
LEADING THE WAY
CampusEnergy2022
Feb. 15-18 | Westin Boston Seaport District Hotel | Boston, Mass.
INTERNATIONAL DISTRICT ENERGY ASSOCIATION

District Energy from the Start

Brandon Curry, HDR

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HDR

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

Problem Statement

- Many District Energy projects focus on EXISTING systems
  - Optimization/Modernization
  - Repair/Replacement
  - Expansion

- Is anything really a blank canvas??

Chicago Focal Point

Development Includes

- Replacement Hospital
- Retail Space
- Housing Complex
- Medical Center
- Athletic Center
- Daycare & School










“the Start”…the Sky is the Limit…





Photo Credits: Architecture 2030

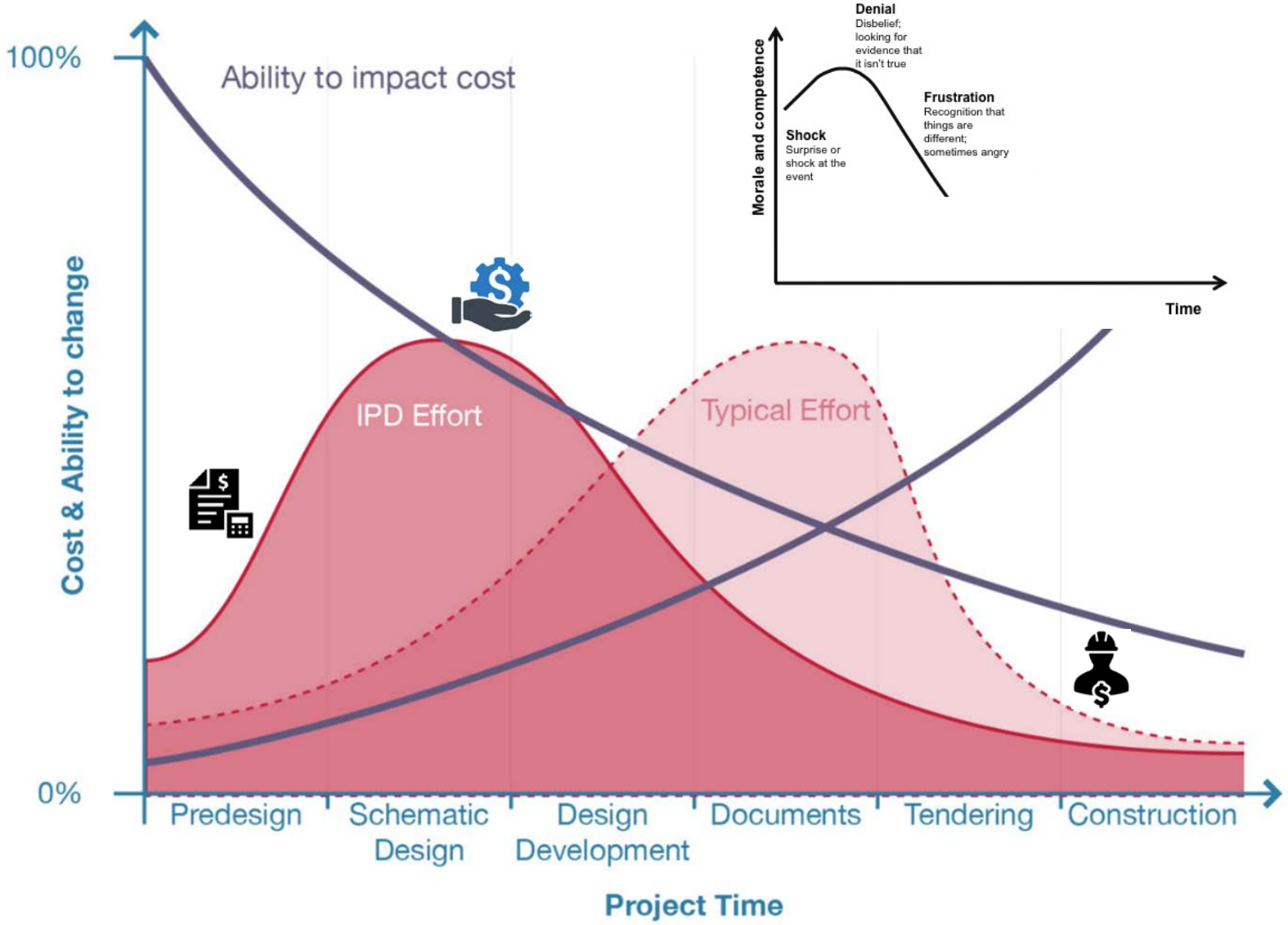
Hurdles to Blue Sky Thinking

Cost Estimation(s)
Shock

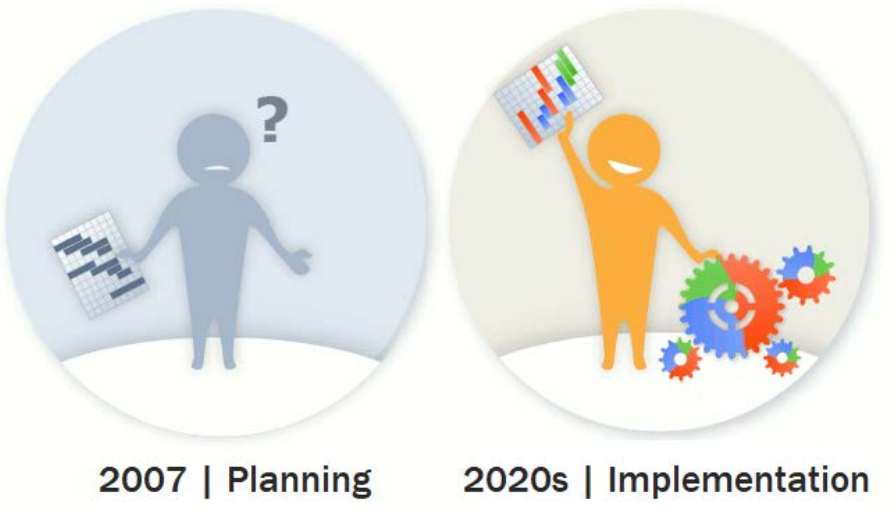
Value Engineering
Denial

Construction Bid(s)
Frustration

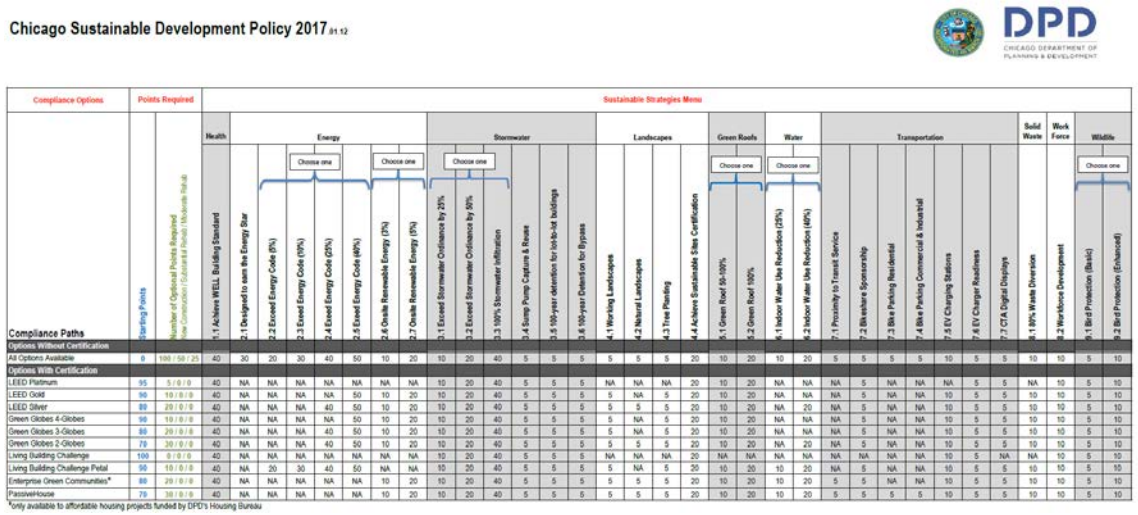
The Kübler-Ross change curve



Pathways to Blue Sky Thinking



Climate Commitments



Local Sustainability Requirements

Long Term Project Development/Permitting & Energy Code Stringency Increases

Chicago Sustainable Development Policy

Chicago Sustainable Development Policy 2017.01.12

DPD
CHICAGO DEPARTMENT OF PLANNING & DEVELOPMENT

Compliance Options	Points Required		Sustainable Strategies Menu																														
			Health	Energy							Stormwater							Landscapes				Green Roofs		Water		Transportation							Solid Waste	Work Force	Wildlife	
						Choose one			Choose one		Choose one											Choose one		Choose one										Choose one	
Compliance Paths	Starting Points	Number of Optional Points Required New Construction / Substantial Rehab / Moderate Rehab	1.1 Achieve WELL Building Standard	2.1 Designed to earn the Energy Star	2.2 Exceed Energy Code (5%)	2.3 Exeed Energy Code (10%)	2.4 Exeed Energy Code (25%)	2.5 Exeed Energy Code (40%)	2.6 Onsite Renewable Energy (3%)	2.7 Onsite Renewable Energy (5%)	3.1 Exceed Stormwater Ordinance by 25%	3.2 Exceed Stormwater Ordinance by 50%	3.3 100% Stormwater Infiltration	3.4 Sump Pump Capture & Reuse	3.5 100-year detention for lot-to-lot buildings	3.6 100-year Detention for Bypass	4.1 Working Landscapes	4.2 Natural Landscapes	4.3 Tree Planting	4.4 Achieve Sustainable Sites Certification	5.1 Green Roof 50-100%	5.2 Green Roof 100%	6.1 Indoor Water Use Reduction (25%)	6.2 Indoor Water Use Reduction (40%)	7.1 Proximity to Transit Service	7.2 Bikeshare Sponsorship	7.3 Bike Parking Residential	7.4 Bike Parking Commercial & Industrial	7.5 EV Charging Stations	7.6 EV Charger Readiness	7.7 CTA Digital Displays	8.1 80% Waste Diversion	8.2 Workforce Development	9.1 Bird Protection (Basic)	9.2 Bird Protection (Enhanced)
Options Without Certification																																	
All Options Available	0	100 / 50 / 25	40	30	20	30	40	50	10	20	10	20	40	5	5	5	5	5	5	20	10	20	10	20	5	5	5	5	10	5	5	10	10	5	10
Options With Certification																																	
LEED Platinum	95	5 / 0 / 0	40	NA	NA	NA	NA	NA	NA	NA	10	20	40	5	5	5	NA	NA	NA	20	10	20	NA	NA	NA	5	NA	NA	NA	5	5	NA	10	5	10
LEED Gold	90	10 / 0 / 0	40	NA	NA	NA	NA	50	10	20	10	20	40	5	5	5	5	NA	5	20	10	20	NA	NA	NA	5	NA	NA	10	5	5	10	10	5	10
LEED Silver	80	20 / 0 / 0	40	NA	NA	NA	40	50	10	20	10	20	40	5	5	5	5	5	5	20	10	20	NA	20	NA	5	NA	NA	10	5	5	10	10	5	10
Green Globes 4-Globes	90	10 / 0 / 0	40	NA	NA	NA	NA	50	10	20	10	20	40	5	5	5	5	NA	5	20	10	20	NA	NA	NA	5	NA	NA	10	5	5	10	10	5	10
Green Globes 3-Globes	80	20 / 0 / 0	40	NA	NA	NA	40	50	10	20	10	20	40	5	5	5	5	NA	5	20	10	20	NA	NA	NA	5	NA	NA	10	5	5	10	10	5	10
Green Globes 2-Globes	70	30 / 0 / 0	40	NA	NA	NA	40	50	10	20	10	20	40	5	5	5	5	5	5	20	10	20	NA	20	NA	5	NA	NA	10	5	5	10	10	5	10
Living Building Challenge	100	0 / 0 / 0	40	NA	NA	NA	NA	NA	NA	NA	10	20	40	5	5	5	NA	NA	NA	20	NA	NA	NA	NA	NA	NA	NA	NA	10	5	NA	NA	10	5	10
Living Building Challenge Petal	90	10 / 0 / 0	40	NA	20	30	40	50	NA	NA	10	20	40	5	5	5	5	NA	5	20	10	20	10	20	NA	5	NA	NA	10	5	5	10	10	5	10
Enterprise Green Communities*	80	20 / 0 / 0	40	NA	NA	NA	NA	NA	10	20	10	20	40	5	5	5	5	5	5	20	10	20	10	20	5	5	NA	NA	10	5	5	10	10	5	10
PassiveHouse	70	30 / 0 / 0	40	NA	NA	NA	NA	NA	10	20	10	20	40	5	5	5	5	5	5	20	10	20	10	20	5	5	5	5	10	5	5	10	10	5	10

*only available to affordable housing projects funded by DPD's Housing Bureau

Planned Development Projects (PD) - New Construction	100 points required
TIF Funded Development Projects (TIF) - New Construction*	100 points required
DPD Housing, Multi-family (>5 units) Projects (DPD-H MF) - New Construction	100 points required
PD, TIF, DPD-H MF and Class L - Renovation Projects*	
Moderate Renovation Projects	25 points required
Substantial Renovation Projects	50 points required

HDR Campus Net Zero Tool

HDR :: CAMPUS NET-ZERO ENERGY AND WATER TOOL :: Little Village Project (Chicago, IL) 01/06/2022 © H

Location Summary	Parameter
Campus Location (Zip Code)	60623
City, State	Chicago, IL
County	Cook
Weather File	CHICAGO MIDWAY AP
Annual Average Temperature (deg F)	52.5
Annual Rainfall (inches)	39.1
Soil Permeability (in/hr)	0.315
Ground Conductivity	TBD

Land Summary	Area (acres)
Total Campus Area	32

Annual Campus Energy Summary	Energy (kBTU)
Gross Total Campus Energy Usage (kBTU)	246,094,680
Net Total Campus Grid Energy (kBTU)	(1,562,531)
Area-Weighted Bldgs Energy Use Intensity	**EUI (kBTU/gsf/yr)**
All Buildings	168.0
All Buildings (except Greenhouse)	168.0

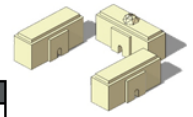
Annual Campus Greenhouse Gas Emissions Summary	CO2e (Metric Tons)
Net Campus GHG CO2e (Metric Tons)	614

Annual Campus Water Usage Summary	Water (Gal/yr)
Gross Campus Water Usage (Gal/yr)	44,788,254
Net Campus Potable Water Usage (Gal/yr)	6,951,216
Municipal Sewer/Wastewater Collection (Gal/yr)	17,458,552
Municipal Stormwater Collection (Gal/yr)	0

Annual Campus Utility Cost Summary	Annual Utility Cost ($)
Gross Campus Utility Cost ($/yr)	$4,261,124
Campus Renewable Energy Offset	($2,884,232)
Net Campus Utility Cost ($/yr)	$1,376,892

Renewable Energy Summary	Parameter
Solar Factor (kWh/1-kW-DC)	1,280
Photovoltaic Array Size (# panels)	172,310

Measure Analysis Selections	
User Spaces Measures	
Fixture Greywater Collection	Yes
Building Rainwater Collection	Yes
Input Resource Measures	
Solar PV Greenhouse	No
Renewable Power System	Yes
Output Resource Measures	
Bio-Digester	Yes
Wastewater Processer	Yes
Stormwater Infiltration Basin	Yes
New Construction Measures	
New Construction (input data on 'Measures' tab)	Yes

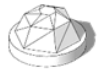


Hospital/Healthcare
Inpatient health care

EUI (kBTU/sf/yr)	237.4	237.4
WUI (Gal/sf/yr)	47.0	47.0
Area (sf)	666,744	
# Floors	10	

Mixed Use
Public assembly

EUI (kBTU/sf/yr)	135.0	135.0
WUI (Gal/sf/yr)	28.6	28.6
Area (sf)	201,327	
# Floors	4	

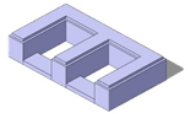


Retail
Retail other than mall

EUI (kBTU/sf/yr)	98.4	98.4
WUI (Gal/sf/yr)	12.4	12.4
Area (sf)	239,352	
# Floors	1	

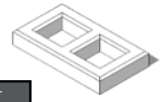
Compost Bio-Digester

Pounds/Day	1,969	input: compost
kWh/Day	146	input: macerator power
Gal/Day	208.54	output: liquid fertilizer
kWh/Day	1,400	generation: gross electric power
kWh/Day	1,254	generation: net electric power



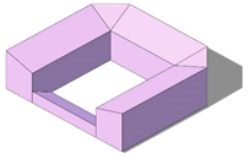
School/Daycare
Education

EUI (kBTU/sf/yr)	75.8	75.8
WUI (Gal/sf/yr)	10.0	10.0
Area (sf)	219,223	
# Floors	2	



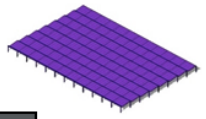
Wastewater Processor

Gal/Day	47,832	input: wastewater
kWh/Day	4,432	input: compressor power
Pounds/Day	17,573	output: dry solids used for soil amendments
Gal/Day	268	output: ammonia fertilizer
Gal/Day	47,301	output: reclaimed water



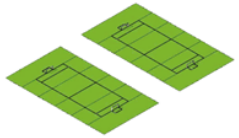
Fitness Center
Public assembly

EUI (kBTU/sf/yr)	135.0	135.0
WUI (Gal/sf/yr)	28.6	28.6
Area (sf)	81,858	
# Floors	2	



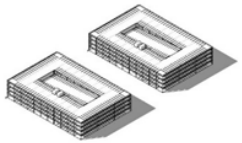
Solar Renewable Energy

Array Area (sf)	7,344,804
Array Area (acre)	168.6
Generation (kWh)	72,105,810
Array Size (kW DC)	56,345



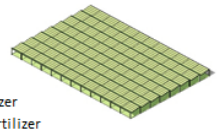
Irrigated Landscapes

EUI (kBTU/sf/yr)	0.1
WUI (Gal/sf/yr)	1.9
Area (sf)	100,000
Impervious Area (sf)	0
Pervious Area (sf)	100,000



Parking Lots/Garages

EUI (kBTU/sf/yr)	5.0
Area (sf)	775,750
# Floors	4
Impervious Footprint Area (sf)	775,750
Pervious Footprint Area (sf)	0
Footprint (sf)	193,938

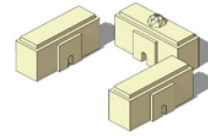


Solar PV Greenhouse

EUI (kBTU/sf/yr)	0.0	
WUI (Gal/sf/yr)	0.0	
Area (sf)	0	
Gal/Day	208.54	input: liquid fertilizer
Gal/Day	268	input: ammonia fertilizer
Pounds/Day	17,573	input: dry solids used for soil amendments
Gal/Day	47,301	input: reclaimed water
kWh/Day	1,254	input: Bio-Digester Generated Energy
lbs/year	0	output: fresh produce yield

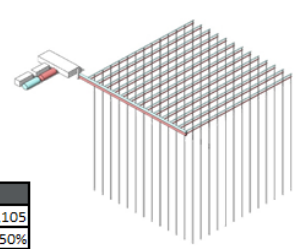
Stormwater Detention

Area (acre)	19.9
Gallons	4,085,403



New Construction

EUI (kBTU/sf/yr)	0.0
WUI (Gal/sf/yr)	0.0
Area (sf)	0
# Floors	0



GSHX Field

Campus Cooling Capacity (tons)	13,105
GSHX Balance Point (% Total Cooling)	50%
GSHX Cooling Capacity (tons)	6,553
GSHX # Wells	1,966
GSHX Field Area (sf)	786,400

Potable Water Supply

Gal/Day	66,345

= sized based on use outputs
= sized on Bio-Digester and Wastewater Processor outputs
= sized based on use needs

Campus Considerations

- Need to limit carbon emissions
- Maximize thermal efficiency for the campus
- Efficiency needs suggest LTHW and CHW
- Incorporate solar if feasible

Central Plant Considerations

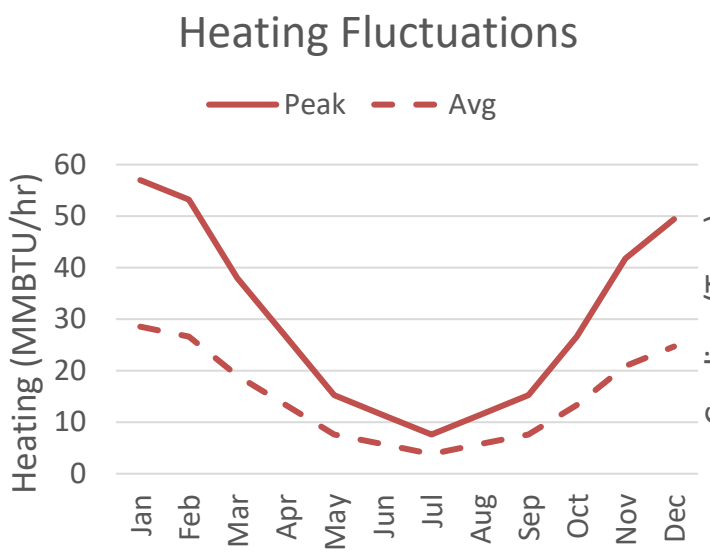
- Limited floor space used for energy service
- Supply power resiliency for the hospital
- Limit emissions from all fuel sources

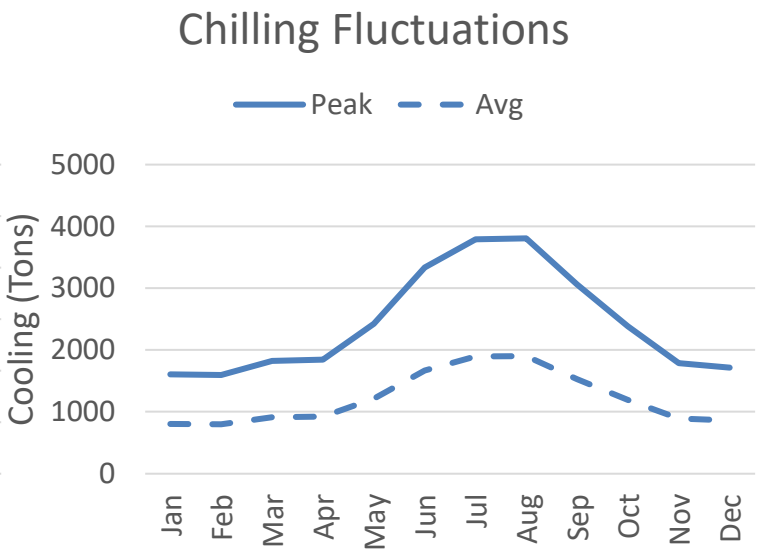
Building Side Consideration

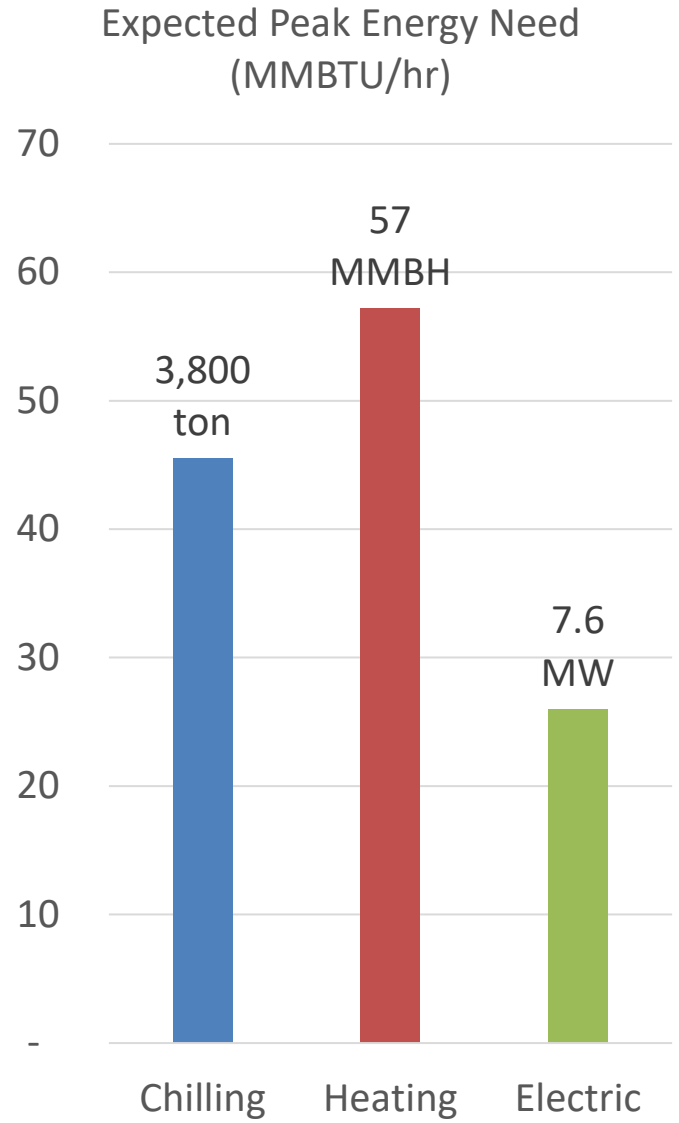
- Approximately 2.3 million GSF to serve
- Ability to interconnection building to district pipes
- Ability to serve loads with LTHW

Available Loads

- Load Service
  - 7.6 MW Peak Electric
  - 3,800 ton Peak Chilling Load
  - 57 MMBtu/hr Peak Heating Load
- Typical seasonal heating and cooling fluctuations





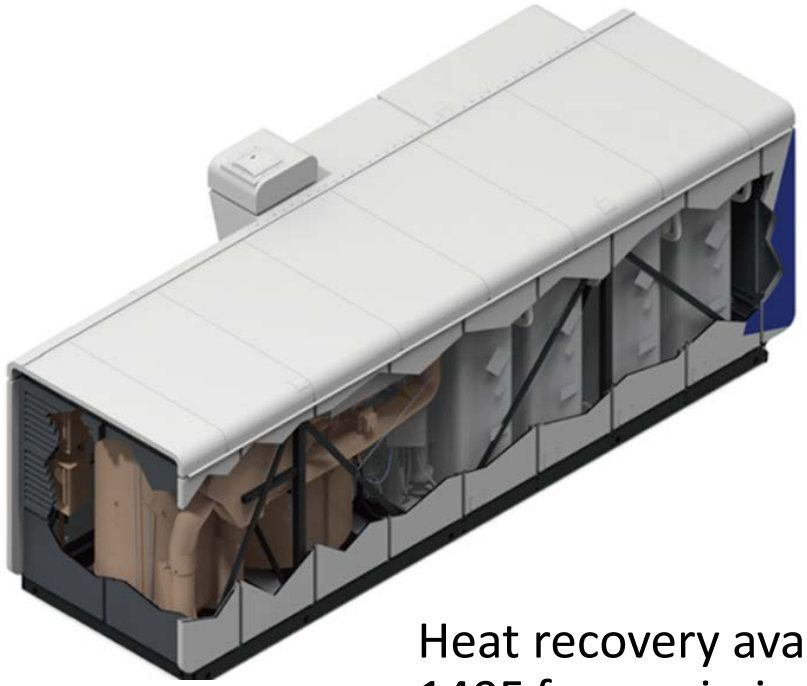


Solar Considerations

- 220,000 sqft of roof space
  - ~1-1.5MW of total installed DC capacity
- Potential for another 500 kW in the parking lot
- Max 2MW of solar vs 7.5MW of peak load
- Capacity factor for Chicago – 15% or less

Fuel Cell Considerations

- Can operate using Natural Gas
- 400kW in a 30’ by 10’ package
  - 11 containers for 5 MW



Units can be stacked to reduce overall footprint

- Each module needs airflow

Heat recovery available but temp limited to
140F for maximize useful heat recovery

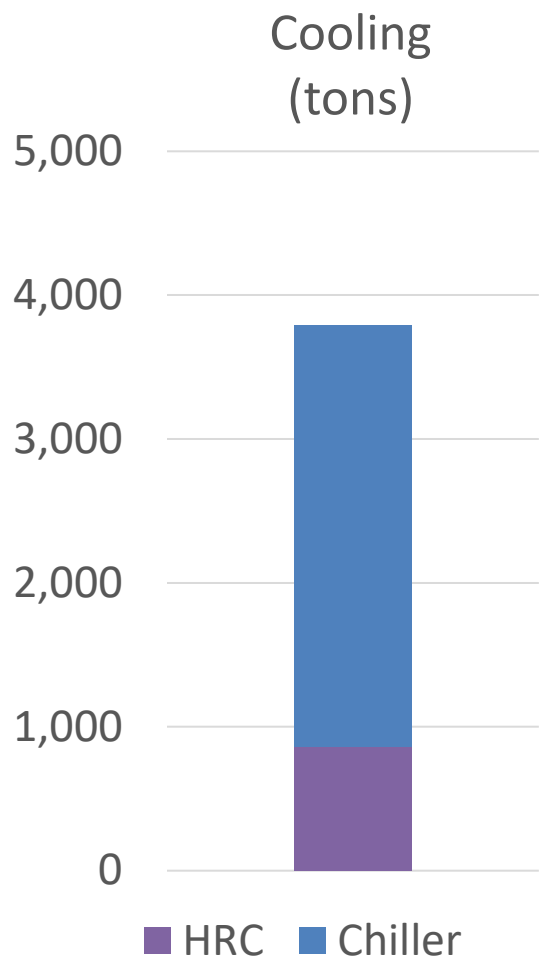
Supplemental Heating and Cooling

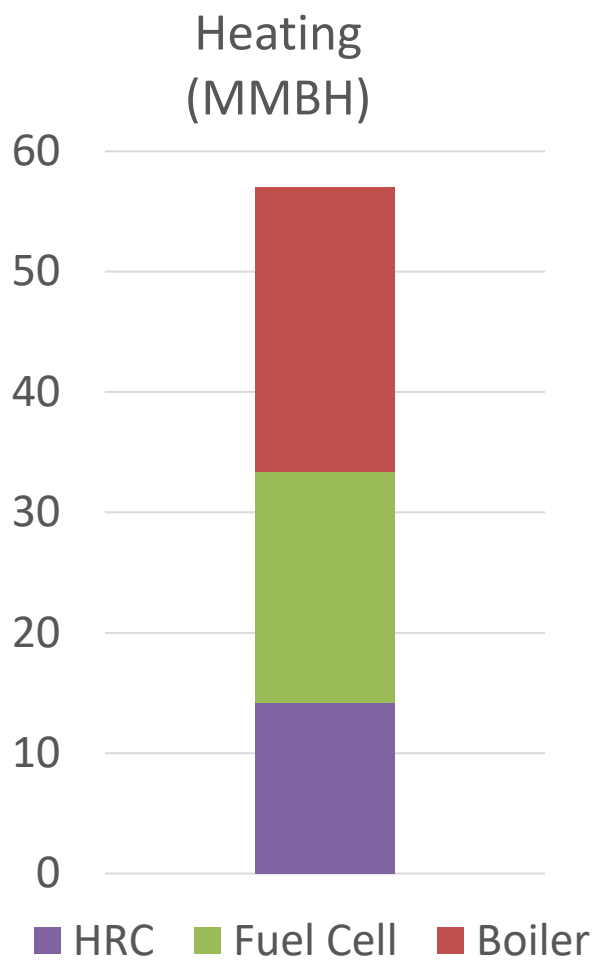
Heat Recovery Chillers

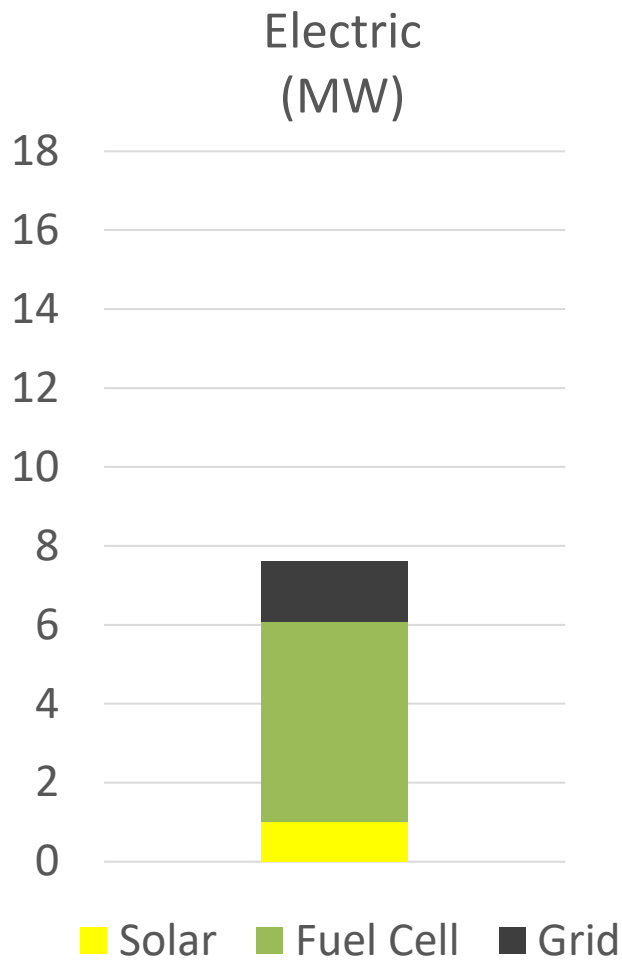
Centrifugal Chillers

Condensing Boilers

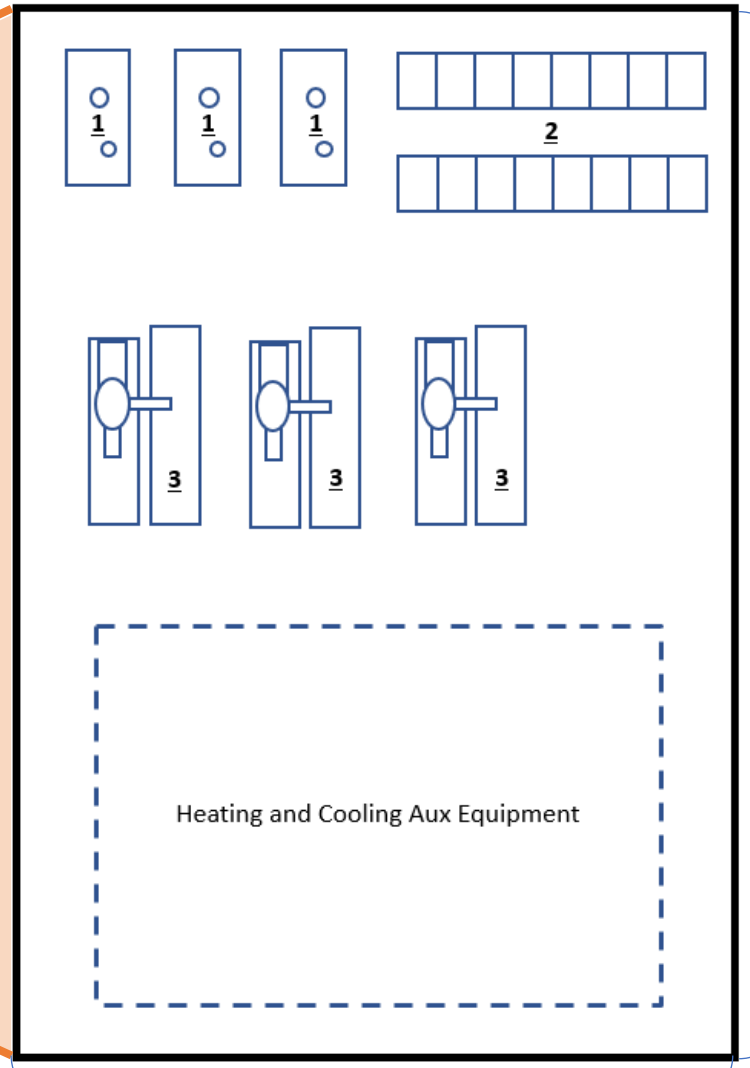
Installed Capacity







Plant Layout Considerations



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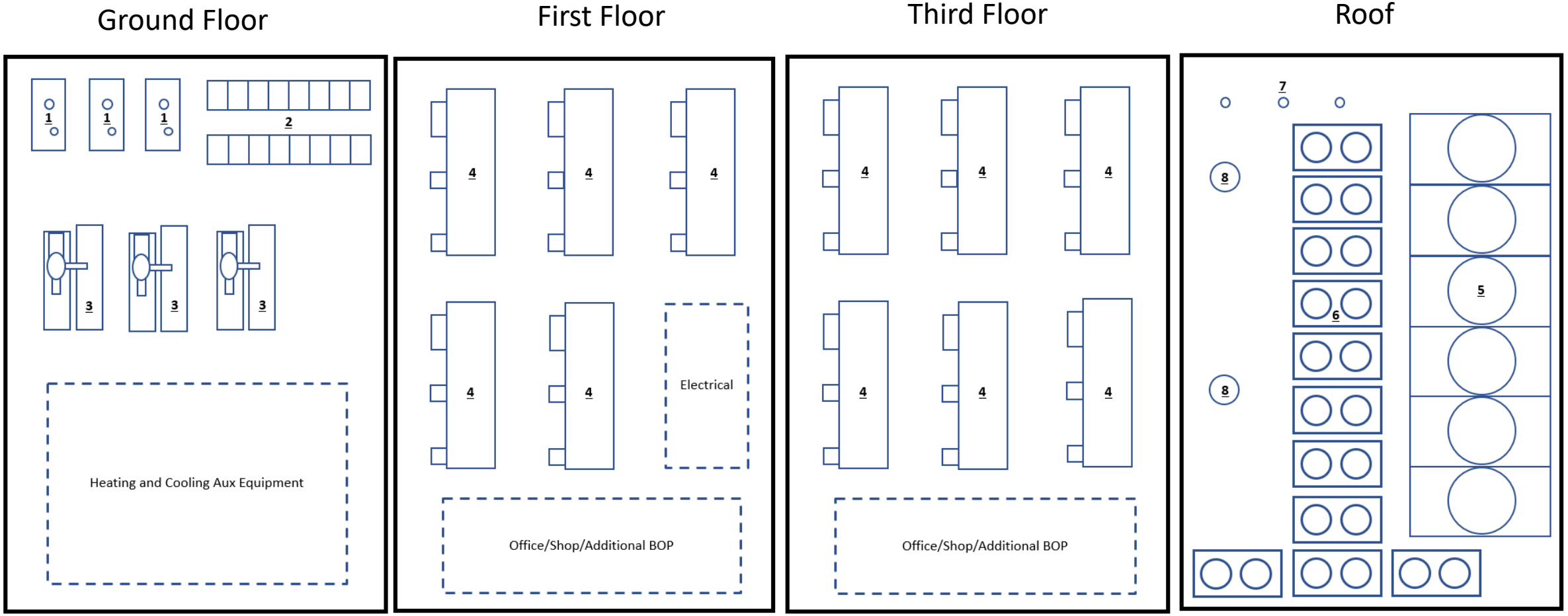

Qualitative Comparisons

Potential Advantages	Technology Considered	Potential Challenges
Green energy source	Rooftop Solar	Limited capacity can be installed
Potential for island operation	Central Generation	Addit. coordination and maintenance
HVAC energy savings	Thermal Distribution	Additional pipe network planning
Low emissions power source	Fuel Cells	High cost and footprint
Fuel use and carbon reduction	Heat Recovery Chillers	Needs coincident load
Efficiency gains in heating	Low Temp Hot Water	Can’t serve high temp user needs

Questions?

Thank You!

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