

# ASHRAE HQ **HVAC** System Updates

4.17.2019



# HVAC Option 1: All-Air TZHP System

TZHP – Thermodynamically Zoned Heat Pumps

## System Type

Rooftop Packaged Thermodynamically Zoned  
ASHPs with DOAS, enthalpy heat recovery,  
DCV, and a desiccant wheel

## Air Distribution Options

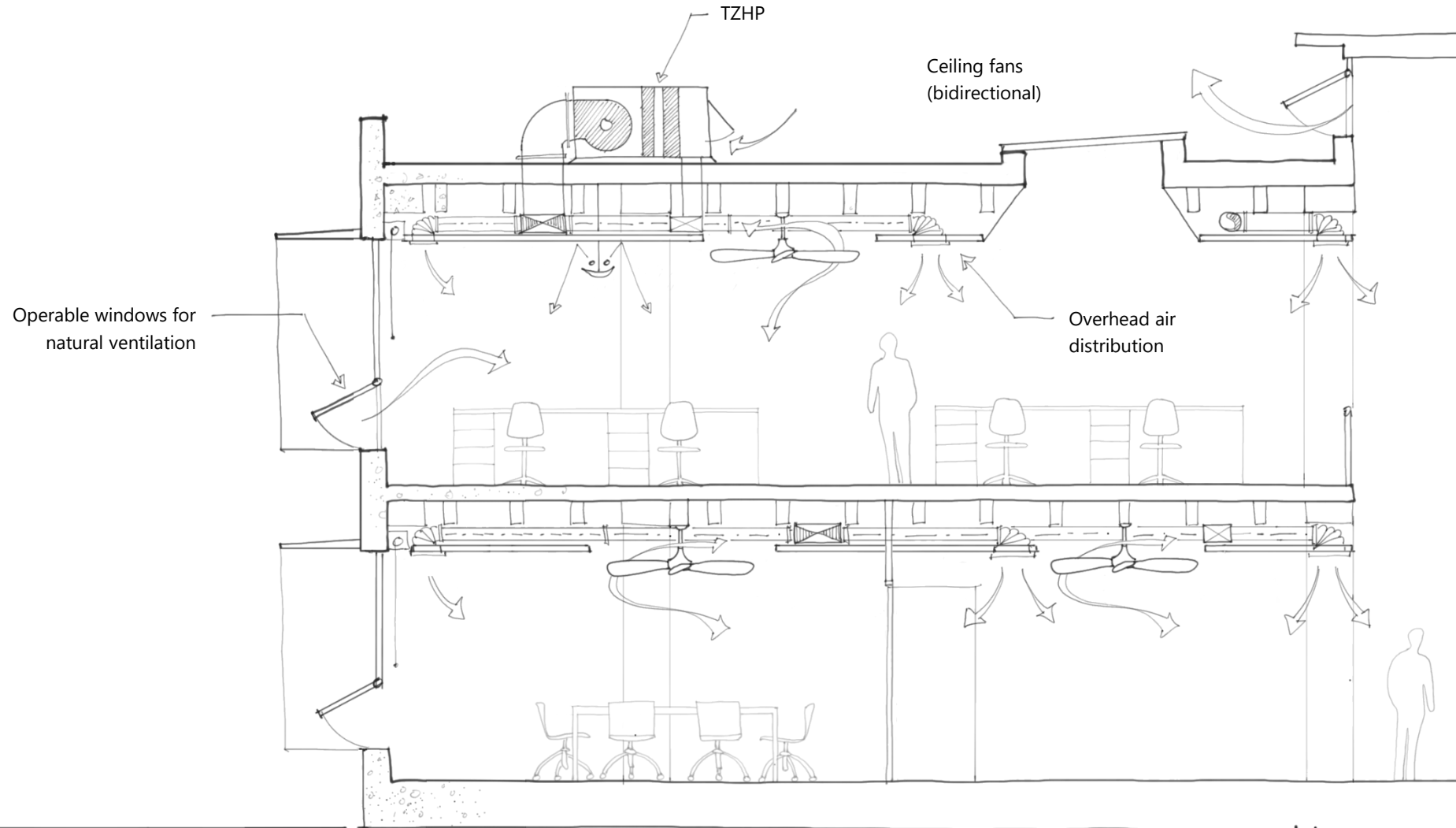
Overhead, Mixed Air

## Mixed-Mode Ventilation

Operable windows and atrium exhaust  
Ceiling fans with reverse control

## Night-Flush / Airside Economizer

Fan-assisted night flush



# HVAC Option 2: Hydronic Systems

DOAS with Hydronic Terminal Units

## DOAS

With enthalpy heat recovery and DCV

Option 1A: Add desiccant wheel

Option 1B: Add DX Trim Coil

## CW Terminal Unit Options

Radiant Ceiling Panels

Sensible Fan Terminal Units

## Heat Pump Options

Option A: Air-Cooled HP

Option B: Water-Cooled HP

Option C: Ground-Source HP

## Night-Flush & Mixed-Mode Ventilation

See Previous

**Option C**  
Geo/Lake exchange

**Option B**  
Cooling tower

**Option A**  
Air-Cooled

Heat pump

DOAS distribution

DOAS

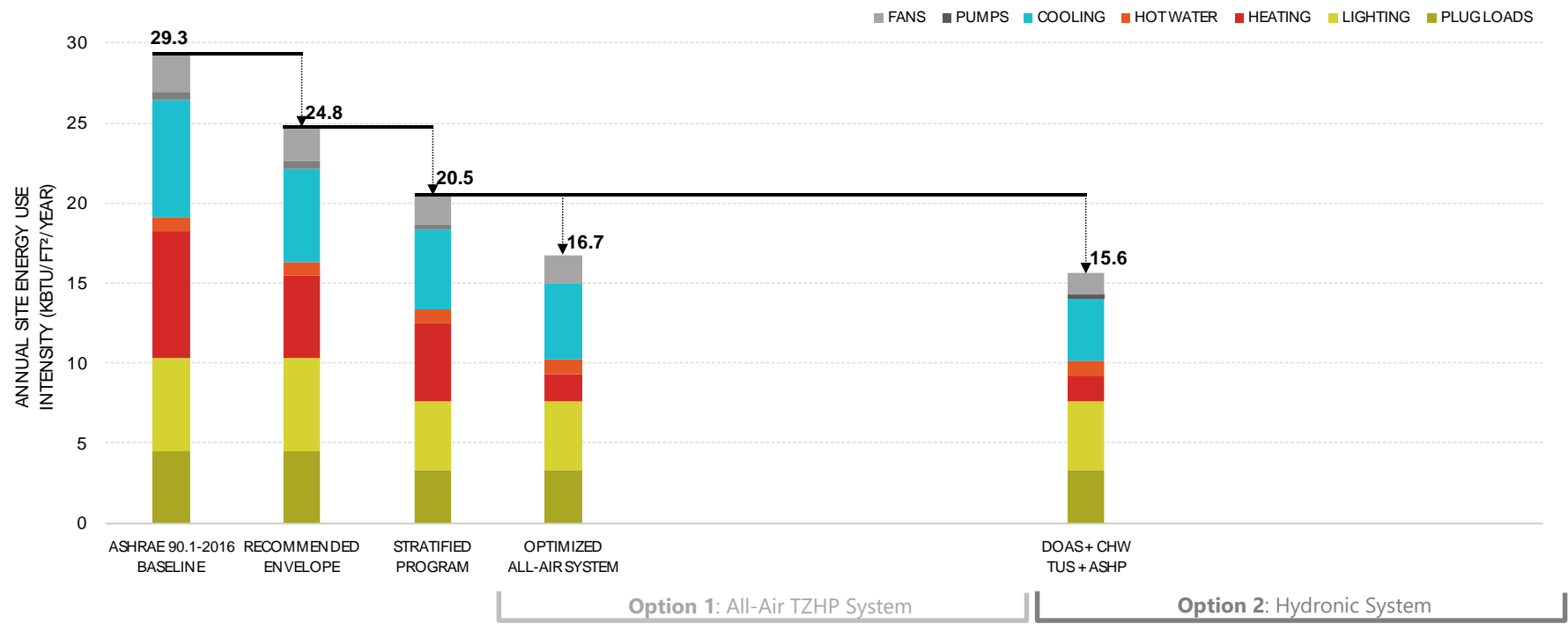
Ceiling fans  
(bidirectional)

Radiant Sails

FCU

# All-Air TZHP vs. Hydronic System

ANNUAL SITE ENERGY USE



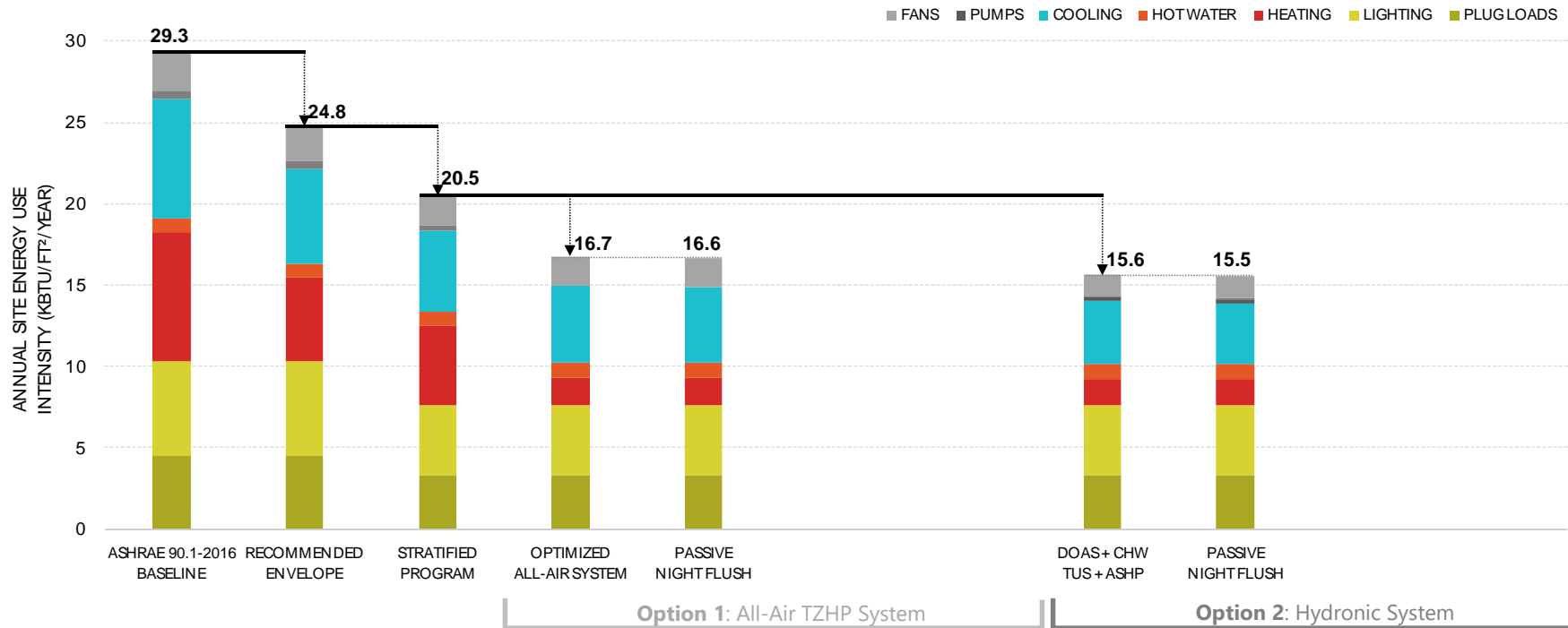
## Path to NZE Recap

NZE Target **21.4** kBTU/ft²/yr

Stretch Target **15.0** kBTU/ft²/yr

# Potential Night-flush Impact

## ANNUAL SITE ENERGY USE

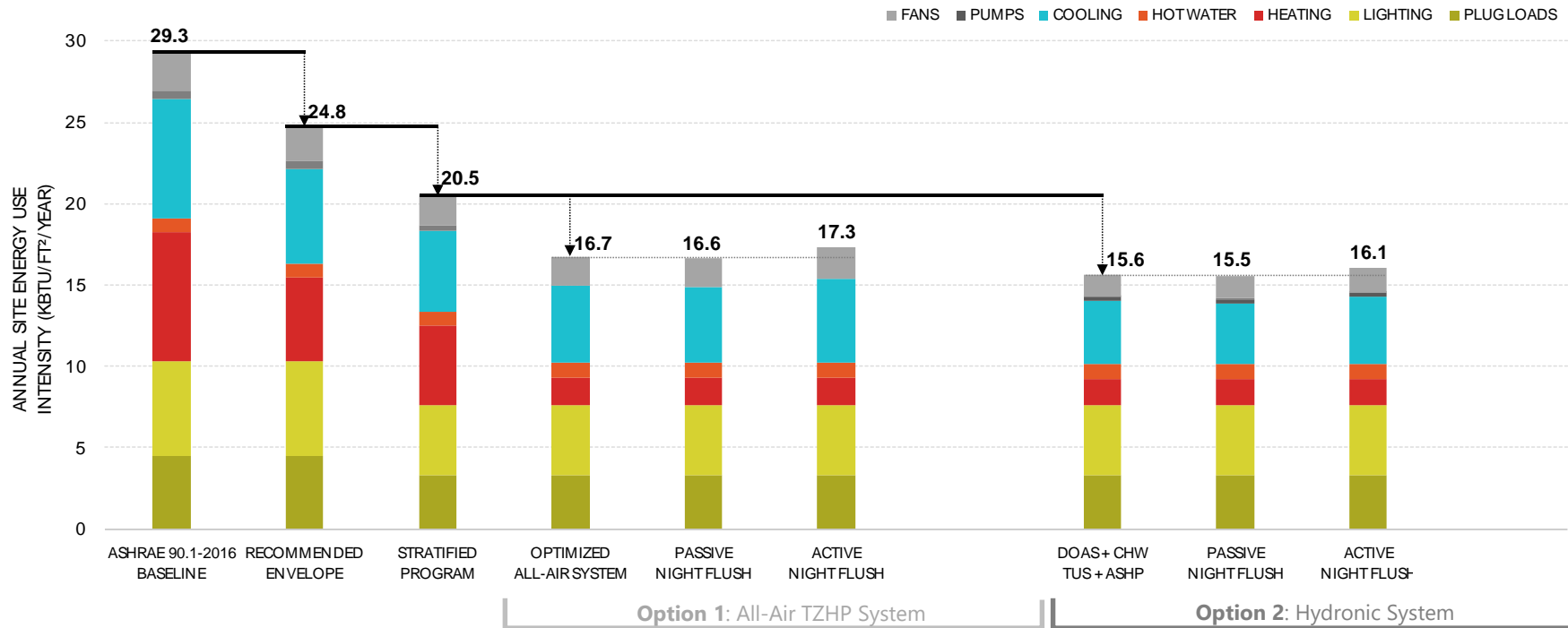


## Passive Night Flush

- HVAC fans operating
  - 10PM - 5AM, April – September
  - 55°F < OAT < 70°F
- Highly thermally massive concrete slabs pre-cool office spaces
- Strategy reduces EUI by 0.1 kBtu/sf
  - Reduced cooling EUI
  - Fan EUI penalty for nighttime fan operation

# Potential Night-flush Impact

## ANNUAL SITE ENERGY USE

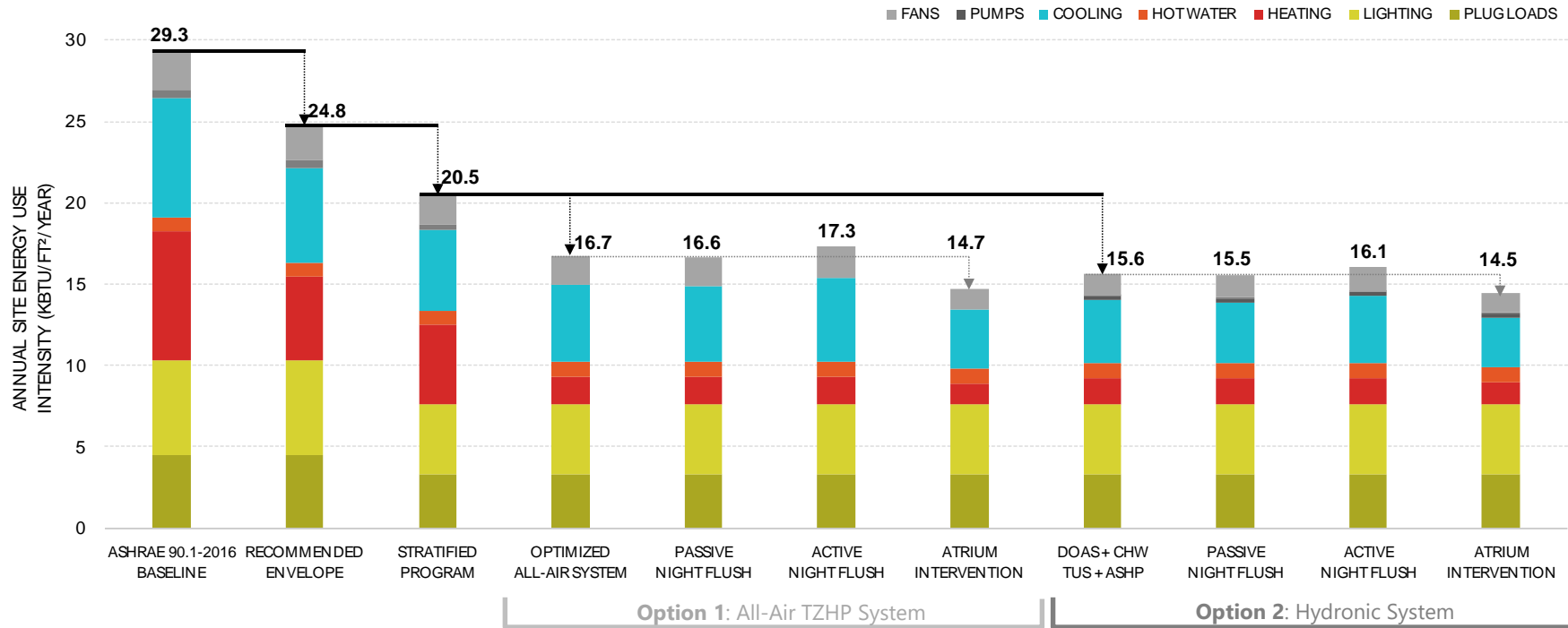


## Active Night Flush

- HVAC fans and cooling coils operating
  - 10PM - 5AM, April – September
  - 55°F < SAT < 70°F
- Active cooling engaged at night (nighttime COP > daytime COP)
- Strategy increases EUI by 0.6 kBtu/sf
  - Cooling EUI penalty (cannot provide enough pre-cooling to overcome daytime cooling needs)
  - Fan EUI penalty for nighttime fan operation

# Atrium Impact

## ANNUAL SITE ENERGY USE



## Atrium Intervention

- Atrium model updated to match current proposed design
  - Reduced atrium height
  - Reduce atrium glazing
  - Additional overhangs
- Atrium peak load reduced by more than 50%
- Overall EUI reduced by 1-2 kBtu/sf

# Life Cycle Cost Analysis (LCCA): HVAC Options A & B

## OPTION 1 - ALL-AIR SYSTEM (TZHP):

- **First Cost \$1,856,000**
- Replacement Cost \$281,500 every 15 years
- Maintenance \$28,600 per year
- Life-Cycle Cash Flow (NPV): **\$5,179,476** (\$1,032,241 less money spent than Option 2 over a 30 year period)

## OPTION 2 - HYDRONIC SYSTEM:

- **First Cost \$2,913,000;**
- Replacement Cost \$322,700 once at 25 years;
- Maintenance \$41,200 per year
- Life-Cycle Cash Flow (NPV): **\$6,211,718** (\$1,032,241 more money spent than Option 1 over a 30 year period)

