

# A Parametric Tool for Community-Scale Modeling

Dr. Richard Liesen  
USACE ERDC-CERL

# Community-Scale



# Related Work

- *CitySim* (Robinson et al. 2009)
- *umi* (Reinhart et al. 2013)
- Prototype model approach (Marston et al. 2014)
- Literature review (Reinhart and Davila 2016)

# NZP Tool

- US Army Corps of Engineers
- 2011 –
- Army bases and installations
  - 10,000 – 50,000 residents
  - Sparse building density
  - Standardized building designs

Available Facilities

Add To Study

Street

Visually Group  
 Plan Facilities Only

Facility Groups

Name	# Facilities	New
COF_2015021_1_10:30		
BNHQ_20150211_10:30		
BdeHQ_20150211_10:30		
Misc_20150211_10:30		
DFAC_20150211_10:30		
BNHQ_20150211_10:30		
Misc_20150211_10:30		
UEPH_20150211_10:30		
Misc_20150211_10:30		
TEMF_20150211_10:30		



World Street Map  
 ArmySiteLayer

### Study Inventory Facilities



Master Facility List ▾

Facility Group Summary | **Facilities Summary**

Drag a column header and drop it here to group by that column

Facility Group	Name	Number	Facility Type	Status	Active	Construction Date	Cond. Area (ft <sup>2</sup> )	Floors	Lif
BNHQ Existing Pre1980	ADMIN SPACE	1703	BNHQ	Existing	<input checked="" type="checkbox"/>	1978	19,096	1	40
BNHQ Existing Pre1980	ADMIN SPACE FOR MARINE	1702	BNHQ	Existing	<input checked="" type="checkbox"/>	1978	23,411	1	40
BNHQ Existing Pre1980	ADMIN GEN PURP	1705	BNHQ	Existing	<input checked="" type="checkbox"/>	1979	23,411	1	40
BNHQ Existing Pre1980	ADMIN	1706	BNHQ	Existing	<input checked="" type="checkbox"/>	1978	23,437	1	40
BNHQ Existing Pre1980	ADMIN AREA FOR NAVY	1770	BNHQ	Existing	<input checked="" type="checkbox"/>	1978	2,002	1	40
BNHQ Existing Pre1980	CALL FOR FIRE CLASSROOM	1750	BNHQ	Existing	<input checked="" type="checkbox"/>	1978	12,929	1	40
BNHQ Existing Pre1980	CLASSROOM FOR MARINES	1721	BNHQ	Existing	<input checked="" type="checkbox"/>	1978	2,002	1	40
BNHQ Existing Pre1980	ADMIN AREA FOR MARINES	1772	BNHQ	Existing	<input checked="" type="checkbox"/>	1979	2,002	1	40
BNHQ Existing Pre1980	CLASSROOM FOR MARINES	1760	BNHQ	Existing	<input checked="" type="checkbox"/>	1978	2,002	1	40
BdeHQ Existing Pre1980	GYMNASIUM	1714	BdeHQ	Existing	<input checked="" type="checkbox"/>	1979	16,784	2	40
DFAC Existing Pre1980	FAST FOOD BAR	1711	DFAC	Existing	<input checked="" type="checkbox"/>	1978	4,739	1	40
DFAC Existing Pre1980	ENL PERS DINE, EDP	1740	DFAC	Existing	<input checked="" type="checkbox"/>	1979	22,919	1	40
DFAC Existing Pre1980	DINING FACILITY	N/A	DFAC	Existing	<input checked="" type="checkbox"/>	2015	41,764	1	40
BNHQ Existing Post1980	UNIT CHAPEL	1712	BNHQ	Existing	<input checked="" type="checkbox"/>	1980	9,050	1	40
UEPH Existing Pre1980	ITRO TRAINEE BKS, NAVY	1768	UEPH	Existing	<input checked="" type="checkbox"/>	1978	11,343	3	40
UEPH Existing Pre1980	MARINE ITRO BARRACKS	1726	UEPH	Existing	<input checked="" type="checkbox"/>	1979	11,343	3	40
UEPH Existing Pre1980	PERM PARTY BARRACKS	1730	UEPH	Existing	<input checked="" type="checkbox"/>	1978	11,343	3	40
UEPH Existing Pre1980	ITRO TRAINEE BKS, AIR FOR	1725	UEPH	Existing	<input checked="" type="checkbox"/>	1978	11,343	3	40
UEPH Existing Pre1980	RESERVE COMP BARRACKS	1722	UEPH	Existing	<input checked="" type="checkbox"/>	1978	11,343	3	40
UEPH Existing Pre1980	ITRO STUDENTS, AIR FORCE	1729	UEPH	Existing	<input checked="" type="checkbox"/>	1978	24,664	3	40
UEPH Existing Pre1980	PERM PARTY BKS, 1 ENG BDE	1731	UEPH	Existing	<input checked="" type="checkbox"/>	1979	11,343	3	40
UEPH Existing Pre1980	BARRACKS	1720	UEPH	Existing	<input checked="" type="checkbox"/>	1978	24,644	3	40
UEPH Existing Pre1980	RESERVE COMP BARRACKS	1724	UEPH	Existing	<input checked="" type="checkbox"/>	1978	11,232	3	40
UEPH Existing Pre1980	ITRO TRAINEE BKS, AIR FOR	1728	UEPH	Existing	<input checked="" type="checkbox"/>	1979	24,664	3	40
UEPH Existing Pre1980	BARRACKS, MED HOLD	1723	UEPH	Existing	<input checked="" type="checkbox"/>	1978	24,644	3	40
UEPH Existing Pre1980	ENLISTED UPH	1732	UEPH	Existing	<input checked="" type="checkbox"/>	1979	11,343	3	40

# Prototype Models

Available Facilities

New Selection Add to Selection Remove from Selection Clear Selection Delete Building Add Building Cancel Edits Save Edits

Street

Visually Group Plan Facilities Only

Add To Study

Facility Groups

Name	# Facilities	New
COF_2015021_1_10:30		
BNHQ_20150211_10:30		
BdeHQ_20150211_10:30		
Misc_20150211_10:30		
DFAC_20150211_10:30		
BNHQ_20150211_10:30		
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UEPH_20150211_10:30		
Misc_20150211_10:30		
TEMP_20150211_10:30		

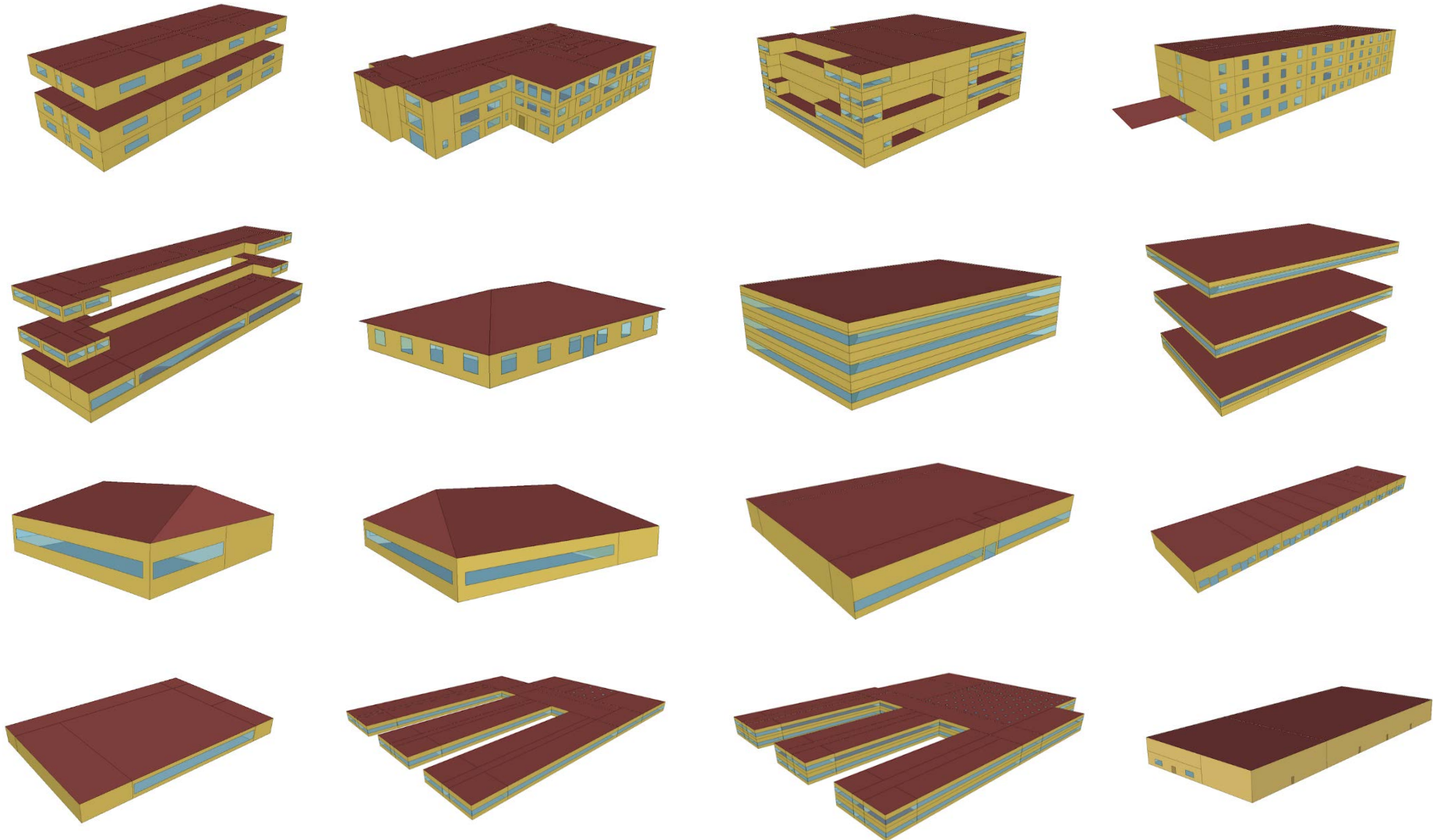
100m 500ft

World Street Map ArmySiteLayer

# 34

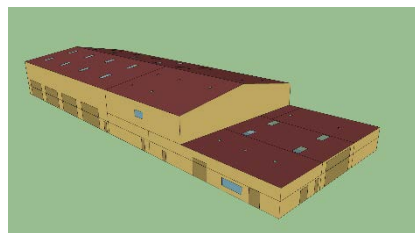
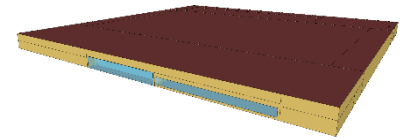
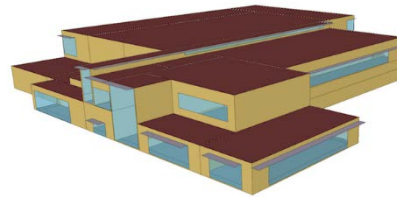
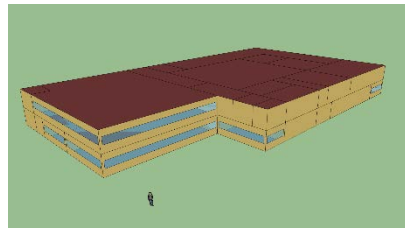
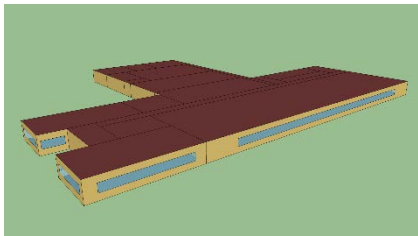
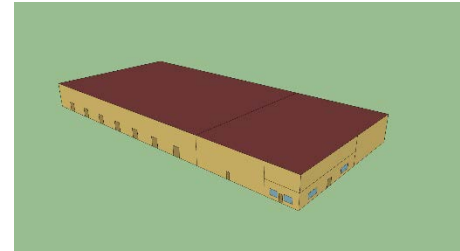
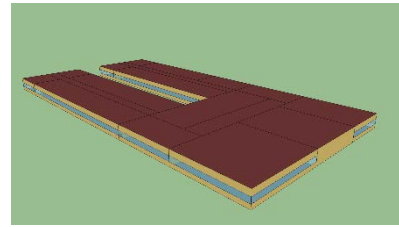
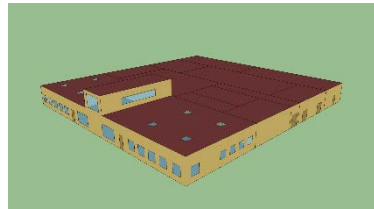
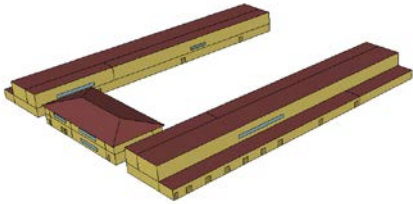
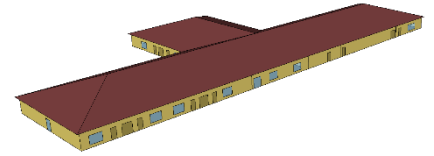
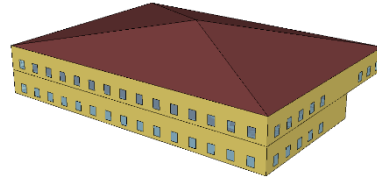
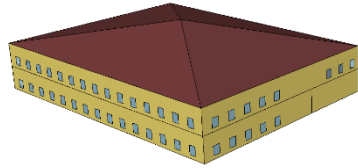
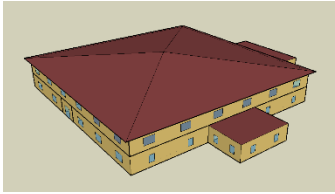


# Prototype Models: Commercial

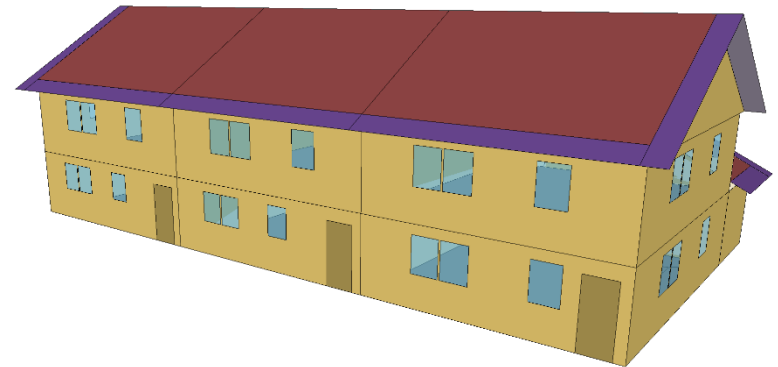
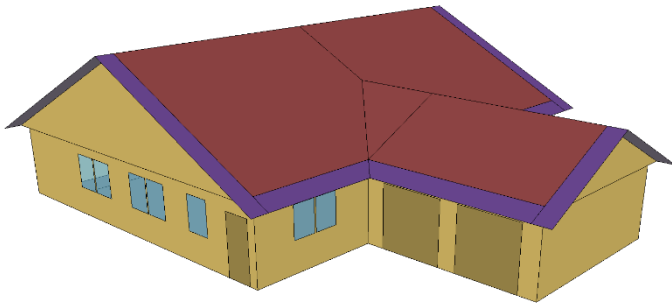
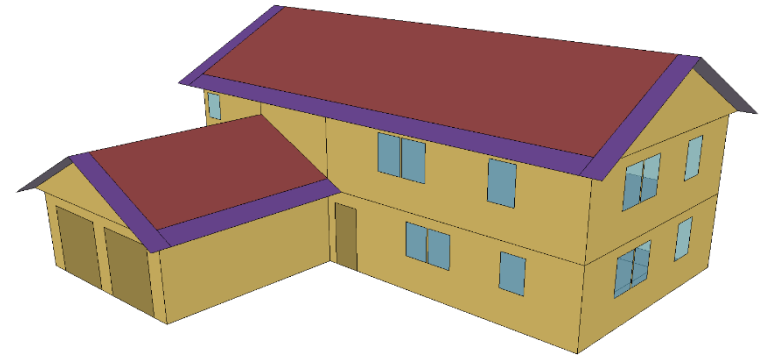
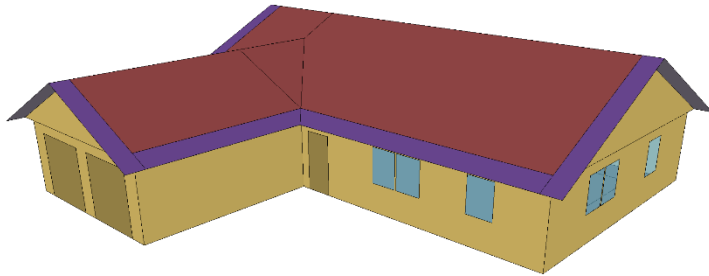




# Prototype Models: Army



# Prototype Models: Residential





## Baseline BdeHQ Existing Pre1980 Baseline Cost

Install Cost 0.00 \$/sqft

## Enhancements

- BdeHQ Existing Pre
- BNHQ Existing Post
- BNHQ Existing Pre1
- COF Existing Pre19
- DFAC Existing Pre1
- TEMF Existing Pre1
- UEPH Existing Pre1

## Baseline BdeHQ Existing Pre1980 Baseline Parameters

Name	Default Value	Value	Unit	Description
> Full-Slab Insulation	0.0	0.0	R	Full-slab insulation R-value
Slab Horizontal Insulation	0.0	0.0	R	Slab horizontal insulation R-value
Slab Horizontal Insulation Width	2.0	2.0	ft	Slab horizontal insulation width
Slab Vertical Insulation	0	0	R	Slab vertical insulation R-value
Slab Vertical Insulation Depth	2.0	2.0	ft	Slab vertical insulation depth
Roof Base Type	Insulation Entirely Above Deck	Insulation Entirely Above Deck		Roof base type
Roof Reflectance	0.3	0.3		Reflective property of roof surface
Roof Emittance	0.85	0.85		Emittance property of roof surface
Roof Base Cavity Insulation	0	0	R	Roof base cavity insulation R-value
Roof Base Continuous Insulation	10.848	10.848	R	Roof base continuous insulation R-value
Roof Exterior Type	Roof Membrane	Roof Membrane		Roof exterior type
Roof Interior Type	Metal Decking	Metal Decking		Roof interior type
Wall Base Type	Concrete MW Solid Grouted	Concrete MW Solid Grouted		Wall base type
Wall Base Cavity Insulation	0	0	R	Wall base cavity insulation R-value

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Enhancements & Cost



**Baseline BdeHQ Existing Pre1980 Baseline Cost**

Install Cost  \$/sqft

**Enhancements**

**Baseline BdeHQ Existing Pre1980 Baseline Parameters**

- BdeHQ Existing Pre**
- BNHQ Existing Post**
- BNHQ Existing Pre1**
- COF Existing Pre19**
- DFAC Existing Pre1**
- TEMF Existing Pre1**
- UEPH Existing Pre1**

Name	Default Value	Value	Unit	Description
Full-Slab Insulation	0.0	0.0	R	Full-slab insulation R-value
Slab Horizontal Insulation	0.0	0.0	R	Slab horizontal insulation R-value
Slab Horizontal Insulation Width	2.0	2.0	ft	Slab horizontal insulation width
Slab Vertical Insulation	0	0	R	Slab vertical insulation R-value
Slab Vertical Insulation Depth	2.0	2.0	ft	Slab vertical insulation depth
Roof Base Type	Insulation Entirely Above Deck	Insulation Entirely Above Deck		Roof base type
Roof Reflectance	0.3	0.3		Reflective property of roof surface
Roof Emittance	0.85	0.85		Emittance property of roof surface
Roof Base Cavity Insulation	0	0	R	Roof base cavity insulation R-value
Roof Base Continuous Insulation	10.848	10.848	R	Roof base continuous insulation R-value
Roof Exterior Type	Roof Membrane	Roof Membrane		Roof exterior type
Roof Interior Type	Metal Decking	Metal Decking		Roof interior type
Wall Base Type	Concrete MW Solid Grouted	Concrete MW Solid Grouted		Wall base type
Wall Base Cavity Insulation	0	0	R	Wall base cavity insulation R-value

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## Baseline BdeHQ Existing Pre1980 Baseline Cost

Install Cost 0.00 \$/sqft

## Enhancements

- BdeHQ Existing Pre
- BNHQ Existing Post
- BNHQ Existing Pre1
- COF Existing Pre19
- DFAC Existing Pre1
- TEMF Existing Pre1
- UEPH Existing Pre1

## Baseline BdeHQ Existing Pre1980 Baseline Parameters

	Name	Default Value	Value	Unit	Description
>	Full-Slab Insulation	0.0	0.0	R	Full-slab insulation R-value
	Slab Horizontal Insulation	0.0	0.0	R	Slab horizontal insulation R-value
	Slab Horizontal Insulation Width	2.0	2.0	ft	Slab horizontal insulation width
	Slab Vertical Insulation	0	0	R	Slab vertical insulation R-value
	Slab Vertical Insulation Depth	2.0	2.0	ft	Slab vertical insulation depth
	Roof Base Type	Insulation Entirely Above Deck	Insulation Entirely Above Deck		Roof base type
	Roof Reflectance	0.3	0.3		Reflective property of roof surface
	Roof Emittance	0.85	0.85		Emittance property of roof surface
	Roof Base Cavity Insulation	0	0	R	Roof base cavity insulation R-value
	Roof Base Continuous Insulation	10.848	10.848	R	Roof base continuous insulation R-value
	Roof Exterior Type	Roof Membrane	Roof Membrane		Roof exterior type
	Roof Interior Type	Metal Decking	Metal Decking		Roof interior type
	Wall Base Type	Concrete MW Solid Grouted	Concrete MW Solid Grouted		Wall base type
	Wall Base Cavity Insulation	0	0	R	Wall base cavity insulation R-value

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Save Changes

## Baseline BdeHQ Existing Pre1980 Baseline Cost

Install Cost 0.00 \$/sqft

## Enhancements

- BdeHQ Existing Pre
- BNHQ Existing Post
- BNHQ Existing Pre1
- COF Existing Pre19
- DFAC Existing Pre1
- TEMF Existing Pre1
- UEPH Existing Pre1

## Baseline BdeHQ Existing Pre1980 Baseline Parameters

Name	Default Value	Value	Unit	Description
> Full-Slab Insulation	0.0	0.0	R	Full-slab insulation R-value
Slab Horizontal Insulation	0.0	0.0	R	Slab horizontal insulation R-value
Slab Horizontal Insulation Width	2.0	2.0	ft	Slab horizontal insulation width
Slab Vertical Insulation	0	0	R	Slab vertical insulation R-value
Slab Vertical Insulation Depth	2.0	2.0	ft	Slab vertical insulation depth
Roof Base Type	Insulation Entirely Above Deck	Insulation Entirely Above Deck		Roof base type
Roof Reflectance	0.3	0.3		Reflective property of roof surface
Roof Emittance	0.85	0.85		Emittance property of roof surface
Roof Base Cavity Insulation	0	0	R	Roof base cavity insulation R-value
Roof Base Continuous Insulation	10.848	10.848	R	Roof base continuous insulation R-value
Roof Exterior Type	Roof Membrane	Roof Membrane		Roof exterior type
Roof Interior Type	Metal Decking	Metal Decking		Roof interior type
Wall Base Type	Concrete MW Solid Grouted	Concrete MW Solid Grouted		Wall base type
Wall Base Cavity Insulation	0	0	R	Wall base cavity insulation R-value

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Save Changes

## Enhancements

## BdeHQ Existing Pre

## Lighting Package

High-Efficiency...

## Equipment Package

High-Efficiency...

## Infiltration Package

Reduced Infiltration

Vestibule

## HVAC Package

High-Efficiency Chiller

High-Efficiency Boiler

High-Efficiency...

Supply Temperature...

Reduced Duct...

## CoolRoof Package

Cool Roof

## Daylighting Package

Daylighting Controls

## Envelope Package

Passive House...

## On-Site Water...

Grewwater and...

## Basecase BdeHQ Existing Pre1980 Envelope Package Cost

Install Cost 4.00 \$/sqft

## Basecase BdeHQ Existing Pre1980 Passive House Insulation Parameters

Name	Default Value	Value	Unit	Description
Wall Base Type	Steel Framing at 16 in. on center	Steel Framing at 16 in. on center		Wall base type
Wall Base Cavity Insulation	19	19	R	Wall base cavity insulation R-value
Wall Base Continuous Insulation	25	25	R	Wall base continuous insulation R-value
Roof Base Type	Insulation Entirely Above Deck	Insulation Entirely Above Deck		Roof base type
Roof Base Cavity Insulation	0	0	R	Roof base cavity insulation R-value
Roof Base Continuous Insulation	45	45	R	Roof base continuous insulation R-value
Slab Vertical Insulation	15	15	R	Slab vertical insulation R-value
Slab Vertical Insulation Depth	2	2	ft	Slab vertical insulation depth
Window U-Value	0.35	0.35	U	Window U-value
Window SHGC	0.35	0.35	SHGC	Window solar heat gain coefficient

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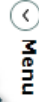




Packages Defined  Custom Spaces Defined

Focus: Energy

Alternative: Basecase



Enhancements & Cost



Basecase BdeHQ Existing Pre1980 Envelope Package Cost

Install Cost 4.00 \$/sqft

Enhancements

Basecase BdeHQ Existing Pre1980 Passive House Insulation Parameters

- ▲ BdeHQ Existing Pre
  - ▲ Lighting Package
    - High-Efficiency...
  - ▲ Equipment Package
    - High-Efficiency...
  - ▲ Infiltration Package
    - Reduced Infiltration Vestibule
  - ▲ HVAC Package
    - High-Efficiency Chiller
    - High-Efficiency Boiler
    - High-Efficiency...
    - Supply Temperature...
    - Reduced Duct...
  - ▲ CoolRoof Package
    - Cool Roof
  - ▲ Daylighting Package
    - Daylighting Controls
  - ▲ Envelope Package
    - Passive House...
  - ▲ On-Site Water...
    - Greywater and

Name	Default Value	Value	Unit	Description
Wall Base Type	Steel Framing at 16 in. on center	Steel Framing at 16 in. on center		Wall base type
Wall Base Cavity Insulation	19	19	R	Wall base cavity insulation R-value
Wall Base Continuous Insulation	25	25	R	Wall base continuous insulation R-value
Roof Base Type	Insulation Entirely Above Deck	Insulation Entirely Above Deck		Roof base type
Roof Base Cavity Insulation	0	0	R	Roof base cavity insulation R-value
Roof Base Continuous Insulation	45	45	R	Roof base continuous insulation R-value
Slab Vertical Insulation	15	15	R	Slab vertical insulation R-value
Slab Vertical Insulation Depth	2	2	ft	Slab vertical insulation depth
Window U-Value	0.35	0.35	U	Window U-value
Window SHGC	0.35	0.35	SHGC	Window solar heat gain coefficient

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- Infiltration Package
  - Reduced Infiltration Measure
    - infiltration = 0.25 CFM/ft<sup>2</sup>
  - Vestibule Measure
    - vestibule = true
  
- HVAC Package
  - High-Efficiency Boiler Measure
    - boiler\_type = “condensing”
    - boiler\_eff = 0.9
  - High-Efficiency Chiller Measure
    - chiller\_cop = 4.45
  - High-Efficiency Fan Measure
    - fan\_eff\_supply = 0.75
    - fan\_eff\_return = 0.75

Details   **Input**   Simulation   Package Selection   Results

● Packages Defined   ● Custom Spaces Defined

Focus: **Water**

Alternative: **Baseline**

Enhancements & Cost



**Baseline BNHQ\_Existing-Post1980 Baseline Cost**

Install Cost  \$/sqft

**Baseline BNHQ\_Existing-Post1980 Baseline Parameters**

- BNHQ\_Existing-Pos**
- BNHQ\_Existing-Pre
- COF\_20150106\_13
- DFAC-Existiung-Pre
- Gym-Existing-Pre1
- HeatPlant-existing
- TEMF\_20150106\_1
- UEPH-Existing-Pre1

Name	Default Value	Value	Unit	Description
Shower Usage Distribution	Until: 24:00,0.0, For: SummerDesignDay, Until: 06:00,0.0, Until: 22:00,1.0, Until: 24:00,0.05, For: WinterDesignDay, Until: 06:00,0.0, Until: 08:00,0.1, Until: 12:00,0.3, Until: 17:00,0.1, Until: 19:00,0.05, Until: 24:00,0.0, For: Saturday Sunday Holidays AllOtherDays, Until: 24:00,0.0;'	Until: 24:00,0.0, For: SummerDesignDay, Until: 06:00,0.0, Until: 22:00,1.0, Until: 24:00,0.05, For: WinterDesignDay, Until: 06:00,0.0, Until: 08:00,0.1, Until: 12:00,0.3, Until: 17:00,0.1, Until: 19:00,0.05, Until: 24:00,0.0, For: Saturday Sunday Holidays AllOtherDays, Until: 24:00,0.0;'		Table of when Shower is operated in a typical day
Shower Water Source	Potable	Potable		Source of input water for Shower
BathroomFaucet Flow Rate	2.2000000000000002	2.2000000000000002	gal/min	Flow rate of BathroomFaucet
BathroomFaucet Flow Length	1	1	min	Flow length of BathroomFaucet per use
BathroomFaucet Use Rate	3	3		Number of times daily BathroomFaucet is operated by a typical occupant
BathroomFaucet Operating Temperature	100	100	Fahrenheit	Average operating water temperature of BathroomFaucet
	'Through: 12/31, For: Weekdays, Until: 05:00,0.0, Until: 07:00,0.1, Until: 08:00,0.3, Until: 12:00,0.95,	'Through: 12/31, For: Weekdays, Until: 05:00,0.0, Until: 07:00,0.1, Until: 08:00,0.3, Until: 12:00,0.95,		

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- Not Started
- Successful
- Queued
- Initialized
- Running
- Not Found
- Error
- Recovered
- Unknown
- Polling

0:00:24 Since Last Study Plan Status Update.

Energy

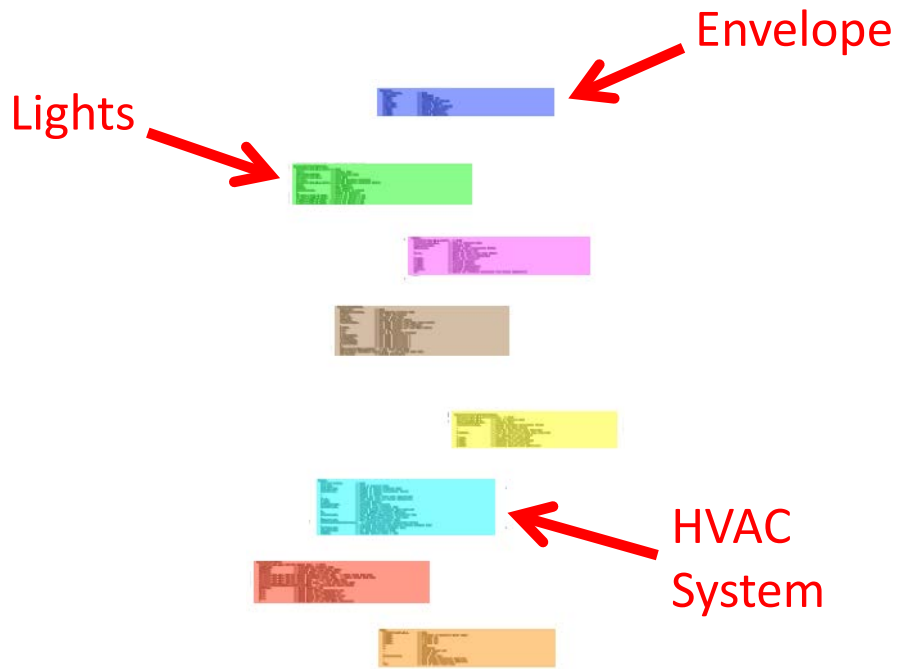
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- ▶  **Baseline**
- ▶  COF Existing Pre1980
- ▶  BNHQ Existing Pre1980
- ▶  BdeHQ Existing Pre1980
- ▶  DFAC Existing Pre1980
- ▶  BNHQ Existing Post1980
- ▶  UEPH Existing Pre1980
- ▶  TEMF Existing Pre1980

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# Params NZP



# Template

```
Lights,  
  Zone A Lighting,  !- Name  
  Zone A,          !- Zone Name  
  Zone A Lighting Sch,  !- Schedule Name  
  Watts/Area,     !- Design Level Calculation Method  
  ,               !- Lighting Level  
  7.532,         !- Watts per Area  
  ,              !- Watts per Person  
  ,              !- Return Air Fraction  
  0.3,           !- Fraction Radiant  
  0.2;          !- Fraction Visible
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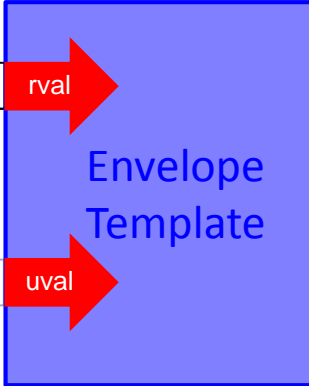
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- VRF type
- 4.15 cop

3.5 rval

5.3 rval

2.8 rval



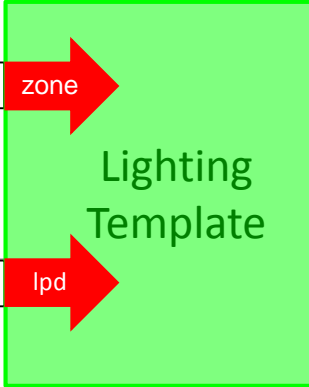
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Material,
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MediumSmooth,  !- Roughness
0.667,         !- Thickness
0.115,        !- Conductivi
5.8,          !- Density {K
1.8,          !- Specific H
0.9,          !- Thermal Abs
0.78,         !- Solar Absor
0.78;         !- Visible Abs

Material,
RG01,         !- Name
Rough,        !- Roughness
1.2700000E-02, !- Thickness
1.440000,    !- Conductivi
8000000,     !- Density {K
1874.000,    !- Specific H
0.9000000,   !- Thermal Abs
0.6500000,   !- Solar Absor
0.6500000;   !- Visible Abs
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7.532 lpd

Zone A zone

7.532 lpd



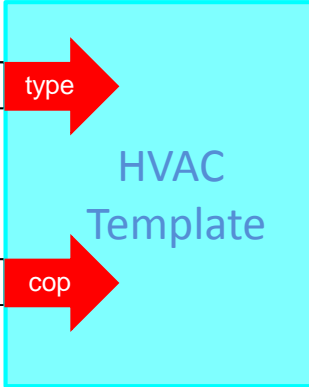
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Lights,
SPACEL-1 Lights 1, !- Name
SPACEL-1,         !- Zone or Zo
LIGHTS-1,        !- Schedule N
LightingLevel,   !- Design Lev
1584,            !- Lighting L
,                !- Watts per
,                !- Watts per
0.2,             !- Return Air
0.59,            !- Fraction R
0.2,             !- Fraction V
0,               !- Fraction R
GeneralLights;   !- End-Use Su

Lights,
SPACEL-1 Lights 1, !- Name
SPACEL-1,         !- Zone or Zo
LIGHTS-1,        !- Schedule N
LightingLevel,   !- Design Lev
1584,            !- Lighting L
,                !- Watts per
,                !- Watts per
0.2;             !- Return Air
```

VAV type

VRF type

4.15 cop

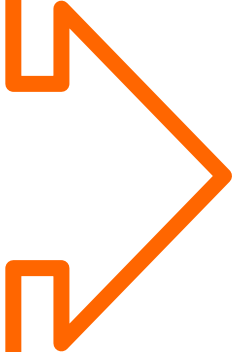


```
AirLoopHVAC,
VAV Sys 1,       !- Name
VAV Sys 1 Controllers, !- Cont
VAV Sys 1 Avail List, !- Avail
autosize,        !- Desi
VAV Sys 1 Branches, !- Bran
,                !- Conn
VAV Sys 1 Inlet Node, !- Supp
PLENUM-1 Out Node, !- Dema
Zone Eq In Node, !- Dema
VAV Sys 1 Outlet Node; !- Supp

AirLoopHVAC:ControllerList,
VAV Sys 1 Controllers, !- Name
Controller:WaterCoil, !- Cont
Central Cooling Coil Controller
Controller:WaterCoil, !- Cont
Central Heating Coil Controller

AvailabilityManagerAssignmentList,
VAV Sys 1 Avail List, !- Name
AvailabilityManager:Scheduled,
VAV Sys 1 Avail; !- Avail
```

3.67 cop





# Templates and Scripting

- ☑ Extremely flexible
- ☑ Simulation-engine neutral
- ☑ All the capabilities of the simulation engine
- ☑ No programmer required

# “Net Zero” Template Library

## Zone Loads

- Classroom
- Corridor
- Fitness
- Kitchen
- Lobby
- Office
- Residence
- Restroom
- Retail
- Storage
- and more...

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## Zone HVAC

- Air-Source HP
- Baseboard Heat
- Chilled Beam
- DOAS Terminal
- Fan Coil Unit
- PTAC
- Radiant Slab
- VAV Terminal
- VRF Terminal
- Window AC
- and more...

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## Systems

- CAV
- Chilled Water
- DHW
- DOAS
- Dual Duct
- Ground HX
- Heat Rejection
- Hot Water
- VAV
- VRF
- and more...

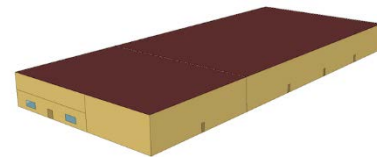
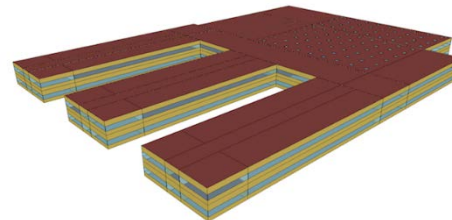
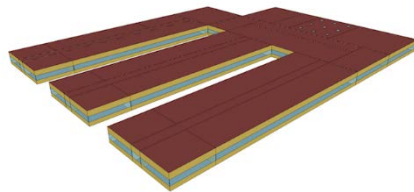
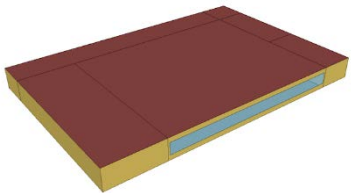
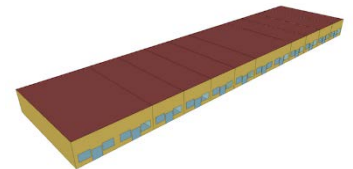
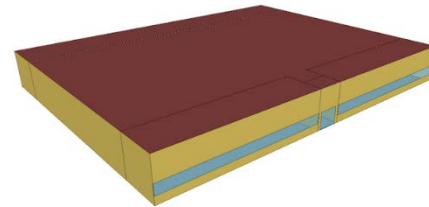
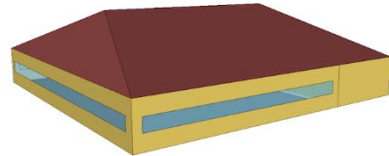
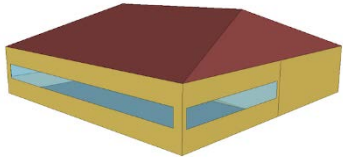
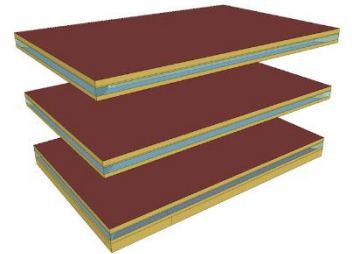
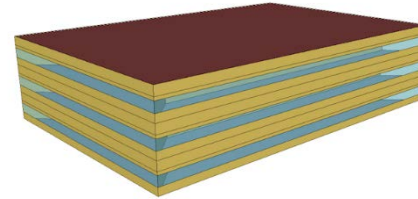
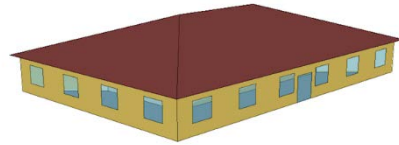
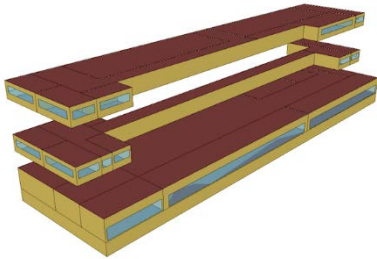
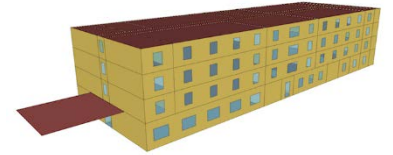
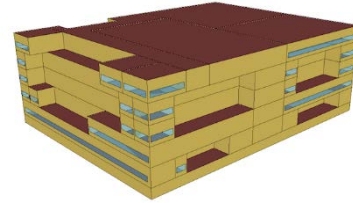
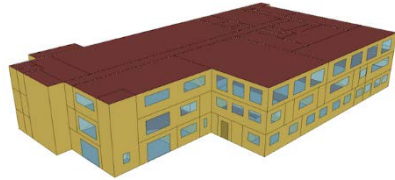
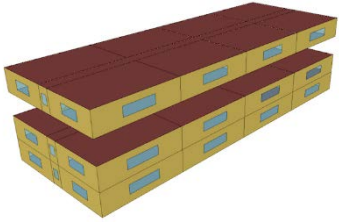
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# “Net Zero” Template Library

- ☑ Modular and reusable
- ☑ Reasonable defaults
- ☑ Baked-in measures
- ☑ Easy to swap HVAC systems



# Prototype Models

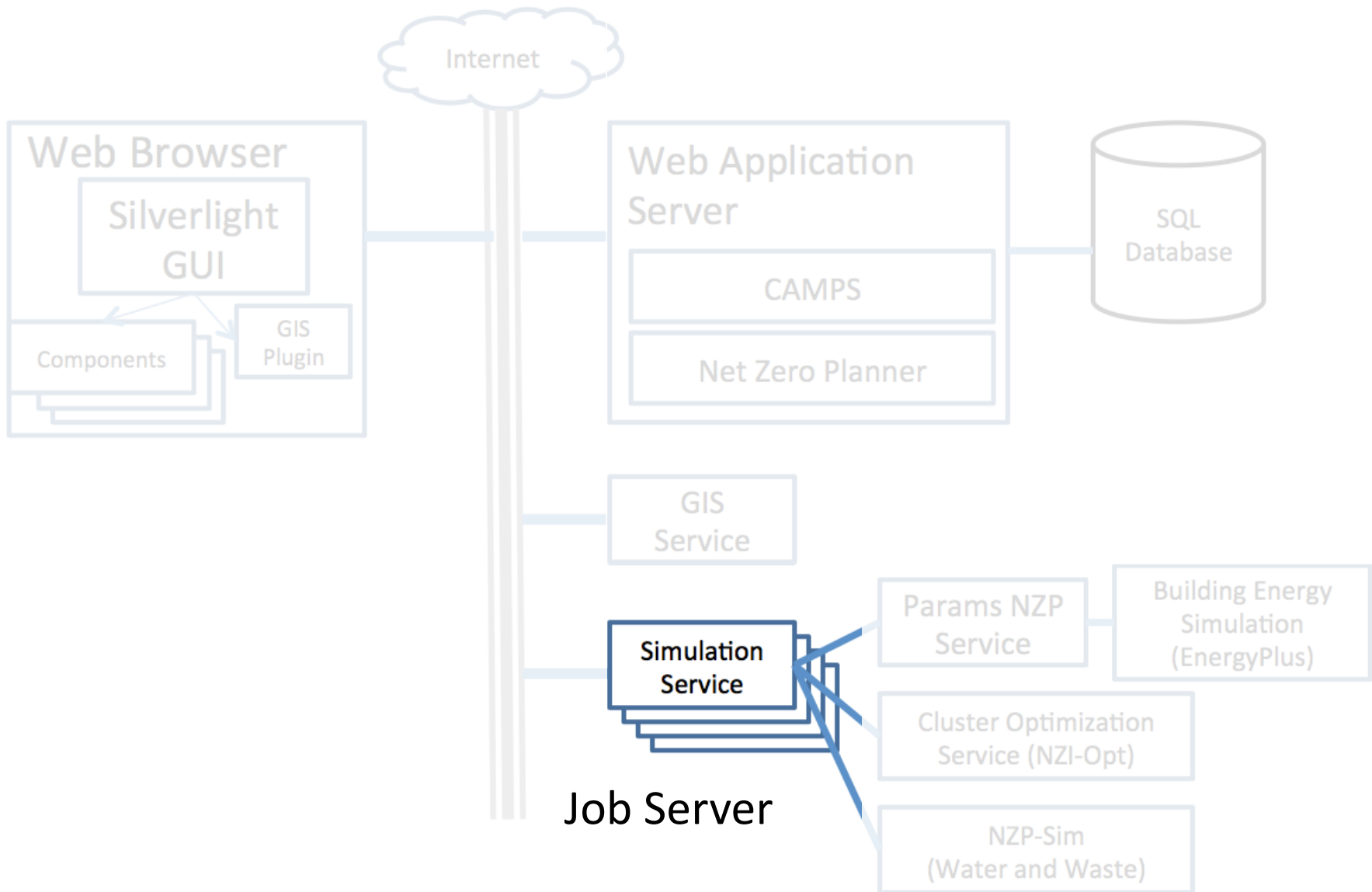


# Parameters

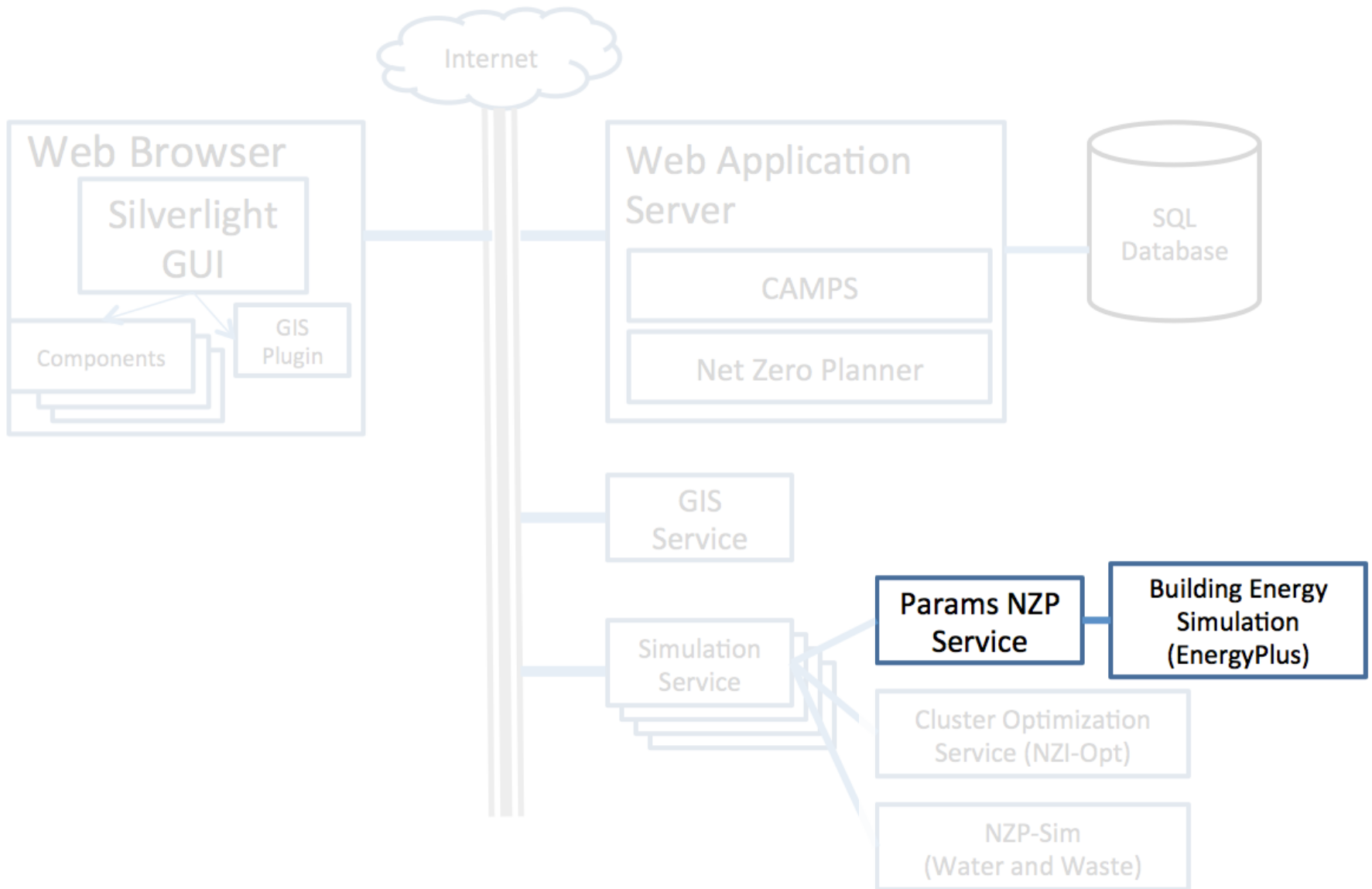
- Wall details
  - Assembly type, cavity and continuous insulation R-values
- Roof details
  - Assembly type, cavity and continuous insulation R-values
- Slab/basement details
  - Horizontal/vertical insulation widths/depths and R-values
- Window details
  - U-value, SHGC
- Infiltration
  - Air leakage rate, air leakage schedule, use of vestibules
- Occupancy
  - People densities and schedules by space type
- Lighting
  - Lighting power densities and schedules by space type
- Equipment
  - Equipment power densities and schedules by space type
- Domestic hot water
  - Flow rates, temperatures, schedules

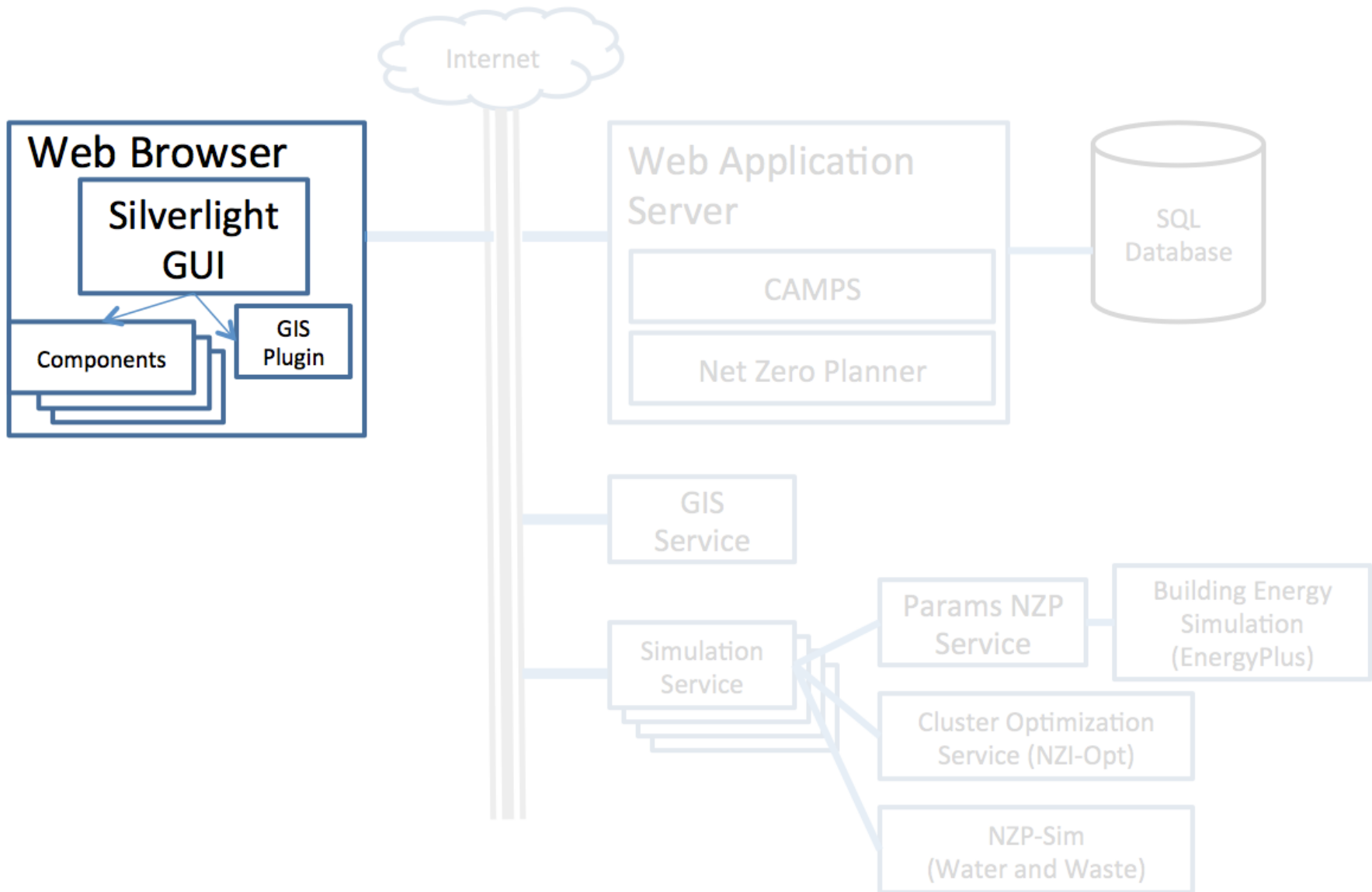
# Parameters

- Zone HVAC
  - Unit type - ATU, FCU, PTAC, PTHP, Win AC, WSHP, VRF, UH, radiant
- Zone HVAC operation
  - Thermostat setpoints, setback/setup schedule, outdoor air
- Zone HVAC performance
  - Fan/heat/cool efficiencies
- Central HVAC
  - System type - VAV, CAV, DOAS, HW, CHW, VRF, dual duct
- Central HVAC operation
  - Schedule, outdoor air, supply setpoints, controls
- Central HVAC performance
  - Fan/pump efficiencies, heating/cooling COPs
- And more...









Energy Alternative Packages

Instructions

Save Changes  
 Auto Select  
 Select Baseline

Packages Criteria Report Viewer

Basecase > BdeHQ Existing Pre1980

Study Plans > Facility Groups > Packages

- Basecase
  - ▶ BdeHQ Existing Pre1980
    - Lighting Package
    - Equipment Package
    - Infiltration Package
    - HVAC Package
    - CoolRoof Package
    - Daylighting Package
    - Envelope Package
    - On-Site Water Harvesting Package
  - ▶ BNHQ Existing Post1980
  - ▶ BNHQ Existing Pre1980
  - ▶ COF Existing Pre1980
  - ▶ DFAC Existing Pre1980
  - ▶ TEMF Existing Pre1980
  - ▶ UEPH Existing Pre1980

Electricity:  Gas:

Package	Energy Reduction (%)	Electric Usage (kBtu)	Electric Cost (\$)	Gas Usage
Lighting Package	8.91	843,714	19,783	245,004
Equipment Package	14.90	747,653	17,531	269,484
Infiltration Package	30.88	703,647	16,499	122,502
HVAC Package	39.64	631,820	14,815	89,658
CoolRoof Package	39.71	629,527	14,761	91,086
Daylighting Package	40.40	620,175	14,542	92,208
Envelope Package	43.09	616,641	14,459	63,546
On-Site Water Harvesting Package	43.09	616,641	14,459	63,546

Water Alternative Packages

Energy Alternative Packages

Instructions

Save Changes  
 Auto Select  
 Select Baseline

Study Plans > Facility Groups > Packages

Basecase

BdeHQ Existing Pre1980

- Lighting Package
- Equipment Package
- Infiltration Package
- HVAC Package
- CoolRoof Package
- Daylighting Package
- Envelope Package
- On-Site Water Harvesting Package

- ▶ BNHQ Existing Post1980
- ▶ BNHQ Existing Pre1980
- ▶ COF Existing Pre1980
- ▶ DFAC Existing Pre1980
- ▶ TEMF Existing Pre1980
- ▶ UEPH Existing Pre1980

Packages Criteria Report Viewer

Basecase > BdeHQ Existing Pre1980

Electricity: kBtu   Gas: kBtu

Package	Energy Reduction (%)	Electric Usage (kBtu)	Electric Cost (\$)	Gas Usage
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Water Alternative Packages

Details   Input   Simulation   Package Selection   **Results**

- Instructions
- Energy Reports**
  - Debug Report
  - Demand By End Use
  - Demand Intensity By End Use
  - Energy By End Use
  - Energy Intensity By End Use
  - Load Duration Curve
  - Package Parameter Summary
  - Package Parameters
  - Site Summary**
  - Source Summary

Reports & Filters

**Facilities**

- 
- BdeHQ Existing Pre1980
  - BNHQ Existing Post1980
  - BNHQ Existing Pre1980
  - COF Existing Pre1980
  - DFAC Existing Pre1980
  - TEMF Existing Pre1980
  - UEPH Existing Pre1980

**Energy Utilities**

- Electric Company
- Gas Company

**Water Utilities**

**Waste Utilities**

**Based On Comparison %:** Baseline

Alternative	Facilities	Total Area ft <sup>2</sup>	Site Electricity kBtu	Site Electricity Intensity kBtu/ft <sup>2</sup>	Site Elec Reduction
Baseline	46	704,622	40,451,088	57.41	0

Facility Group	Facilities	Total Area	Electricity	Electricity Intensity	Electricity Reduction (%)
BdeHQ Existing Pre1980	1	16,784	969,486	57.76	0
BNHQ Existing Post1980	1	9,050	371,682	41.07	0
BNHQ Existing Pre1980	10	119,840	5,020,459	41.89	0
COF Existing Pre1980	2	37,458	883,015	23.57	0
DFAC Existing Pre1980	2	27,658	2,952,570	106.75	0
TEMF Existing Pre1980	2	16,527	443,976	26.86	0
UEPH Existing Pre1980	28	477,305	29,809,902	62.45	0

# Unique Features

- Energy, water, and waste
- Detailed *EnergyPlus* modeling
- Clustering for central heating/cooling plants
- Optimization of supply and distribution systems