



IDEA2018

Local Solutions,
Global Impact

109TH ANNUAL CONFERENCE & TRADE SHOW

June 11-14 | Vancouver Convention Centre | Vancouver, BC

District Zero: A Decision-Making Tool for Net-Zero Communities

Session 5D – Data, Digital Infrastructure & Tools for Buildings & DE Assets

June 13, 2018 – 10:45 - 11:15 AM

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SMPL Tool

(System Master Planning Tool)

NZP / Net Zero Planner

US Army Corps of Engineers

Construction Engineering Research Laboratory

US Department of Defense



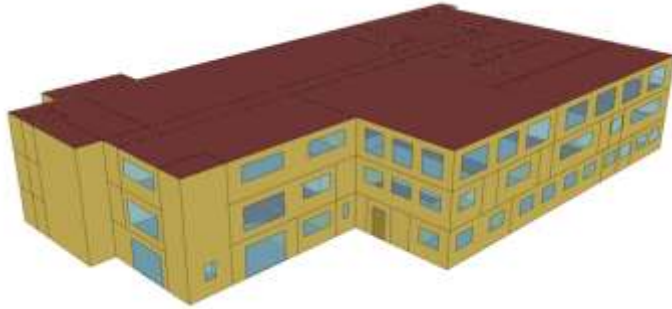
District Zero

Big Ladder Software LLC

Everyone else!



Detailed *EnergyPlus* Modeling



Energy + Water + Waste



District/Cluster Optimization



Multi-Criteria Decision Analysis



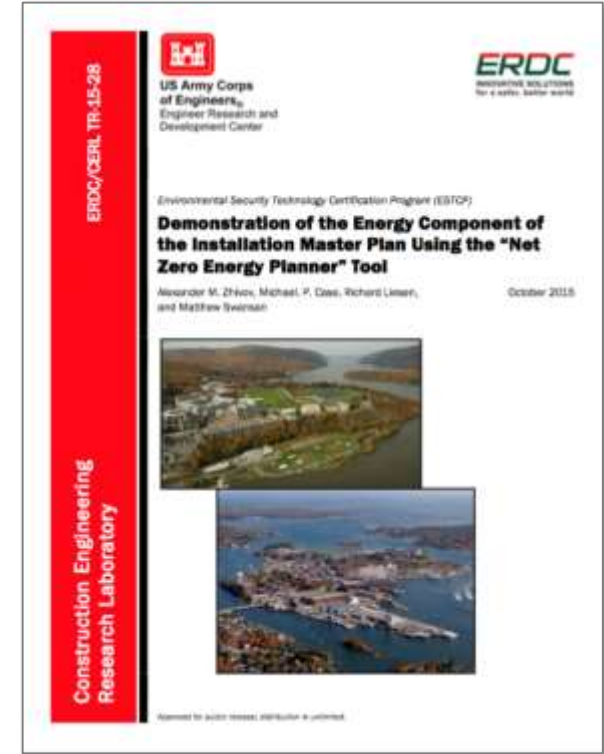
Demonstration Projects

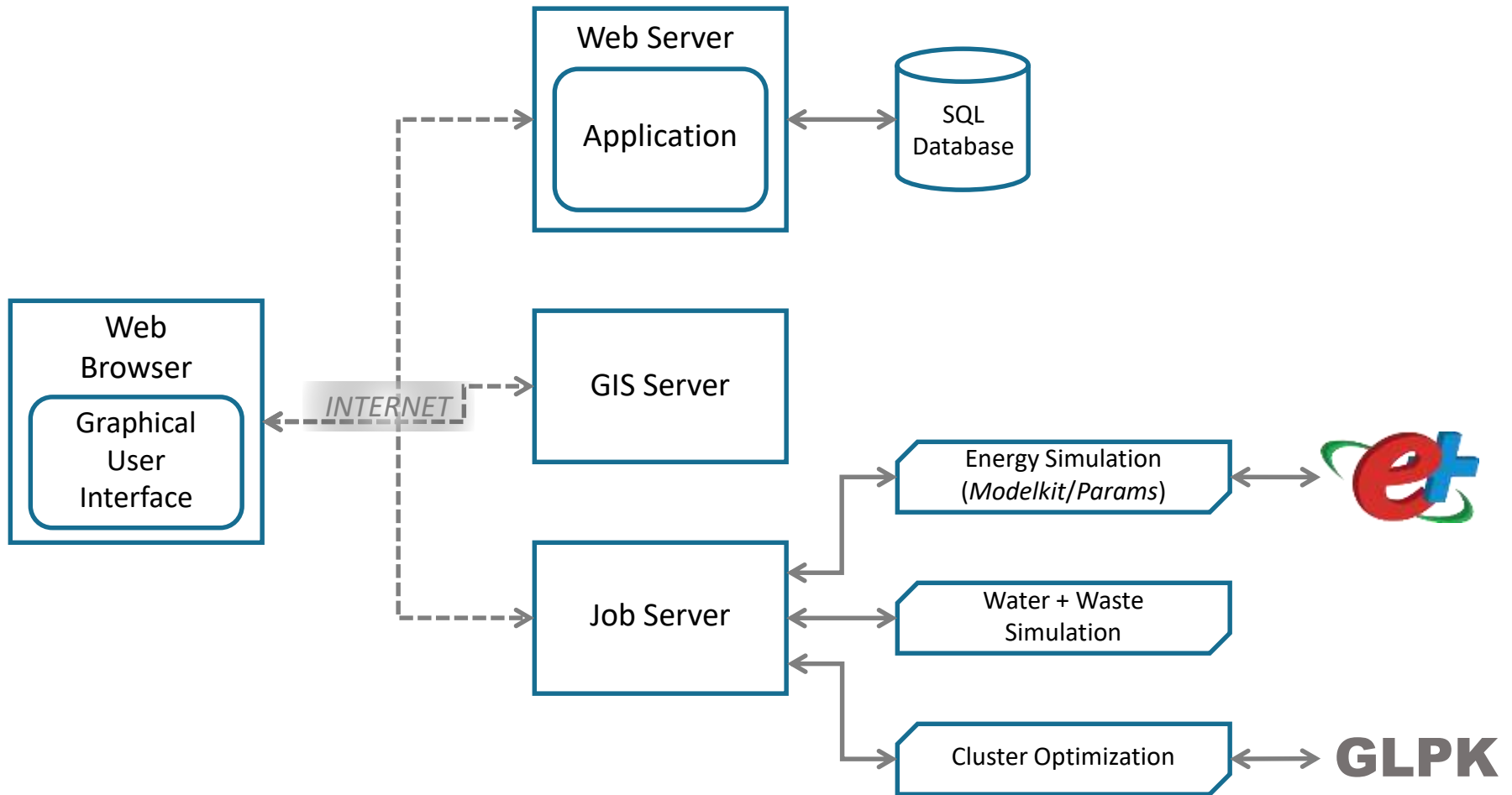
US Military Academy, West Point (New York)
Portsmouth Naval Shipyard (Maine)

- 60-70% Cost Savings
- 68-75% Time Savings

Table 6-1. Cost summary for analysis using the SME and NZP.

Installation	Number of Buildings	Number of Building Categories	Time Required		Cost of Data Analysis Using, \$1000	
			SME	NZP	SME	NZP
USMA, West Point	45	11	5 months	5 wks	167	50
PNSY	127	22	4 months	5 wks	130	50







Details **Facilities** Rates Consumption Manage Users Results

Study Inventory Facilities



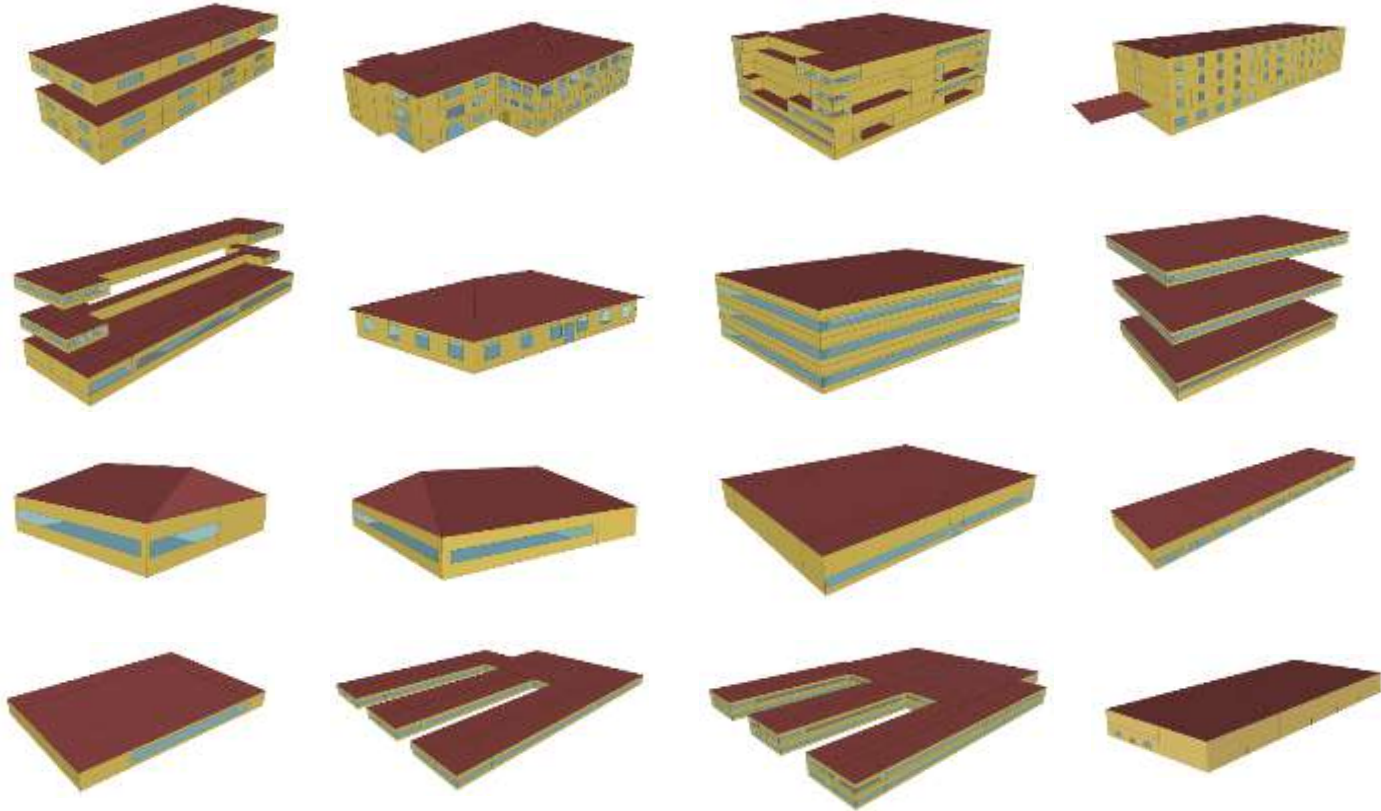
Master Facility List ▾

Facility Group Summary Facilities Summary

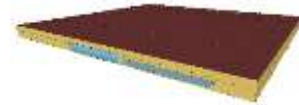
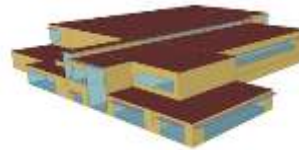
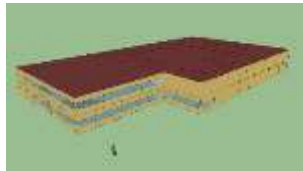
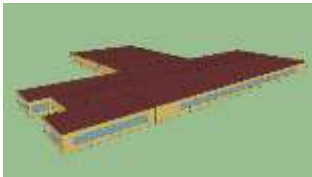
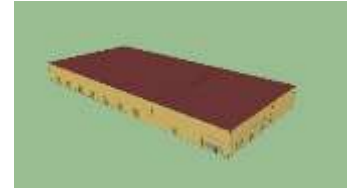
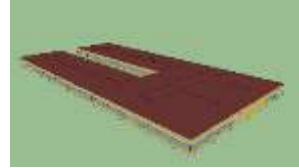
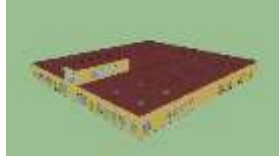
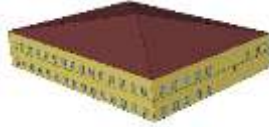
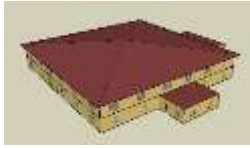
Drag a column header and drop it here to group by that column

Facility Group	Name	Number	Facility Type	Status	Active	Construction Date	Cond. Area (ft^2)	Floors	Life
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

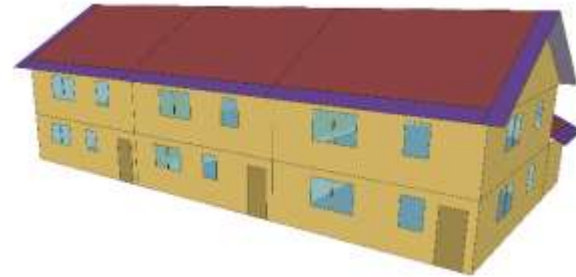
US Commercial Prototype Models



US Army Prototype Models



US Residential Prototype Models



Details Input Simulation Package Selection Results

Packages Defined Custom Spaces Defined

Focus: Energy

Alternative: Baseline



Enhancements & Cost



Baseline BdeHQ Existing Pre1980 Baseline Cost

Install Cost 0.00 \$/sqft

Enhancements

Baseline BdeHQ Existing Pre1980 Baseline Parameters

	Name	Default Value	Value	Unit	Description	
<input type="checkbox"/> BdeHQ Existing Pre	> Full-Slab Insulation	0.0	0.0	R	Full-slab insulation R-value	
<input type="checkbox"/> BNHQ Existing Post	Slab Horizontal Insulation	0.0	0.0	R	Slab horizontal insulation R-value	
<input type="checkbox"/> BNHQ Existing Pre1	Slab Horizontal Insulation Width	2.0	2.0	ft	Slab horizontal insulation width	
<input type="checkbox"/> COF Existing Pre19	Slab Vertical Insulation	0	0	R	Slab vertical insulation R-value	
<input type="checkbox"/> DFAC Existing Pre1	Slab Vertical Insulation Depth	2.0	2.0	ft	Slab vertical insulation depth	
<input type="checkbox"/> TEMF Existing Pre1	Roof Base Type	Insulation Entirely Above Deck	Insulation Entirely Above Deck		Roof base type	
<input type="checkbox"/> UEPH Existing Pre1	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	

Details **Input** Simulation Package Selection Results

● Packages Defined ● Custom Spaces Defined

Focus: **Energy**

Alternative: **Basecase**

Enhancements & Cost



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...

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

Details Input Simulation Package Selection Results

Instructions

Energy Reports

- Cost Optimization Curve
- 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

Facilities

Select All Unselect All

- ☒ 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

Update

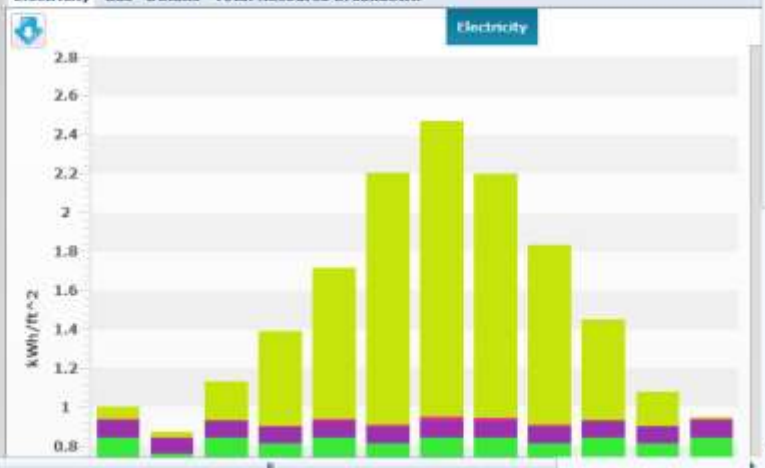
Area: ft² Electricity: kWh/ft² Gas: therm/ft² Common: kWh/ft²

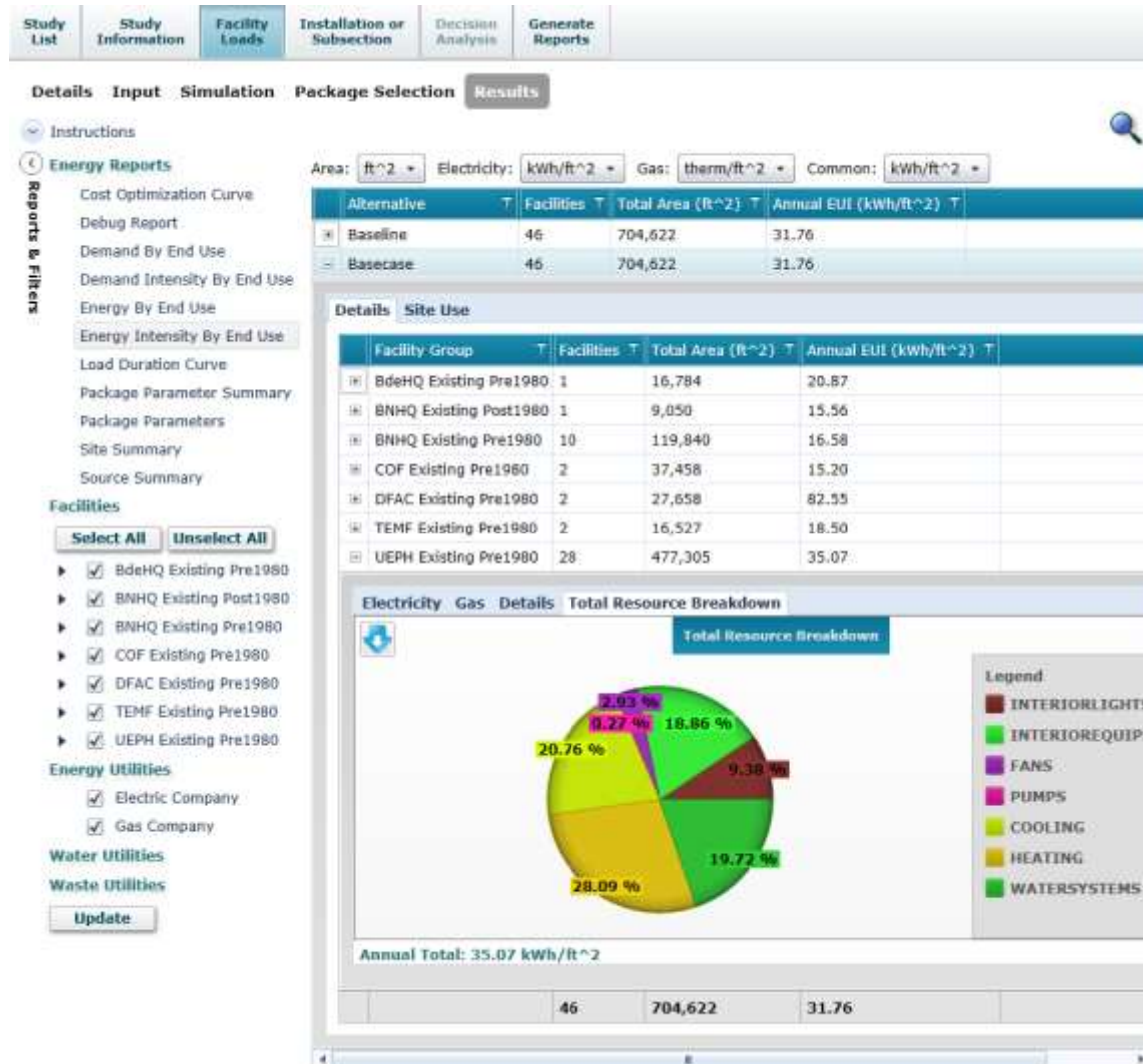
Alternative	Facilities	Total Area (ft ²)	Annual EUI (kWh/ft ²)
Baseline	46	704,622	31.76
Basecase	46	704,622	31.76

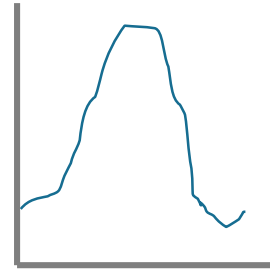
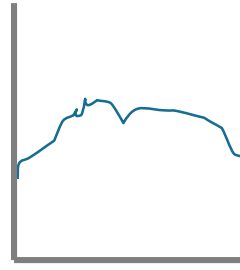
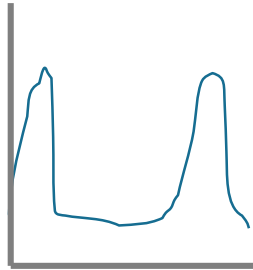
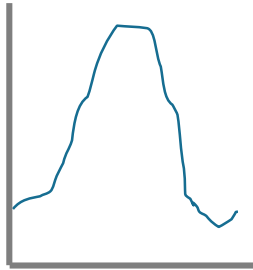
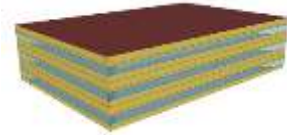
Details Site Use

Facility Group	Facilities	Total Area (ft ²)	Annual EUI (kWh/ft ²)
BdeHQ Existing Pre1980	1	16,784	20.87
BNHQ Existing Post1980	1	9,050	15.56
BNHQ Existing Pre1980	10	119,840	16.58
COF Existing Pre1980	2	37,458	15.20
DFAC Existing Pre1980	2	27,658	82.55
TEMF Existing Pre1980	2	16,527	18.50
UEPH Existing Pre1980	28	477,305	35.07

Electricity Gas Details Total Resource Breakdown







Instructions

Energy Reports

- Cost Optimization Curve
- 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

Facilities

Select All Unselect All

- ☒ BNHQ_Existing-...
- ☒ BNHQ_Existing-Pre1980
- ☒ COF_20150106_13:11
- ☒ DFAC_Existing-Pre1980
- ☒ Gym-Existing-Pre1980
- ☒ HeatPlant-existing-...
- ☒ TEMF_20150106_13:11
- ☒ UEPH-Existing-Pre1980

Energy Utilities

- ☐ Biogas
- ☐ biomass
- ☐ Diesel
- ☒ SHOME Power
- ☒ Omega Pipeline
- ☐ Propane
- ☐ Retail natural gas

Water Utilities

Waste Utilities

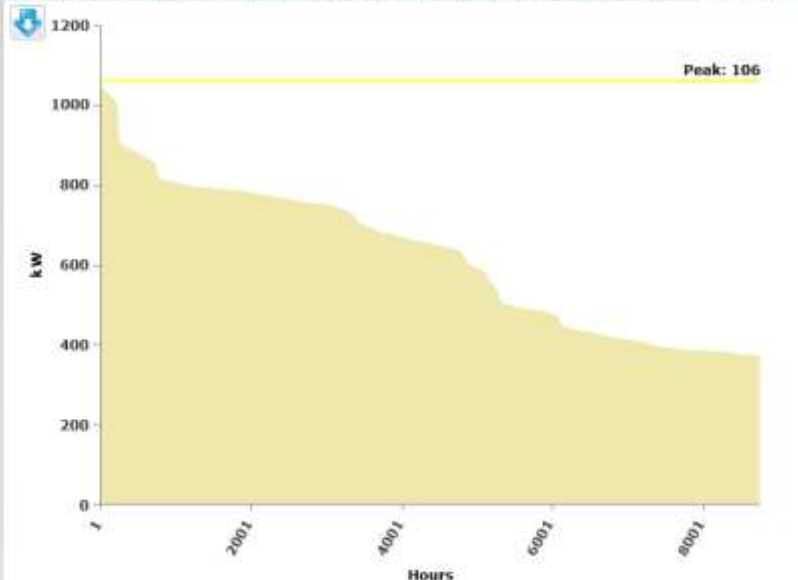
Update

Power: kW

Alternative	
Baseline	
Basecase	
Building EEMs	
Building EEMs - open optimization	

Details Site Load

Heating Demand DHW Demand Cooling Demand Combined Heating/Cooling Demand Electricity Demand



Building EEMs - 50% source reduction

Search

**Remaining Buildings**

N/A

Number of Buidlings: 403

Ground Coverage: 311,912,512 sqft

Total Electrical Load: 65,161,264 kWh/Yr

Total Space Heating Load: 29,428,604 kWh/Yr

Total DHW Load: 24,905,866 kWh/Yr

Total Cooling Load: 41,729,232 kWh/Yr

Total Heating Load Density: 0.17 kWh/Yr/sqft

Total Cooling Load Density: 0.13 kWh/Yr/sqft

View

Delete

**South Cluster**

N/A

Number of Buidlings: 23

Ground Coverage: 6,570,904 sqft

Total Electrical Load: 7,428,096 kWh/Yr

Total Space Heating Load: 4,669,444 kWh/Yr

Total DHW Load: 3,631,677 kWh/Yr

Total Cooling Load: 4,612,399 kWh/Yr

Total Heating Load Density: 1.26 kWh/Yr/sqft

Total Cooling Load Density: 0.70 kWh/Yr/sqft

View

Delete

**Specker Cluster**

N/A

Number of Buidlings: 46

Ground Coverage: 2,917,875 sqft

Total Electrical Load: 8,502,343 kWh/Yr

Total Space Heating Load: 5,107,636 kWh/Yr

Total DHW Load: 6,083,471 kWh/Yr

Total Cooling Load: 6,002,746 kWh/Yr

Total Heating Load Density: 3.84 kWh/Yr/sqft

View

Delete

Details Cluster Networks Equipment & Measure Constraints Optimization Results

Building EEMs Realistic with AIT Barracks added Alternative Clusters

Equipment Defined (Input\Output Device) Equipment Defined (Storage Device)

Instructions

Baseline Base Case Building EEMs High Building EEMs Realistic Building EEMs Realistic with AIT Barracks added Building EEM

Save Changes

Clusters

Remaining Buildings

South Cluster

Specker Cluster

West Cluster

Input / Output Storage

Equipment	Type	Name	Max Num.	Max Power	Input
Click here to add new item					
45	URL	URL_LOW	10	280	200_
46	ACBus	ACBus1	5	20000	EtoBa
47	HeatE	HeatE1	10	10000	800_
48	CoolLoad	CoolingLoad1	1	9999999	Distri
49	HeatLoadHotwater	HWFedHeatingLoad1	1	9999999	Distri
50	Bollers	DistBollersSolution	1	999999	Retai
51	Elec_Chill	DistElec_Chills	1	999999	Efron
52	PhotoVolt	PhotoVolt14kW	10	100000	Solar
53	PhotoVolt	PhotoVolt140kW	10	100000	Solar
54	PhotoVolt	PhotoVolt1400kW	10	100000	Solar

Baseline Clusters

● Constraints Defined

▼ Instructions

Baseline

Base Case

Base Case Buildings with Specker Replacement

Building EEMs High

Building EEMs Realistic

Building EEMs I



Clusters



Save Changes

Clusters

Remaining Building

South Cluster

Specker Cluster

West Cluster

Baseline Remaining Buildings Constraints and Basic Economic Values

Energy Security

Critical Electric Maximum Load: 0.00 kW

Environmental / Renewable (Annual)

Renewable Target (disabled): 0.00 %

Max. Carbon Footprint: 100,000,000.00 metric tons of CO2

Basic Economic Values

Project Lifetime: 0.00 YY

Int. Rate: 5.00 %

Electrical Requirements

Net Metering Allowed: ☐

Miscellaneous

Maximum Investment Cost: 1,000,000,000.00 \$

Maximum Source Energy: 10,000,000,000.00 kWh

Maximum Combustibles: 10,000,000,000.00 kWhs (~1.23 kWhs/lb or 2460 kWhs/Ton)

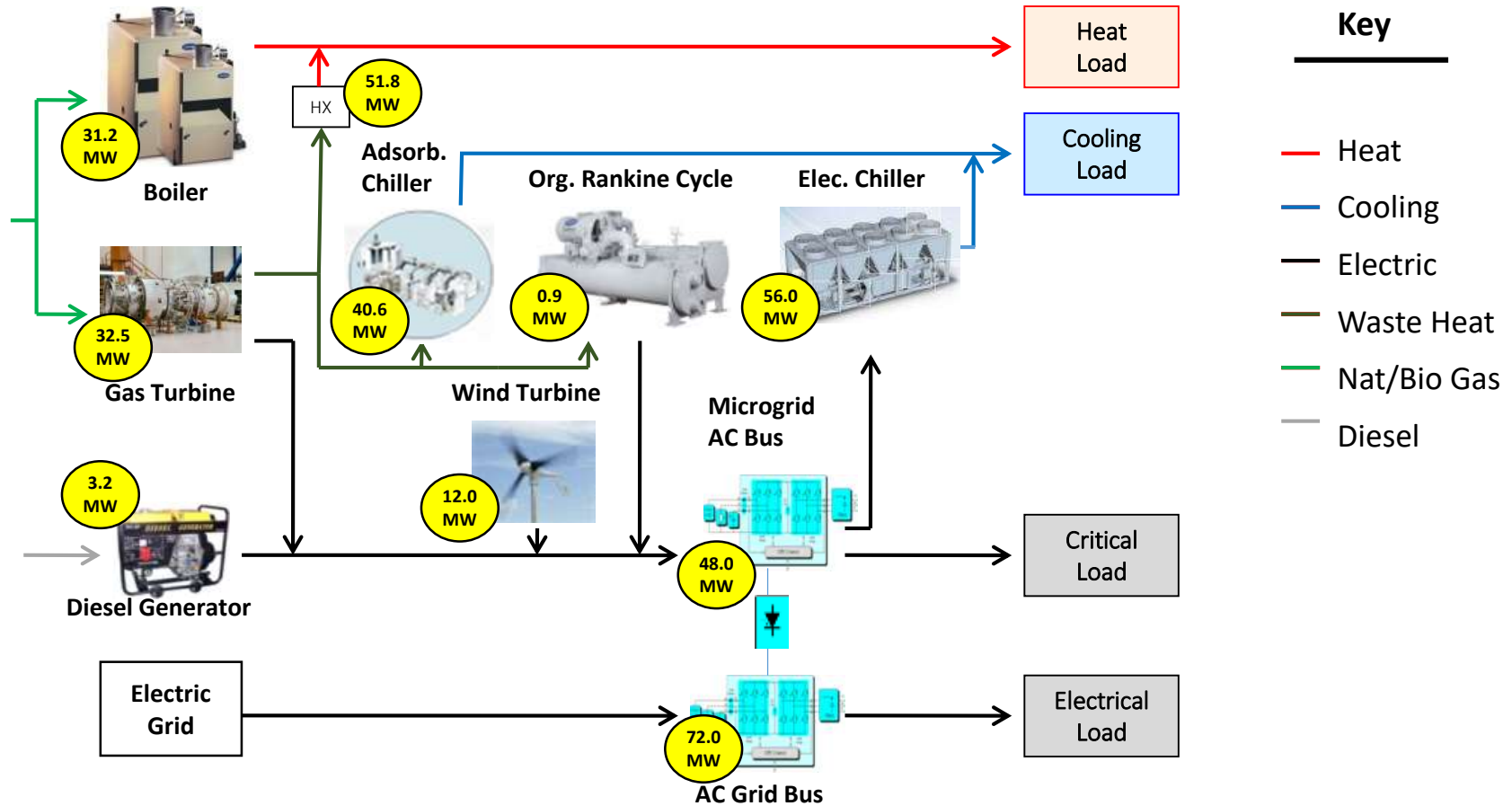
Redundancy Type

Heating

☐ N + 1 Redundancy☒ Additional Capacity: 1.00

Cooling

☐ N + 1 Redundancy☒ Additional Capacity: 1.00



Installation Results - Energy Comparison

Instructions

Reports

Annual Energy Comparison

Energy Overview

Equipment Overview

Energy: kWh Power: kW

	Study Plan	Natural Gas (kWh)	Peak Natural Gas (kW)	Electricity (kWh)	Pe
+	Base Case	123,771,232	139,420	140,980,944	34
+	Baseline	110,828,536	128,586	114,134,760	29
+	Building EEMs High	74,824,808	83,670	97,613,848	25
+	Building EEMs Realistic	110,502,064	119,182	113,842,288	28
+	Building EEMs Realistic with AIT Barracks added	110,455,888	117,735	113,228,744	28
+	Building EEMS Realistic with AIT Barracks MTHW	145,015,104	123,478	113,307,272	27

Installation Results - Equipment Overview

Instructions

Reports

Reports

Annual Energy Comparison

Energy Overview

Equipment Overview



Alternative	Devices
Base Case	20
Baseline	20
Building EEMs High	113
Building EEMs Realistic	110
Building EEMs Realistic with AIT Barracks added	116

Cluster	Devices
Remaining Buildings	64
South Cluster	17
Specker Cluster	21

Equipment	Max Power	Unit	Devices
ACBus1	20,000	kW	1
Air_Elec_Chill_2	352.00	kW	1
Air_Elec_Chill_4	1,055	kW	1
Boil0	100.00	kW	2
Boil2	2,500	kW	2
ExistingBoilers	6,956	kW	2
ExistingElChillers	3,340	kW	2

Close the MCDA Model

MCDA Model: 3 Economic with site and source energy

Name: 3 Economic with site and source energy

Description:

Created: Liesen, Richard (5/26/2016 11:14)

Modified: Liesen, Richard (6/28/2016 15:54)

Access Level: Edit Model Structure, Value Functions and Weights

Rank	Alternative Name	MCDA Score
1	Baseline	0.7000814
2	Best Case w/ Cogen	0.6420052
3	Best Case w/ Solar 30% source red.	0.6211032
4	Best Case	0.6047149
5	Better Case	0.5313668
6	Base Case	0.2782766

Criteria Tree

Properties

Sensitivity
Analysis

Rename

Move Up

Cut

Delete

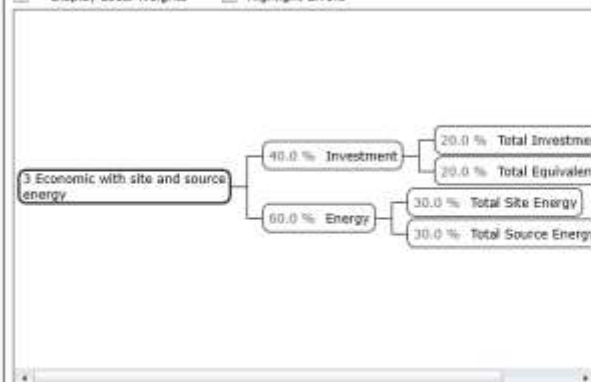
Paste
as a Sub
Criterion

Add New

Move Down

Copy

Paste

☐ * Display Local Weights☐ Highlight Errors

3 Economic with site and source energy



Next Steps

- Pilot Projects with Commercial Customers
- US Department of Defense
Environmental Security Technology Certification Program (ESTCP) grant
- International Energy Agency – Energy in Buildings and Communities
Annex 73 – Towards Net Zero Energy Public Communities





IDEA2018

Local Solutions,
Global Impact

109TH ANNUAL CONFERENCE & TRADE SHOW

June 11-14 | Vancouver Convention Centre | Vancouver, BC

Thank You!

Questions?

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