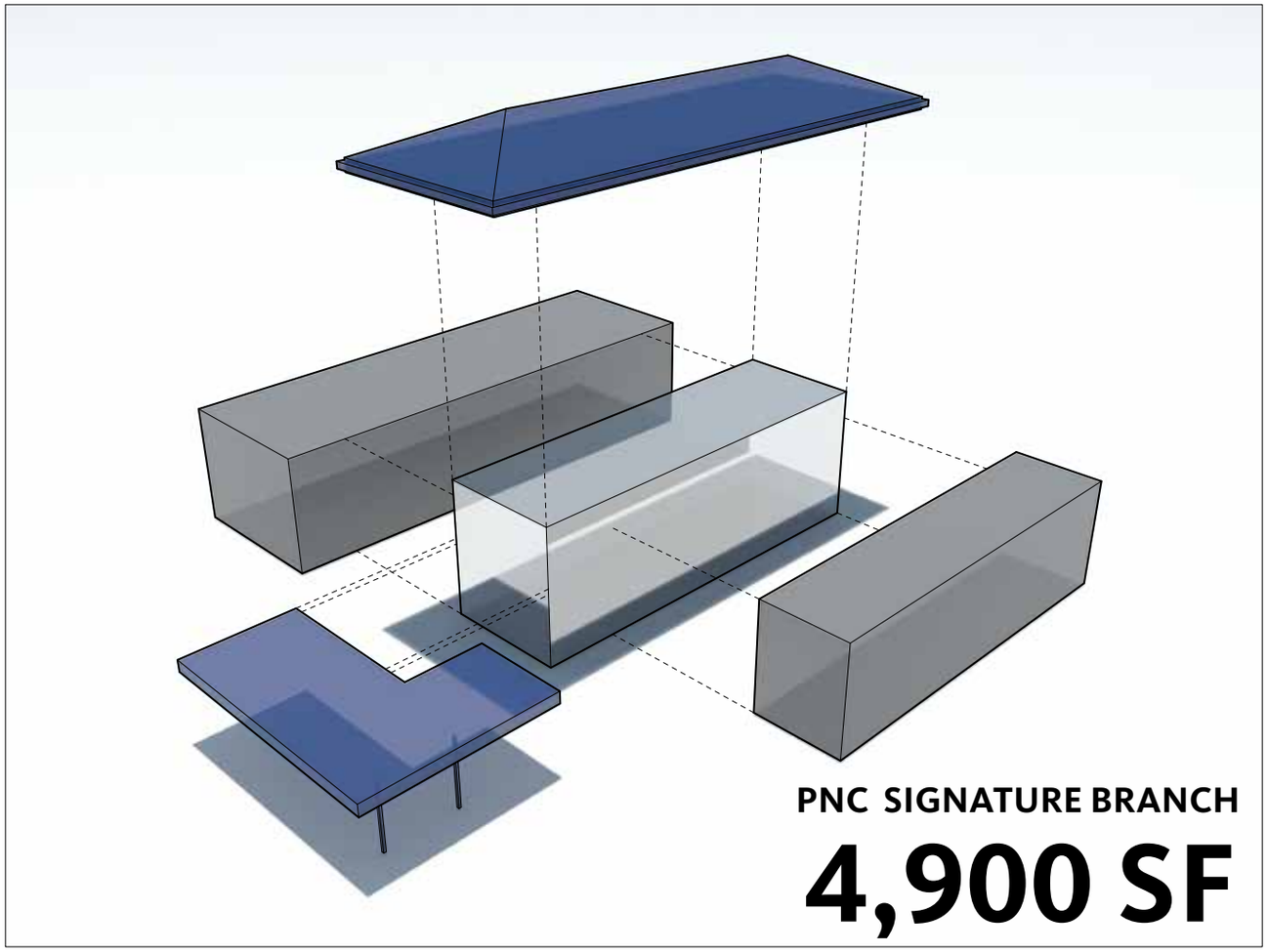






Site Changes = Building Changes

As part of the site permit process the orientation and footprint of the building were modified to accommodate a corner location and an additional entrance. To allow for traffic flow on the site the drive-thru was detached from the building.



PNC SIGNATURE BRANCH

4,900 SF

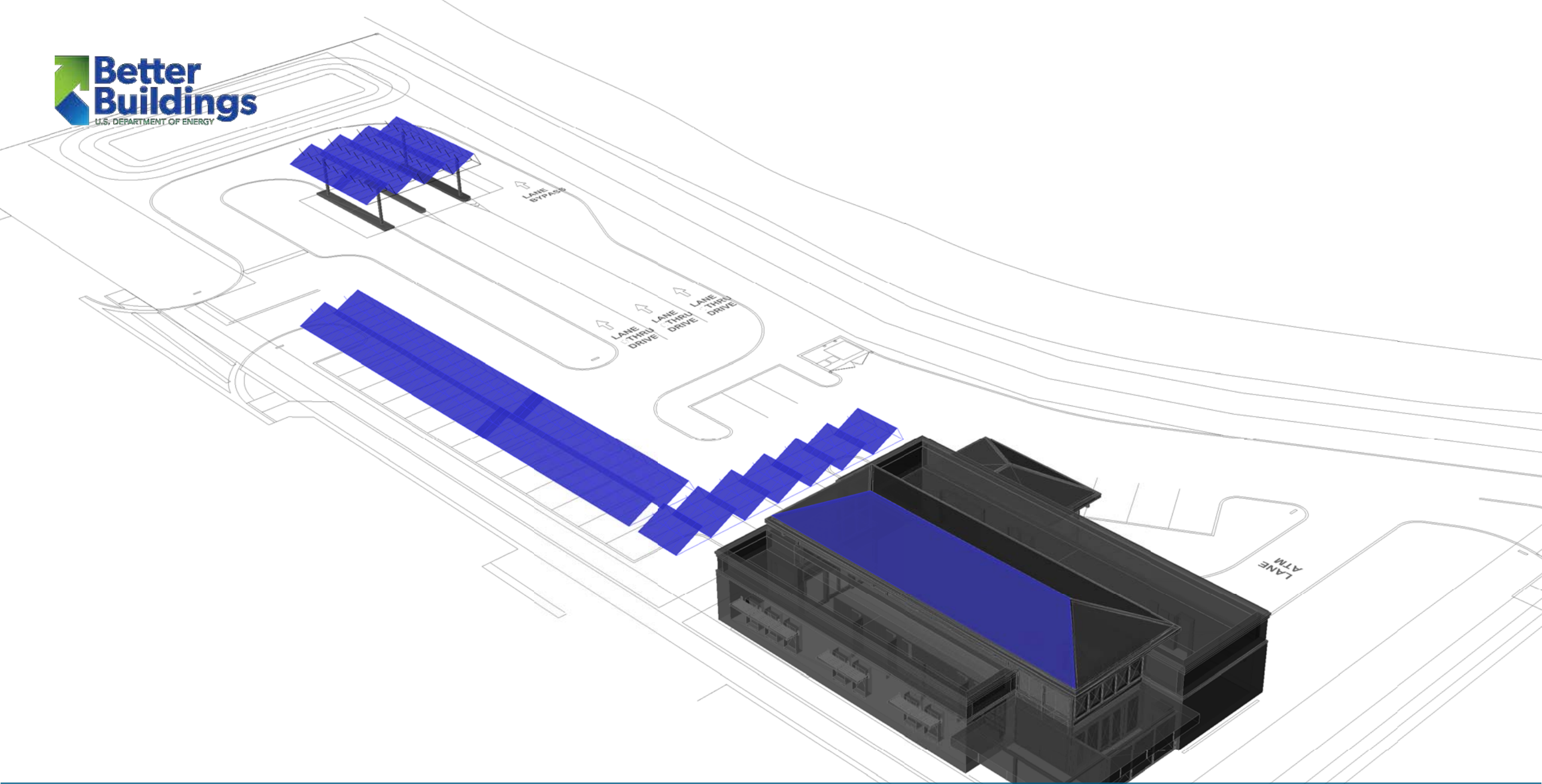
+

PHOTOVOLTAICS

~4,900 SF

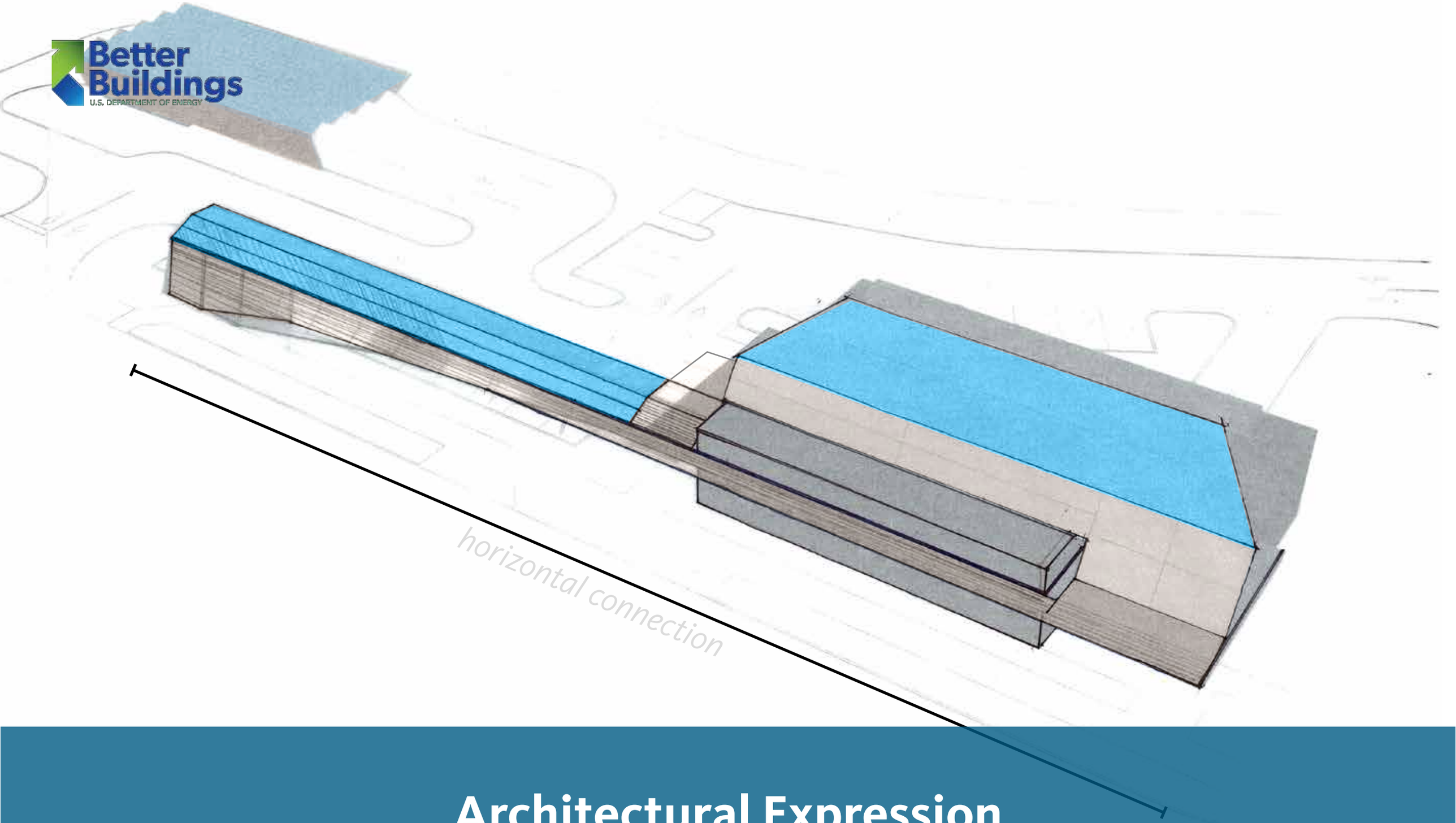
Accommodating Photovoltaics

Based on our initial model and available photovoltaic (PV) technology we knew we would require an area almost equivalent to the building footprint for the PV installation.



Architectural Integration

Rather than relegating the PVs to a solar farm hidden from the public the design team opted to integrate the PVs into the architecture of the building as canopies that would become part of the customer experience.



Architectural Expression

To unify the site elements in a single architectural expression the team designed a louvered screen that would also provide indirect lighting for the primary customer spaces.

Part VI: Beyond 50%

Additional energy efficiency measures

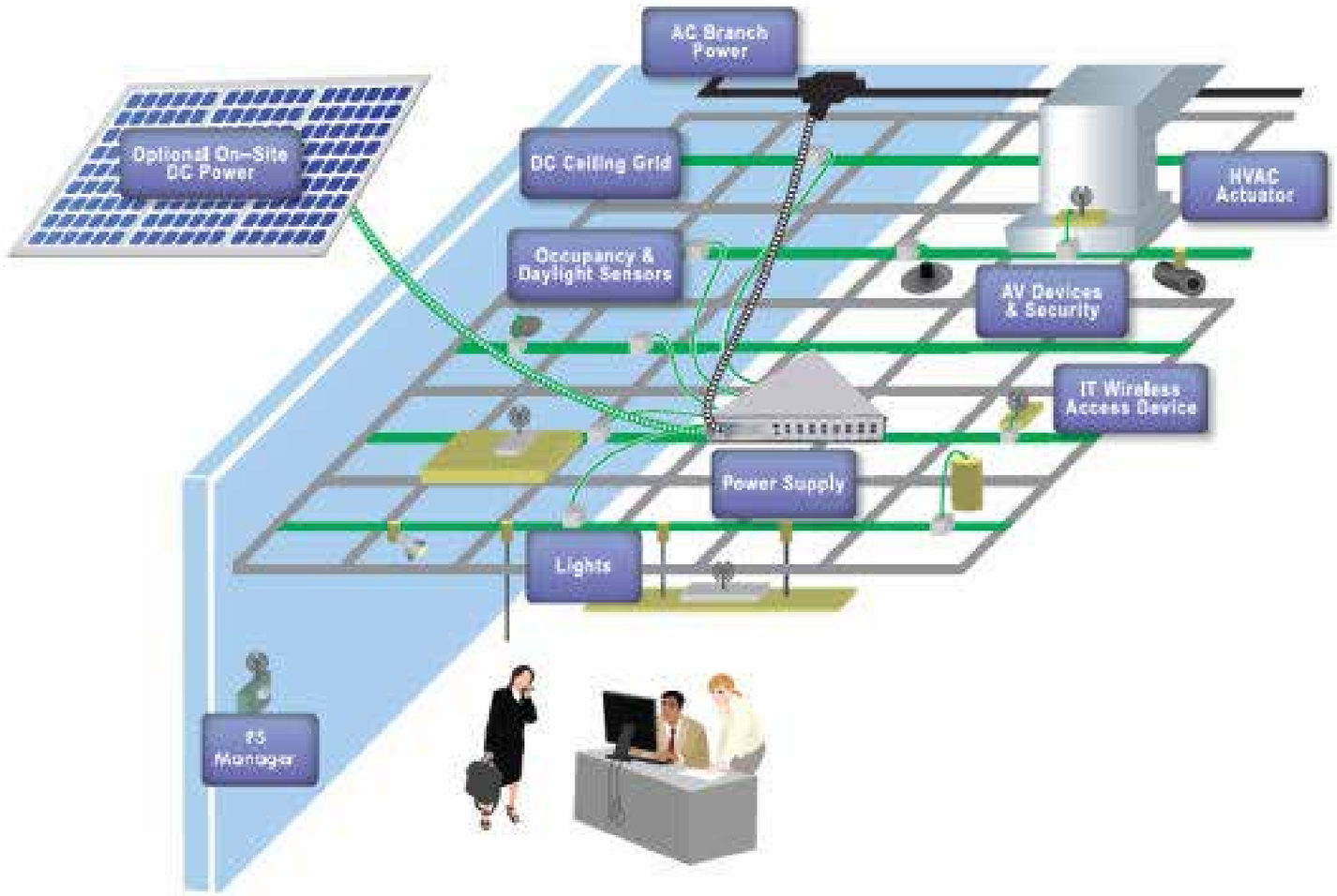


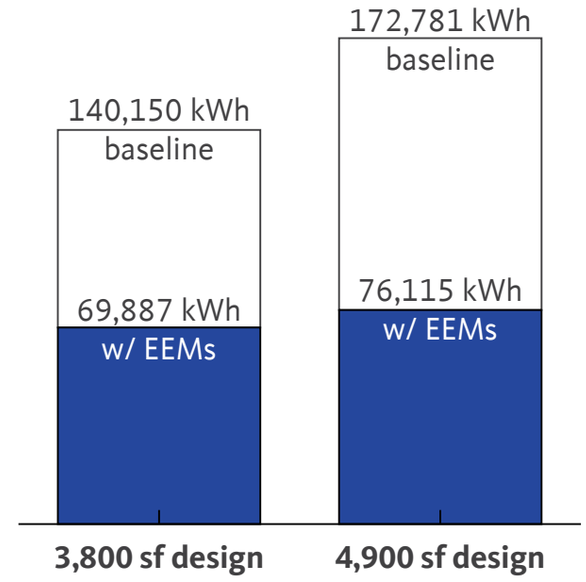
Image: NexTek Power Systems

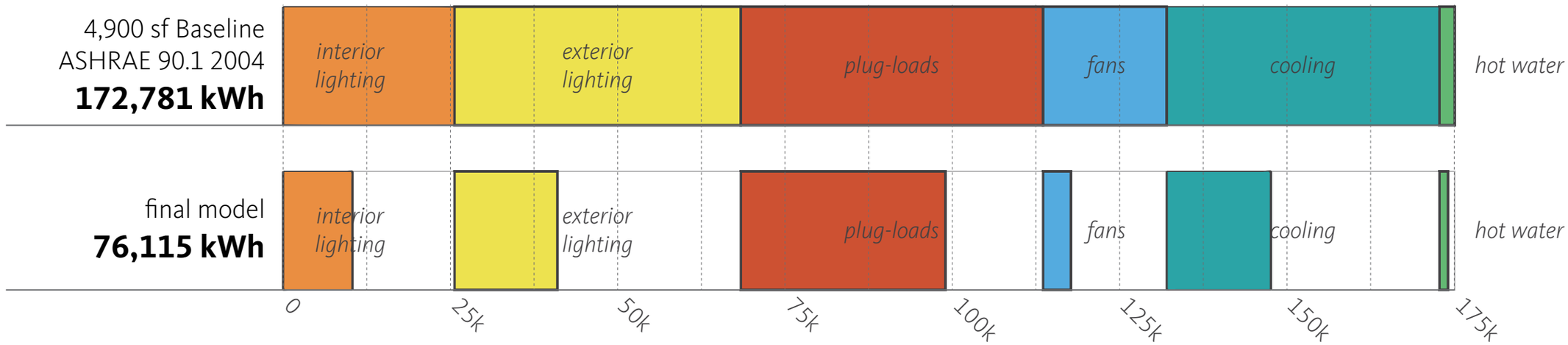
DC Grid

Since all 2'x2' fixtures were LEDs which use direct current (DC) power - the same type of power generated by PVs - the team integrated a DC grid to directly power interior lighting from the PVs, bypassing the utility meter altogether.

Additional Plug-load Efficiency

As newer and more efficient technology came to market, upgrades were made to existing banking and marketing equipment.



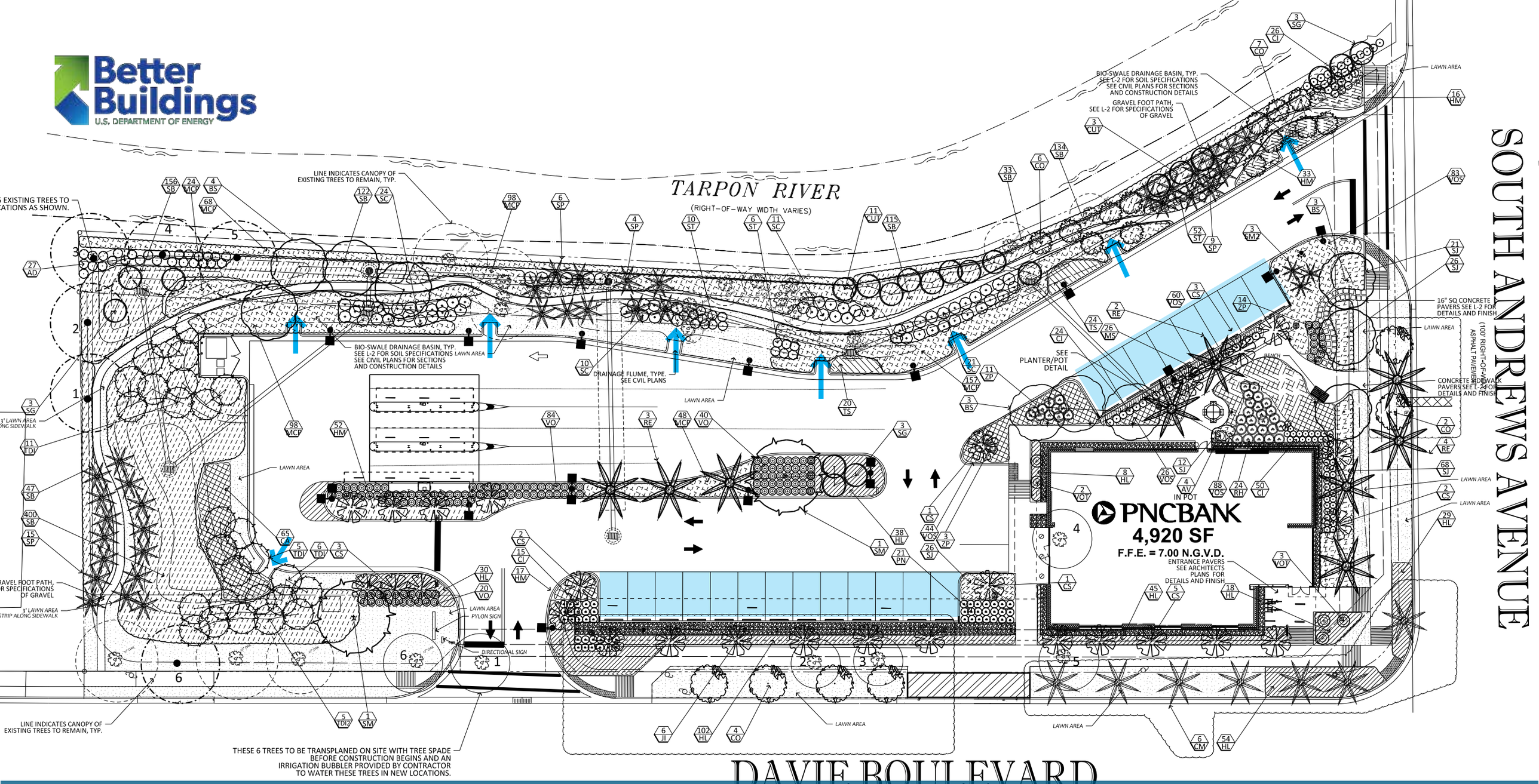


Final Model: Bigger but Better

Despite a larger footprint, our final model showed that the design revisions had a positive impact. Our final model prior to construction showed a **56%** reduction.

Part V: Beyond Energy

A holistic sustainable approach



Site & Landscape

Nearly all site runoff is diverted to bioswales located around the perimeter of the site where storm water will be slowed and filtered through native vegetation. All plants on site are native plants which require less irrigation and maintenance.

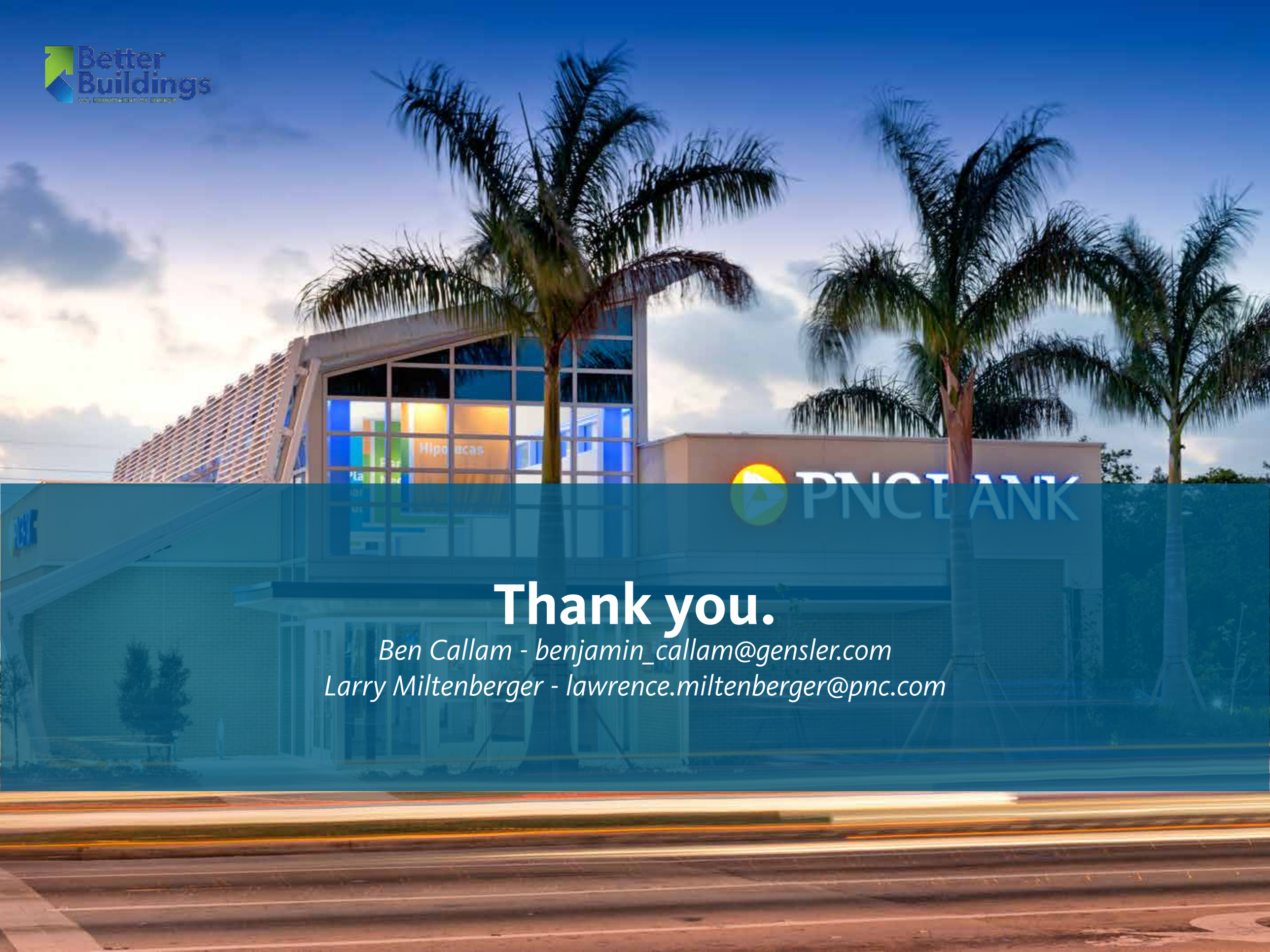
Building a Teaching Tool

Interactive screens located throughout the branch describe the project's sustainable features and show live energy usage as tools to educate the community about the importance of green building.

#1 Lesson: Creative adaptation & human engagement are just as important as engineering measures for sustainable design success.

Where we are today:

Monitoring, verifying and tuning a complex project like this may take up to a year+ post occupancy. Thus far, our model appears to be quite close to the meter data with the exception of HVAC consumption which is under investigation.



Thank you.

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