

June 13<sup>th</sup>, 2018

# UNION POINT

LOW CARBON TRANSITION STRATEGY

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# Introduction

- About the project
- Challenges
- Near term Strategy
- Long term Strategy
- Discussion





EXISTING AERIAL VIEW

ABX BOSTON 2017 | BOSTON'S NEW "SMART CITY" UNION POINT | NOVEMBER 9, 2017





An aerial photograph of the Boston area, showing the city's coastline and surrounding land. A yellow arrow points from the city center towards a small peninsula in the water. The word 'BOSTON' is written in white capital letters above the arrow, and 'UNION POINT' is written in white capital letters below the arrow. A yellow box with the text '12 MILES' is placed next to the arrow. The image is in grayscale, with the water appearing dark and the land appearing lighter.

**BOSTON**

**12 MILES**

**UNION POINT**



WEYMOUTH

ABINGTON

ROCKLAND



## THE NUMBERS



+4,000

residential units



10M SF

of opportunity



1,500

acres of land



1,000

acres of green space



50

mile trail system











NORTH GATEWAY

WEST GATEWAY

NORTH VILLAGE

WEST VILLAGE

DISCOVERY

DOWNTOWN

EAST GATEWAY

UPTOWN

UNION POINT DISTRICTS

ABX BOSTON 2017 | BOSTON'S NEW "SMART CITY": UNION POINT | NOVEMBER 8, 2017

## SMART CITY 1.0 TECHNOLOGY





SMART CITY 2.0  
SMART WITH HEART



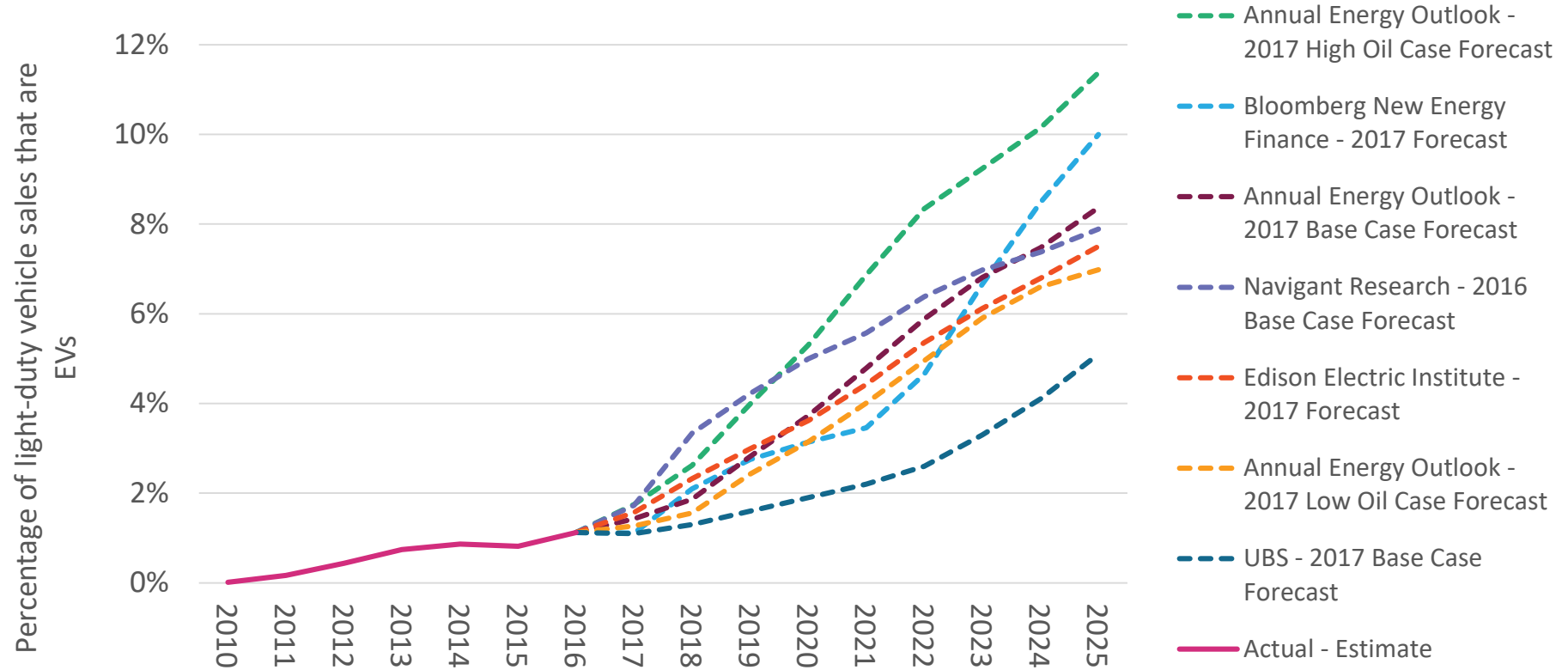
# TECHNOLOGY TO SERVE HUMANITY







# ELECTRIC VEHICLE ADOPTION

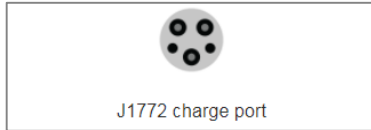




# TYPES OF CHARGERS



## AC LEVEL 1



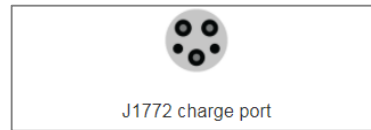
**120 V**

**1.4 – 2.0 kW**

**12 – 14 hrs per charge**



## AC LEVEL 2



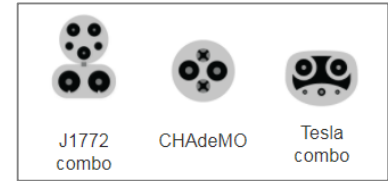
**240 V**

**3.3 – 7.7 kW**

**3 – 4 hrs per charge**



## DC FAST CHARGING



**250 – 450+ V**

**~50 kW, can be 90+ kW**

**80% charge in 30 min**

# CHARGING STRATEGY





# POTENTIAL GRID IMPACT

## Low Penetration

500 MWh

Monthly Energy

5 MW

Non-Coincident Peak

0.5 MW

Coincident Peak

## High Penetration

1,000 MWh

Monthly Energy

11 MW

Non-Coincident Peak

1.0 MW

Coincident Peak

# CLIMATE NOW

**69°F**

**Average Summer  
Temperature**

**11**

**Hot Days  
(over 90°F)**

**120**

**Cold Days  
(below 32°F)**

**5.25''**

**Rainfall per  
Storm**



# CLIMATE CHANGE (by 2050)



**76°F**

**Average Summer  
Temperature**

*Up to 7°F hotter*



**60**

**Hot Days  
(over 90°F)**



**68**

**Cold Days  
(below 32°F)**

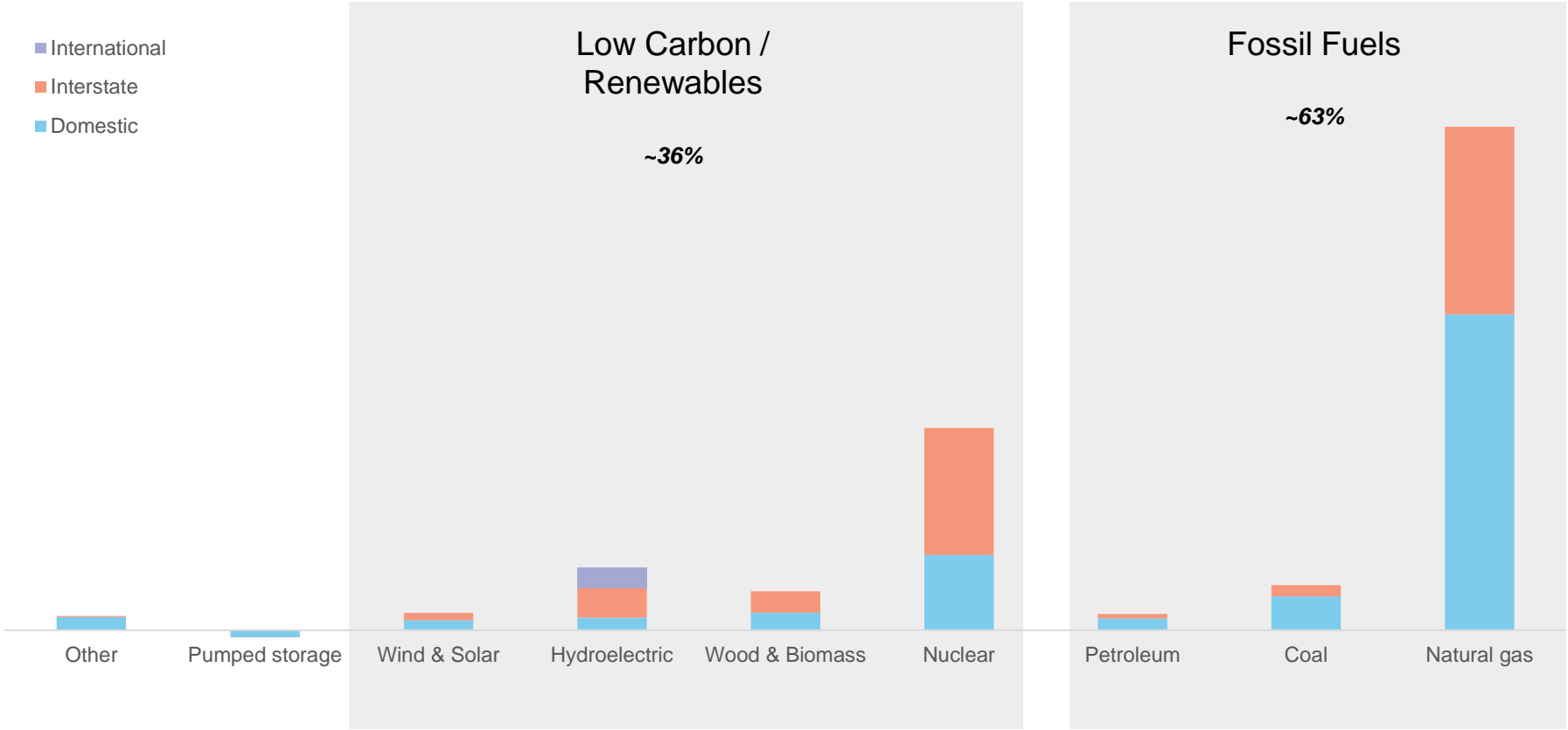


**6.00''**

**Rainfall per  
Storm**

*Up to 1'' increase*

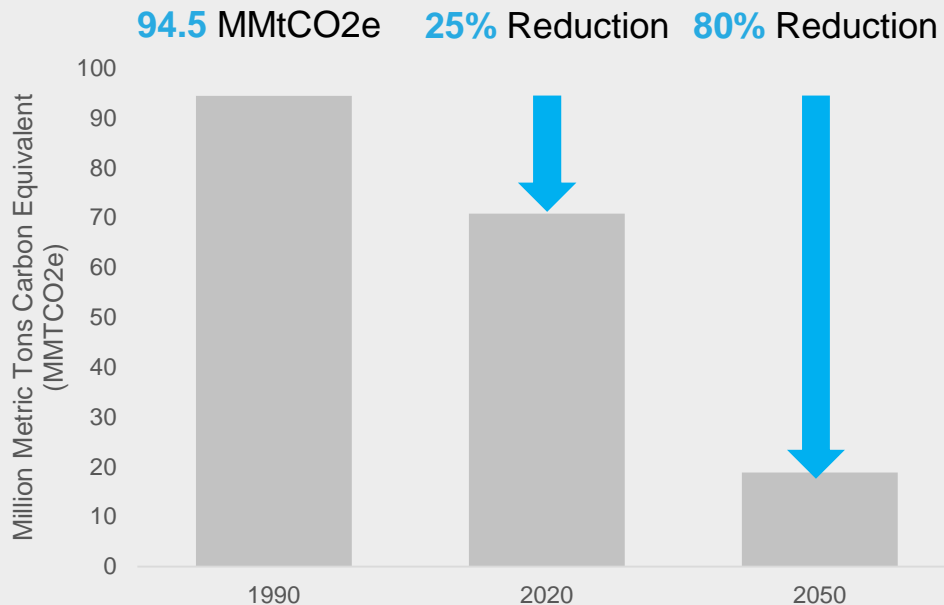
# M.A. GRID | CURRENT





# IN PLACE: Global Warming Solutions Act (2008) supported by EO (2016)

## Global Warming Solutions Act



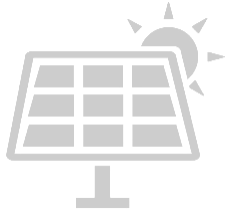
## State Executive Order 569

Signed into effect by Governor Charlie Baker September 2016

Proposed DEP rules to ensure MA meets Global Warming Solutions Act (2008) with particular focus on:

- Natural gas infrastructure
- Transportation
- Electricity generation
- Electricity sales

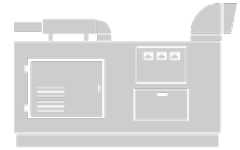
# 2020 ENERGY SUPPLY GOALS



**1600 MW** solar power installed  
**1465 MW** in January 2017



**200 MW** wind energy installed  
**115 MW** in January 2017



**5%** electricity from CHP and  
other alternative energy  
~**2%** at the end of 2015

# PROPOSED: 100 Percent Renewable Energy Act

## **Stage 1**

By 2035

Massachusetts must get all of its electricity from renewables such as wind and solar

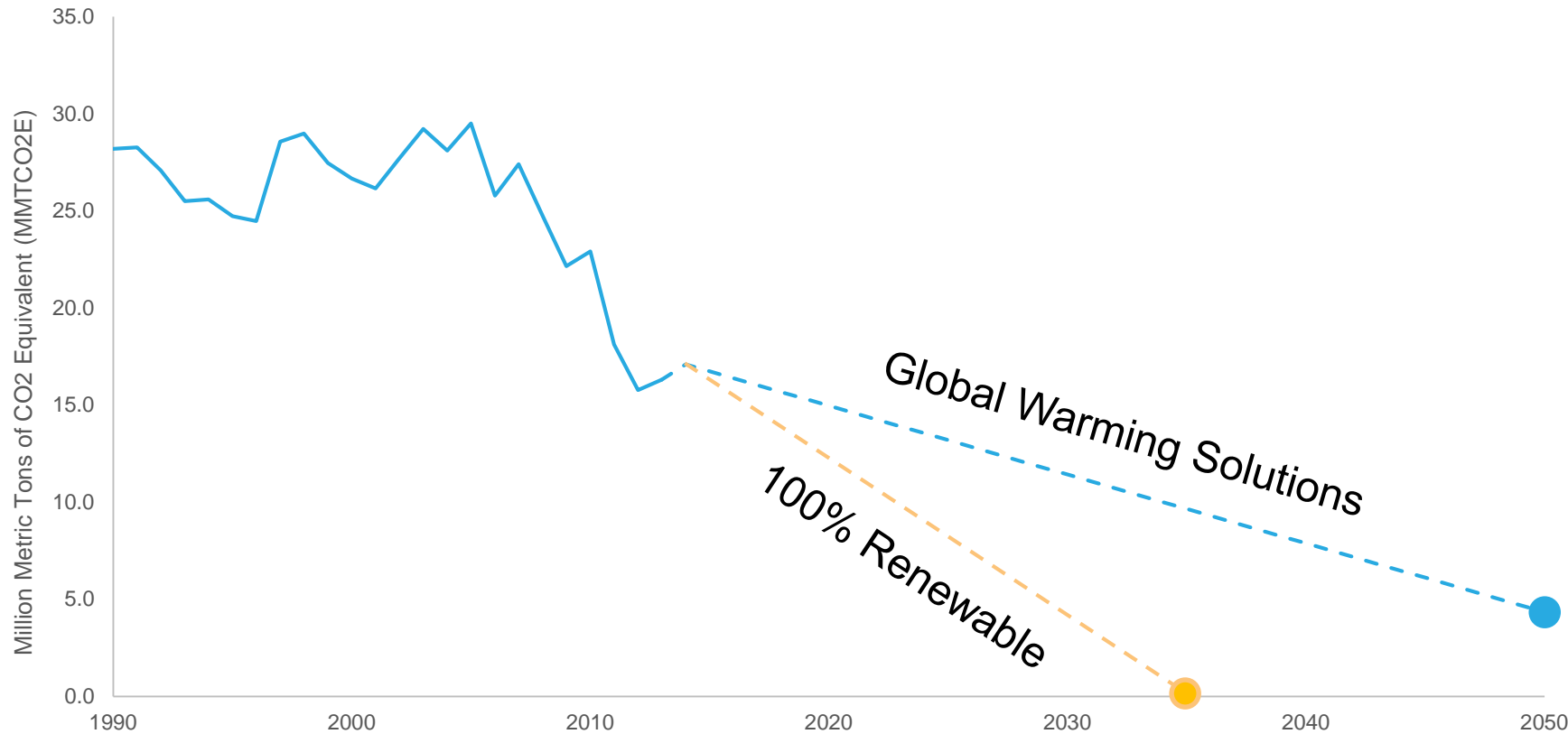
## **Stage 2**

By 2050

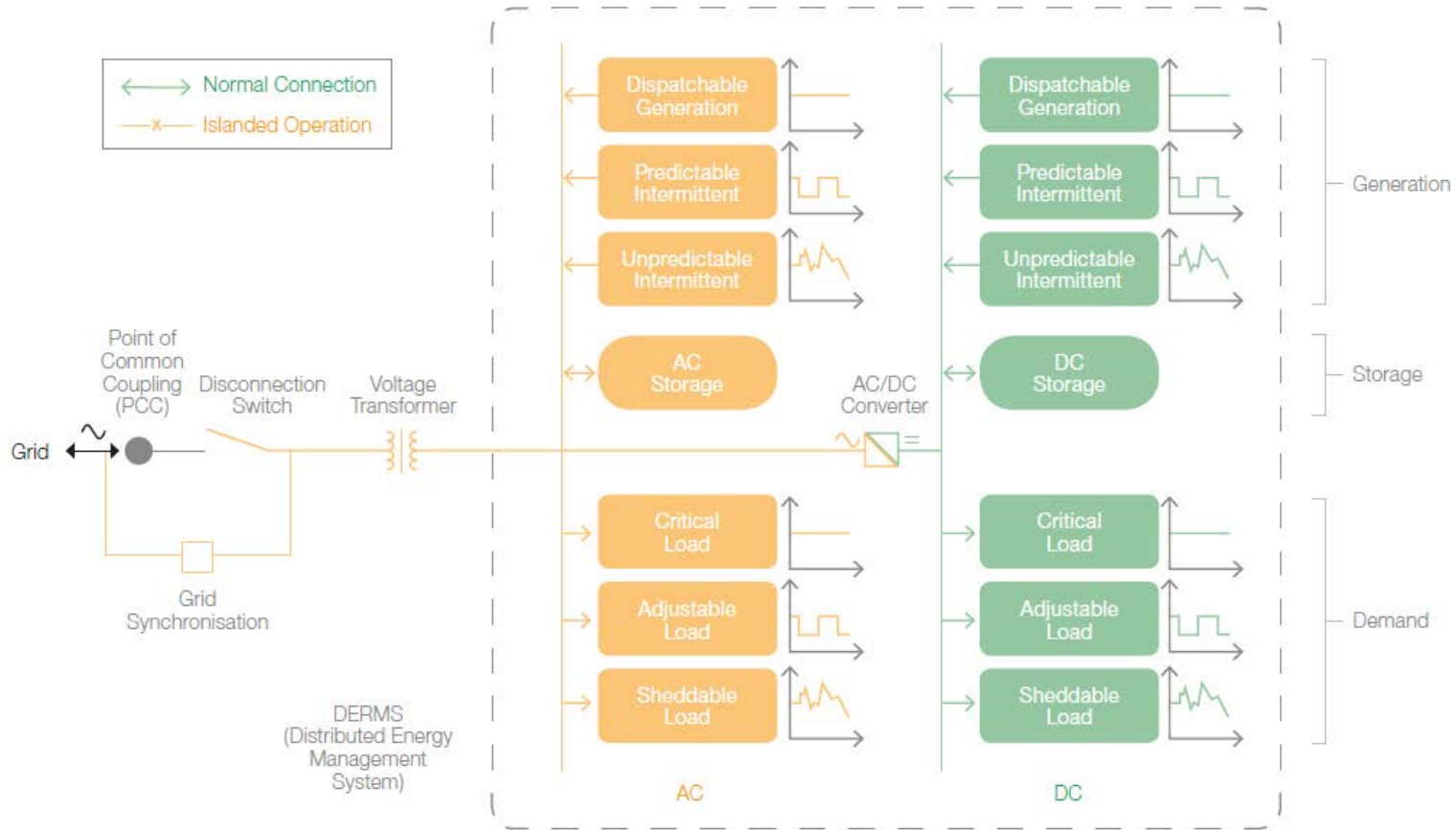
Eliminate the use of fossil fuels for heating, transportation, and other sectors



# EMISSIONS FROM ELECTRICITY CONSUMPTION

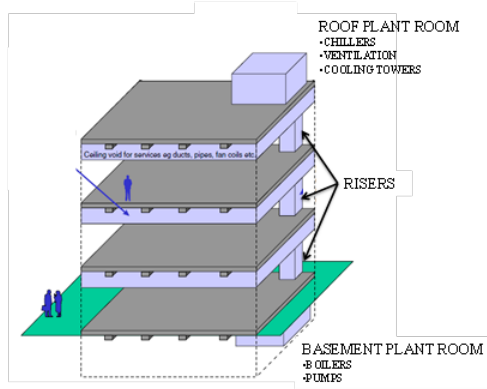


# I WANT A MICROGRID!



# BUILDING SYSTEMS v's DISTRICT SYSTEMS

## *Baseline* (Building by Building System)



Electricity Peak Demand

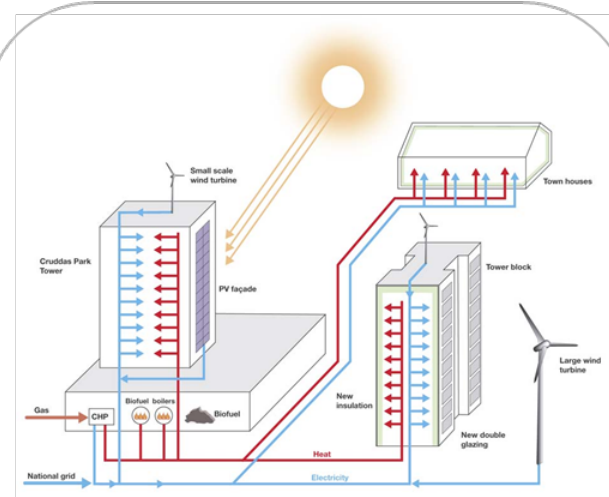
Electricity Annual Consumption

Gas Annual Consumption

Total Carbon

vs.

## *District System* (Cogen / Tri-Gen?)



Electricity Peak Demand

Electricity Annual Consumption

Gas Annual Consumption

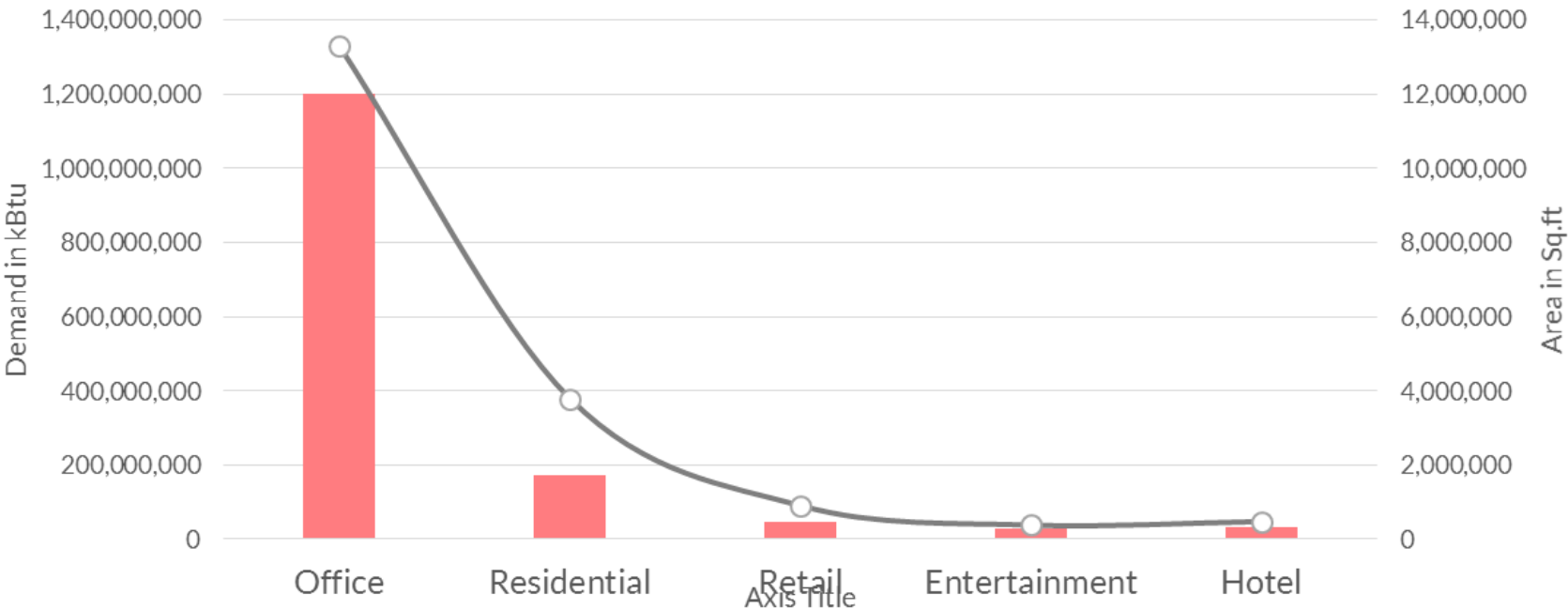
Total Carbon



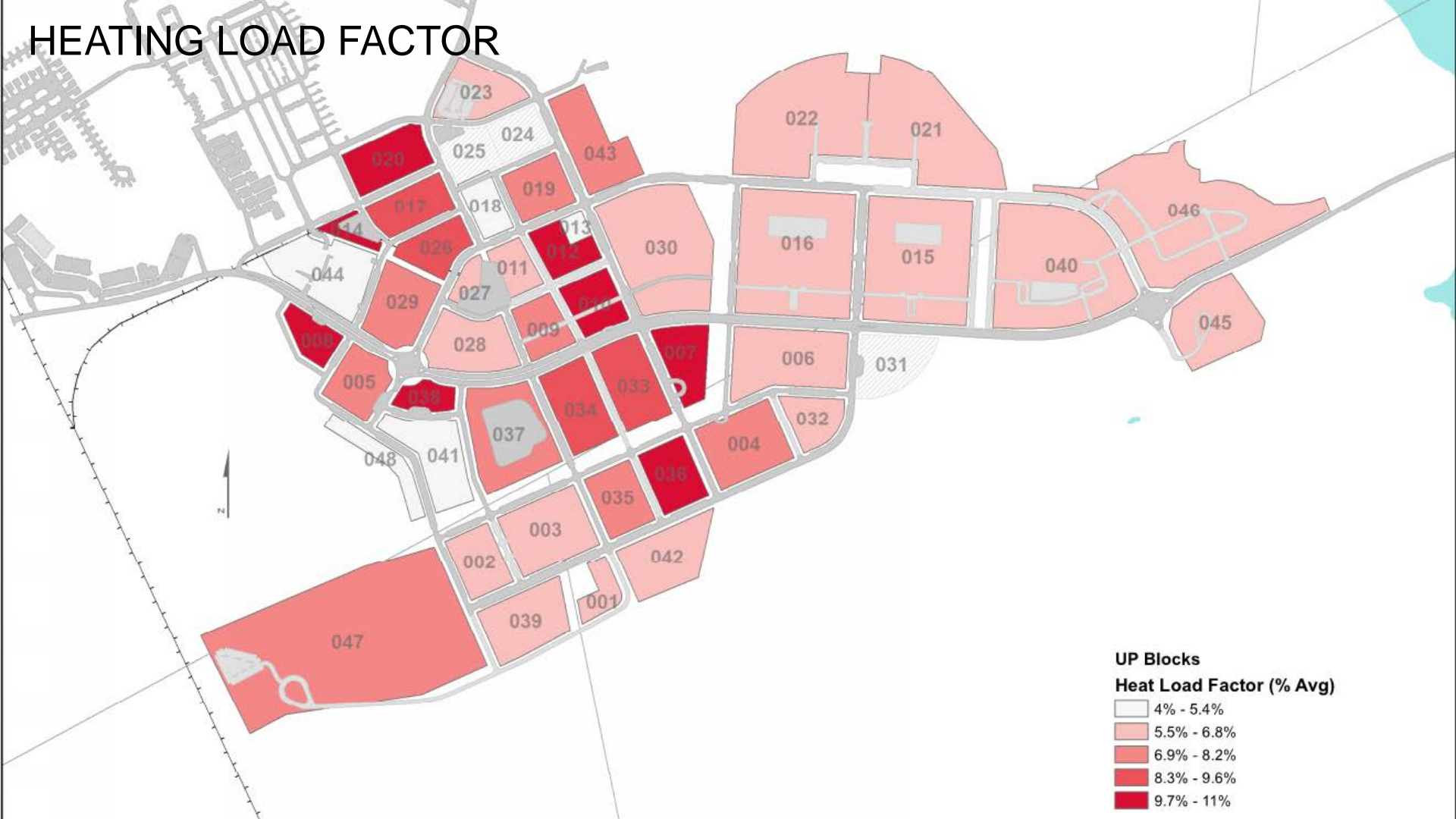
# SCENARIOS

Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Business As Usual (BAU)	Aggressive demand reductions	Aggressive demand reductions	Aggressive demand reductions	Very Aggressive demand reductions
	Thermal loops	Co-Gen/Tri-gen	Condenser loop	All Electric
	PV + Battery + Other	PV + Battery + Other	PV + Battery + Other	PV + Battery + Other

# SITE DEMAND BY LAND USE TYPE



# HEATING LOAD FACTOR



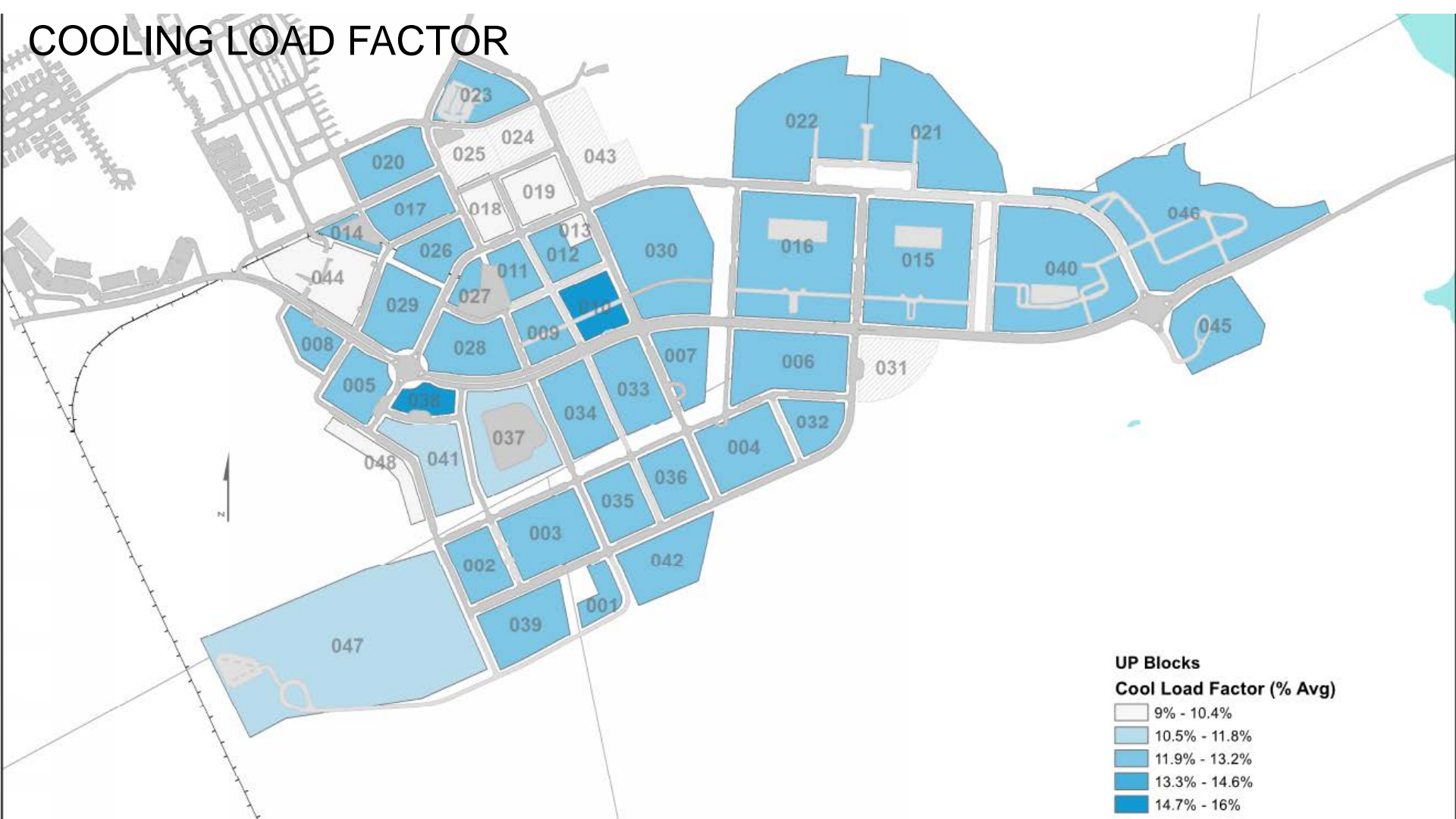
## UP Blocks

### Heat Load Factor (% Avg)

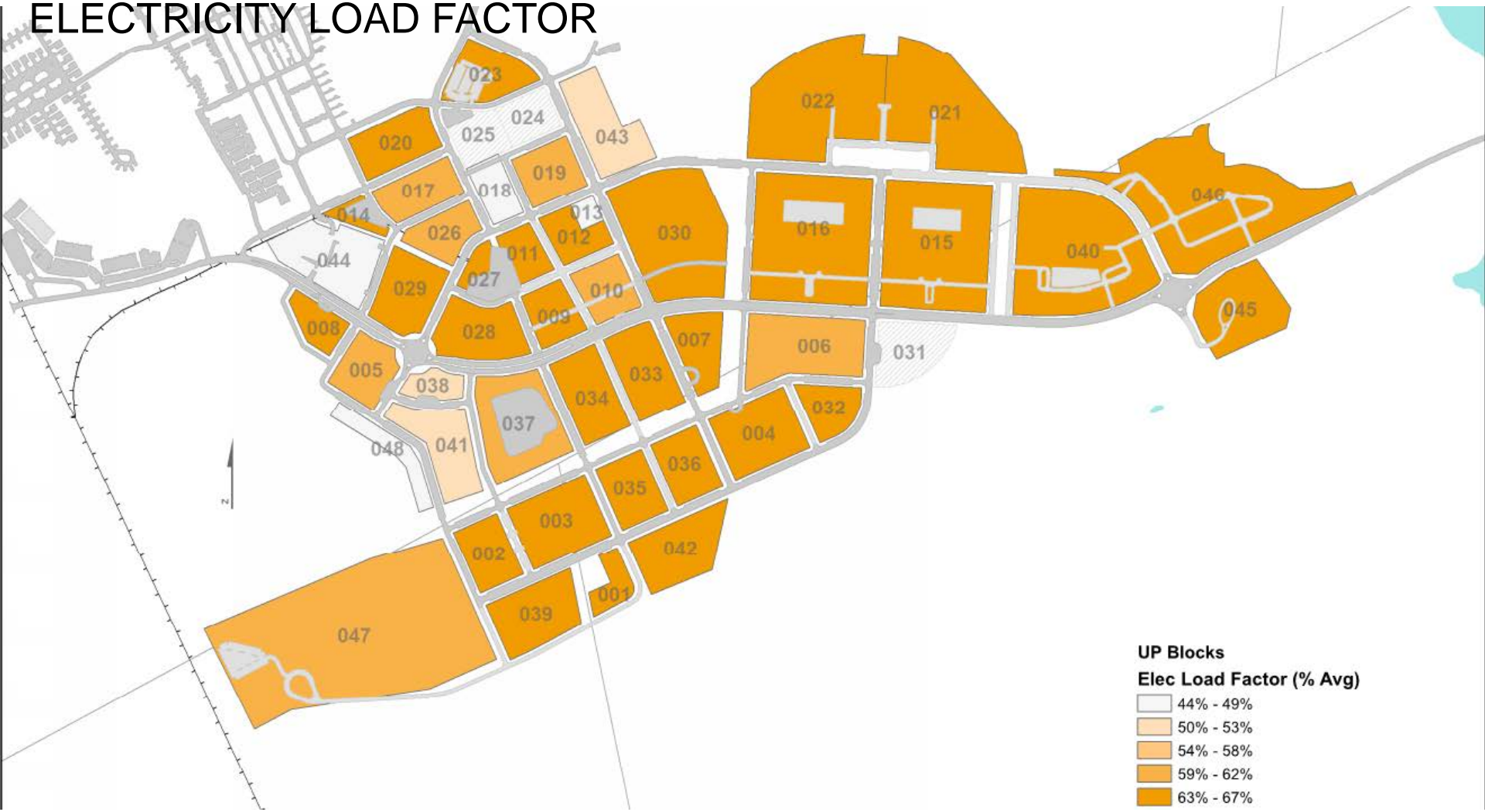




# COOLING LOAD FACTOR



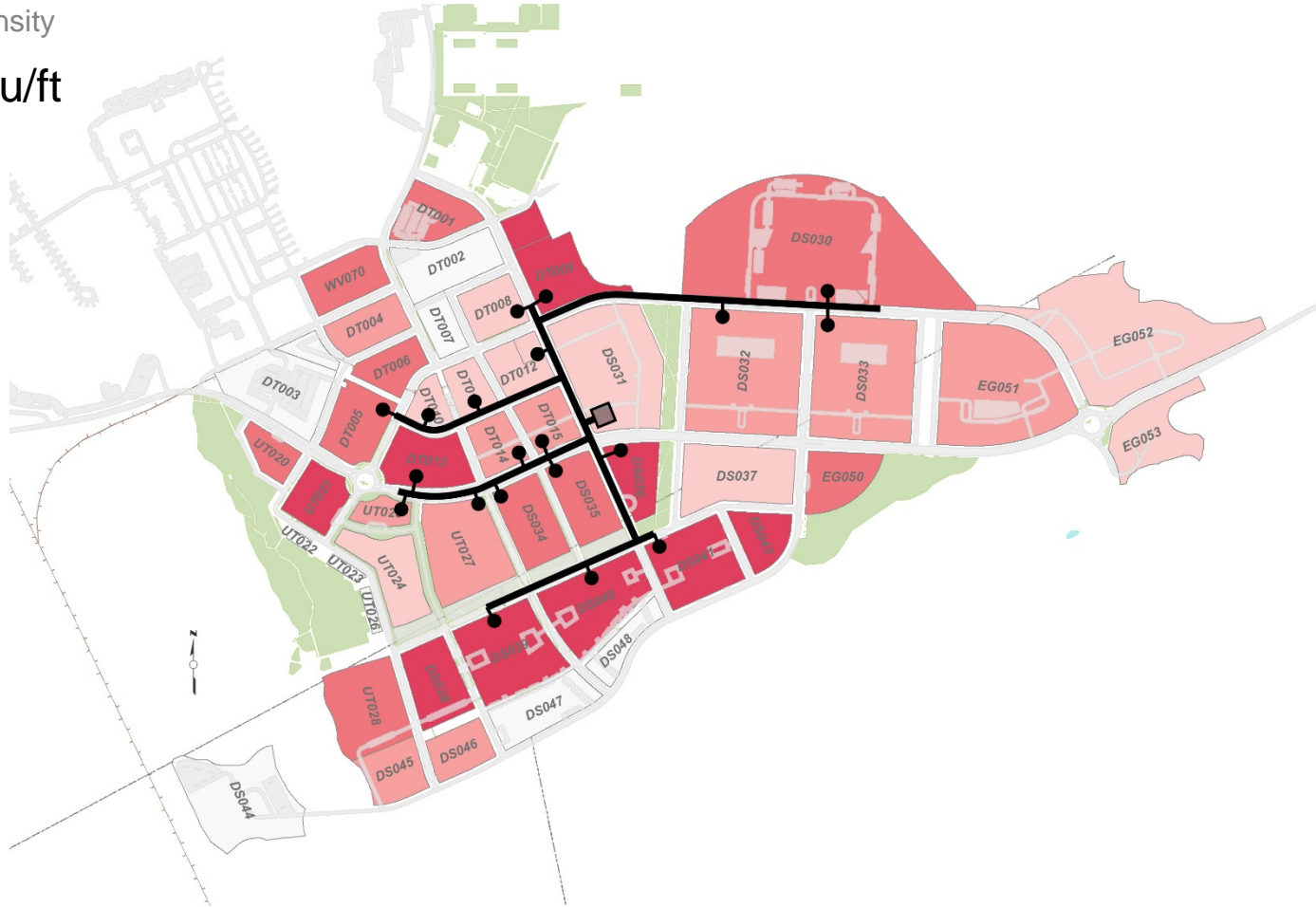
# ELECTRICITY LOAD FACTOR



# EXTENDED DISTRICT HEATING NETWORK

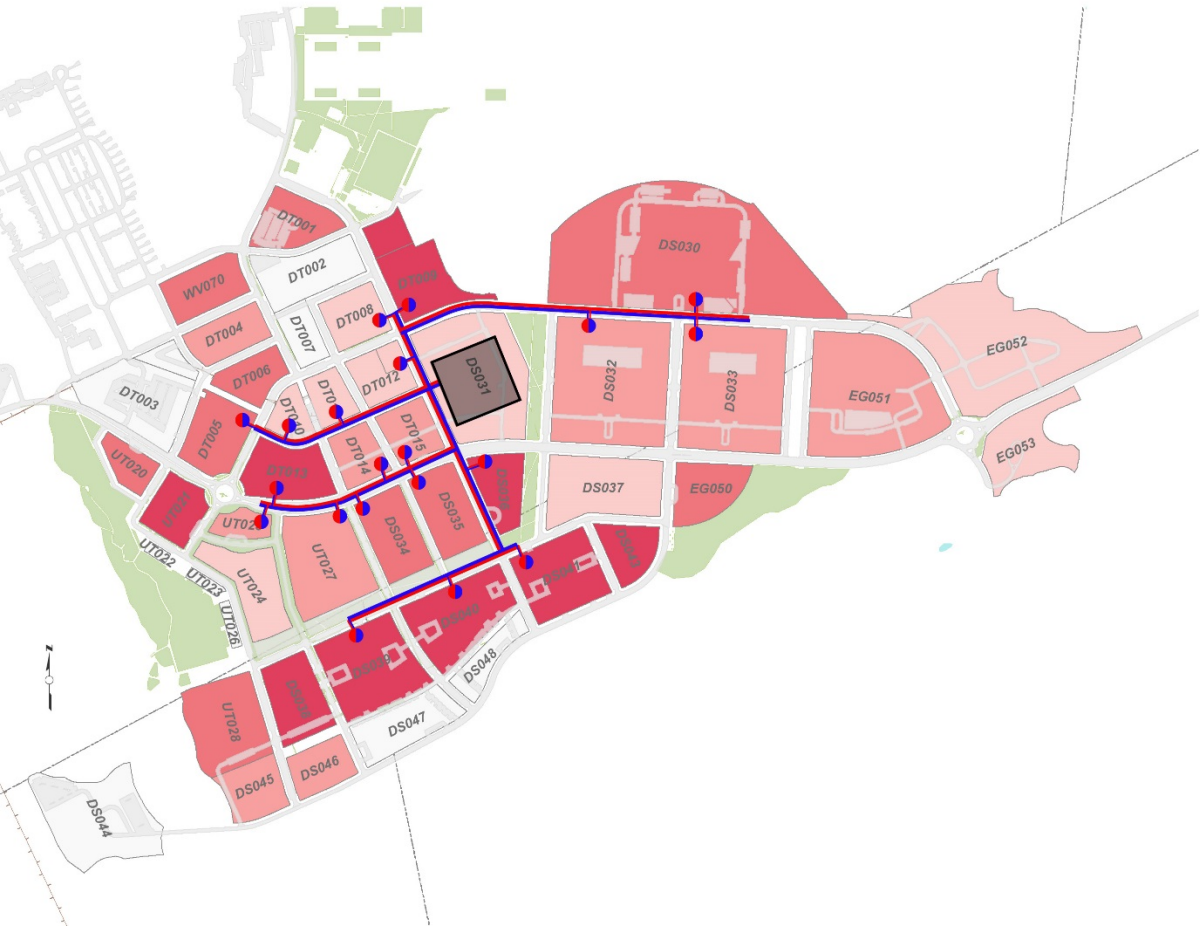
## Heat Load Density

3,942 kBtu/ft





# 4-PIPE HOT WATER & CHILLED WATER w/ heat recovery



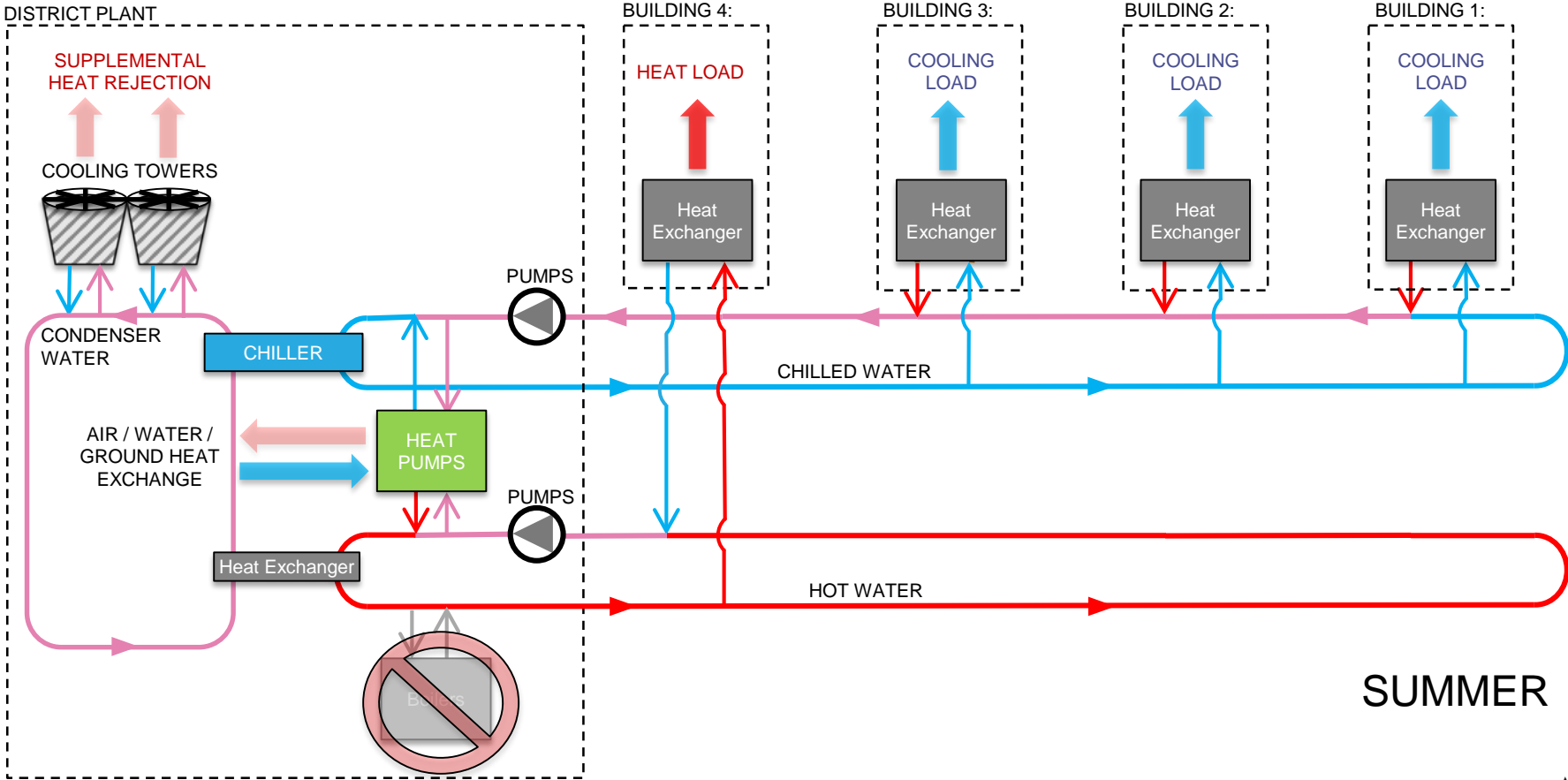
Trench length (ft)  
6,900  
(4-pipe network)

Pipe diameters (in)  
5 to 16    10 to 30

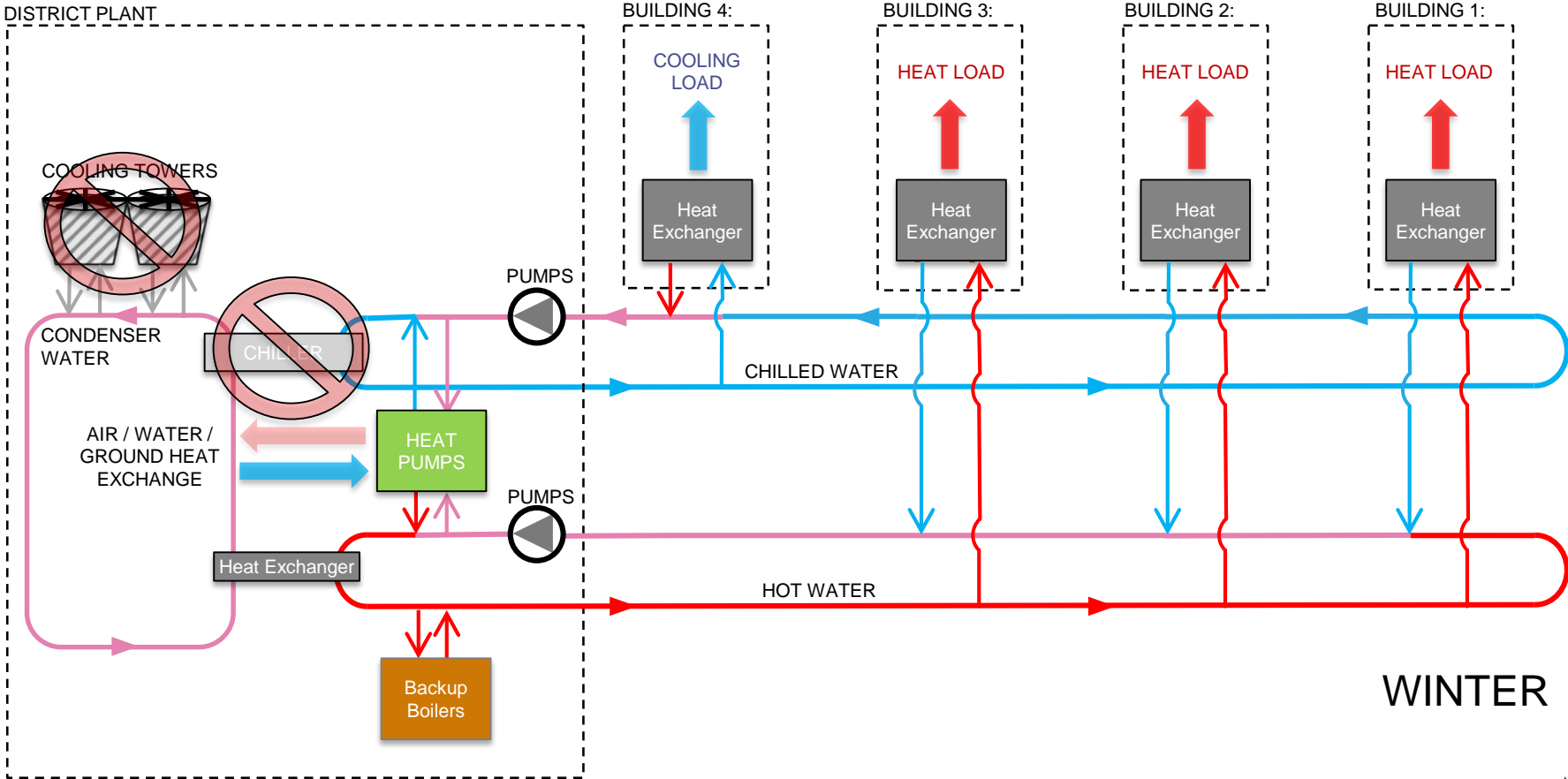
Plant Area (sq.ft)  
35,218

Supply Split (%)  
NGRID  
PV  
DE

# 4-PIPE HW & CHW WITH HEAT RECOVERY

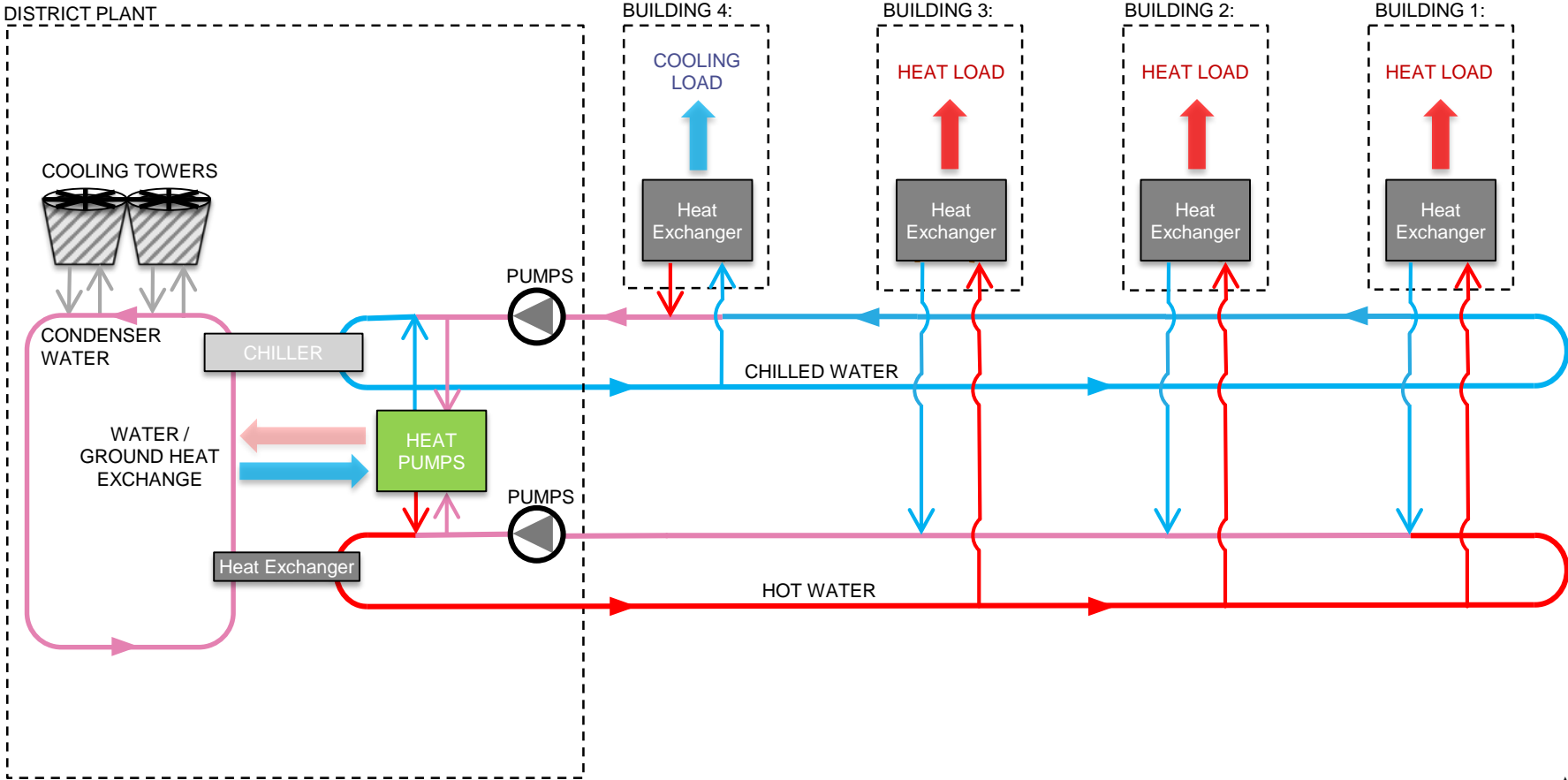


# 4-PIPE HW & CHW w HEAT RECOVERY



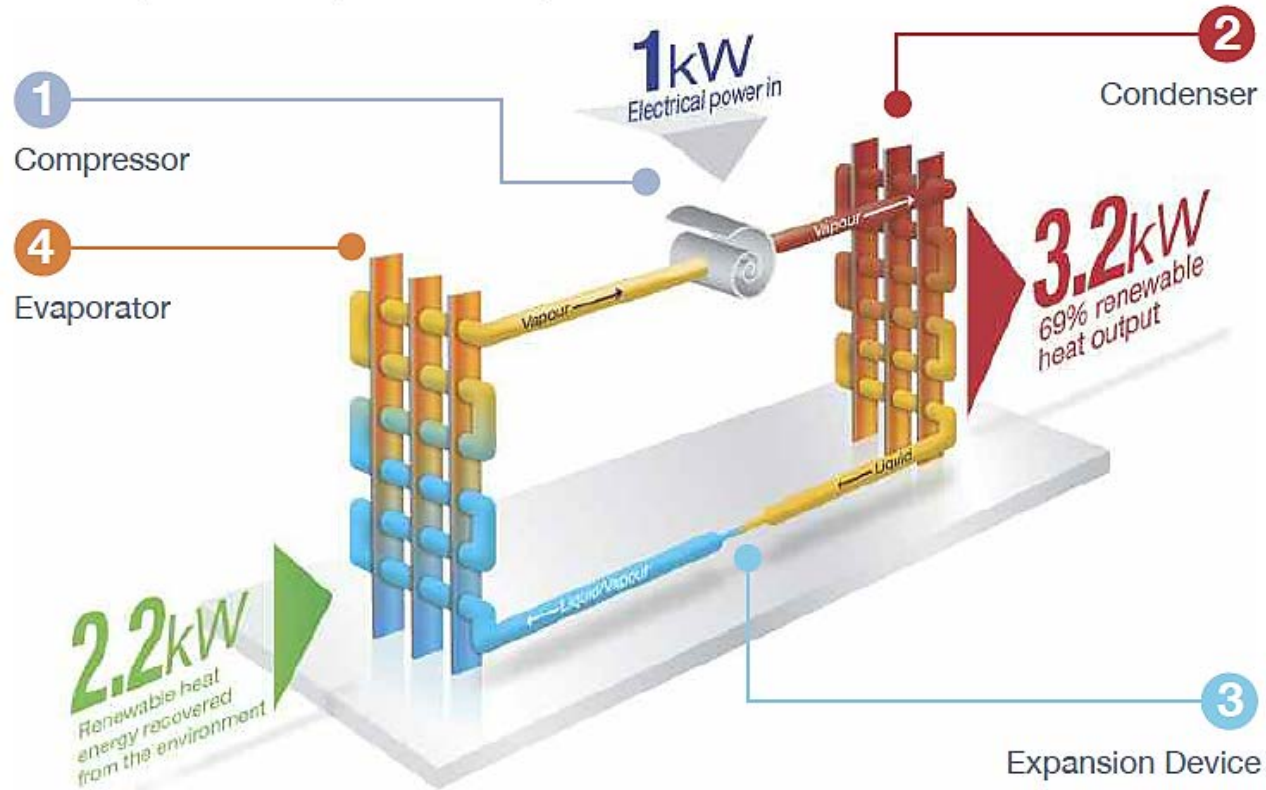


# 2C.1: 4-PIPE HW & CHW CENTRALIZED HEAT PUMP *ALL ELECTRIC*

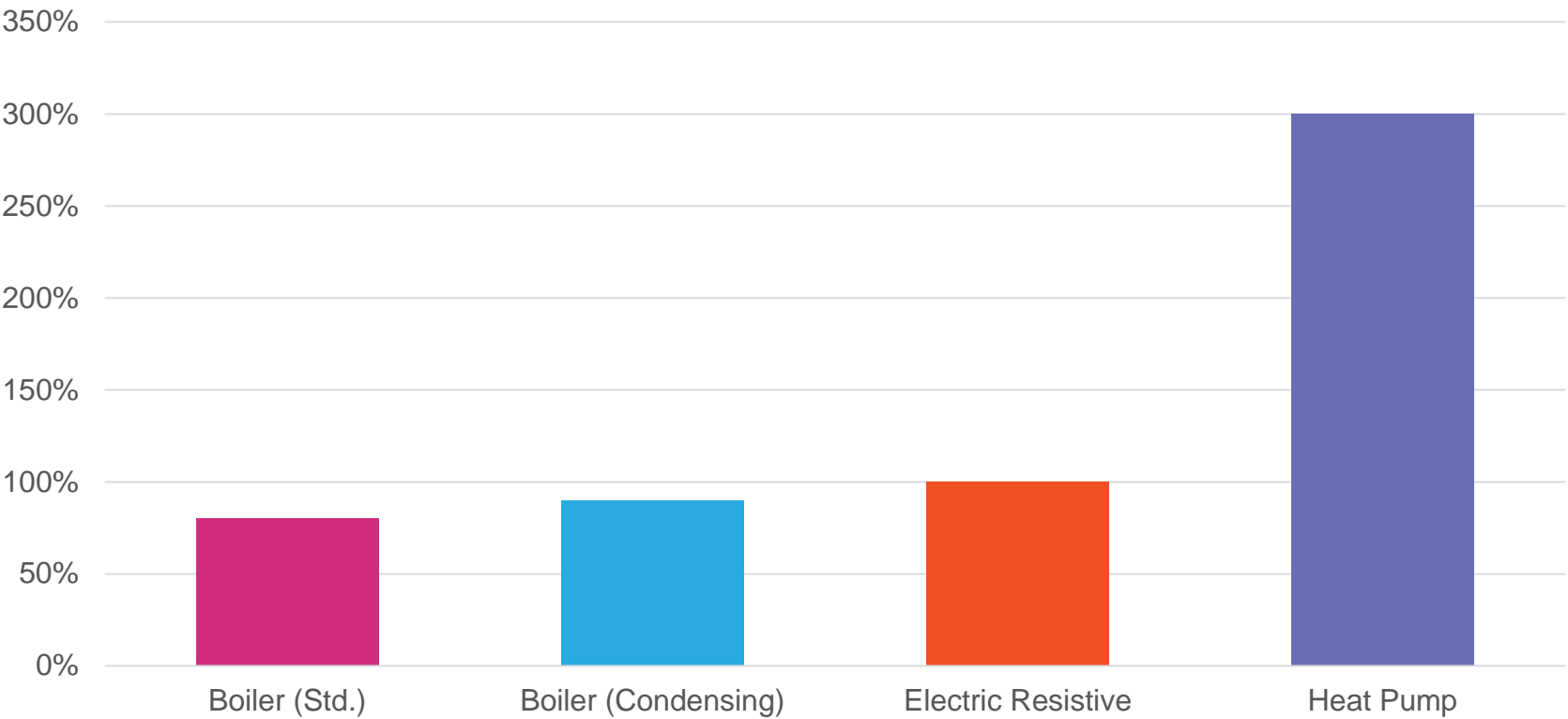


# HEAT PUMPS

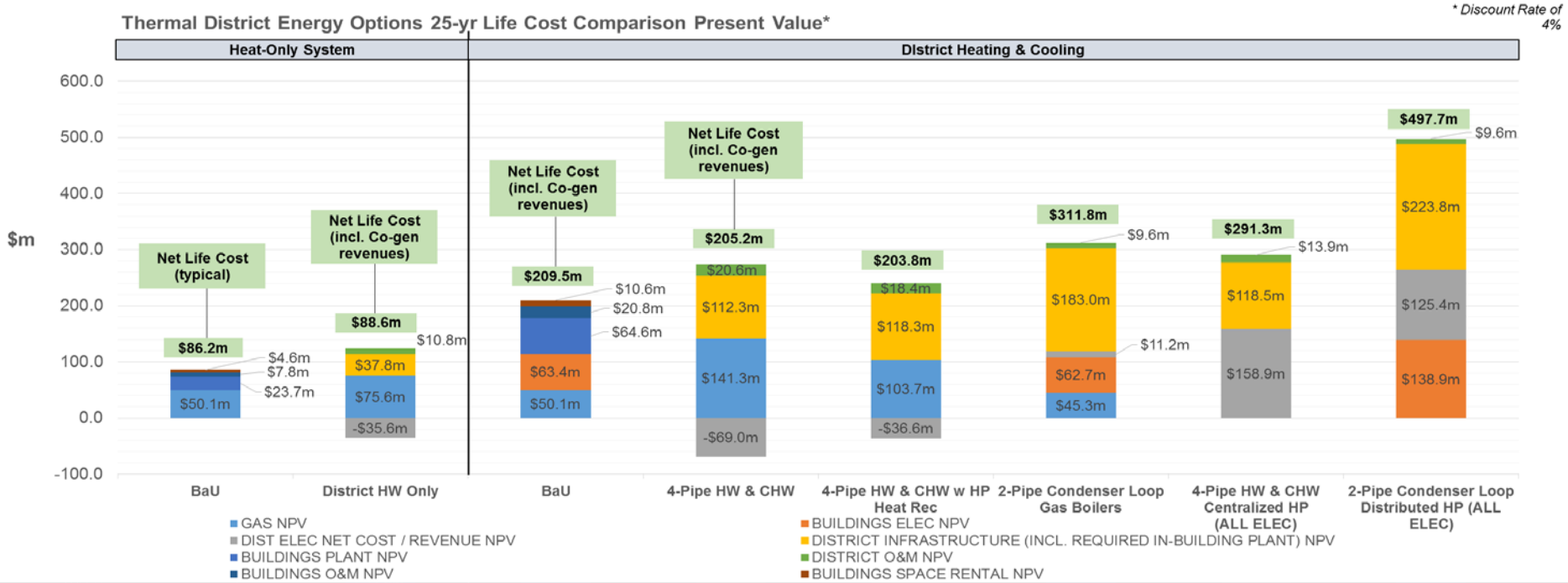
The Vapour Compression Cycle<sup>11</sup>:



# HEATING TECHNOLOGY EFFICIENCIES

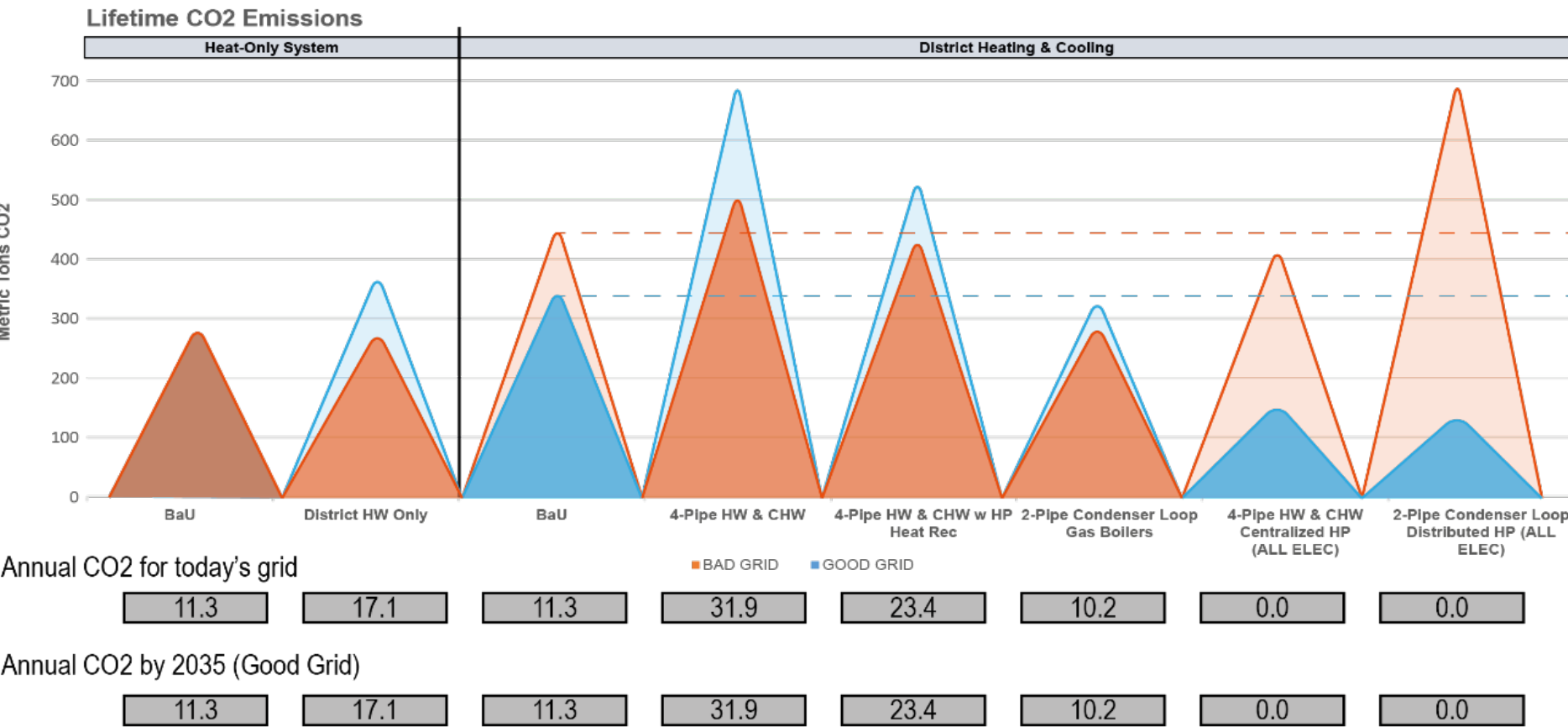


# OPTION COMARISON - COST

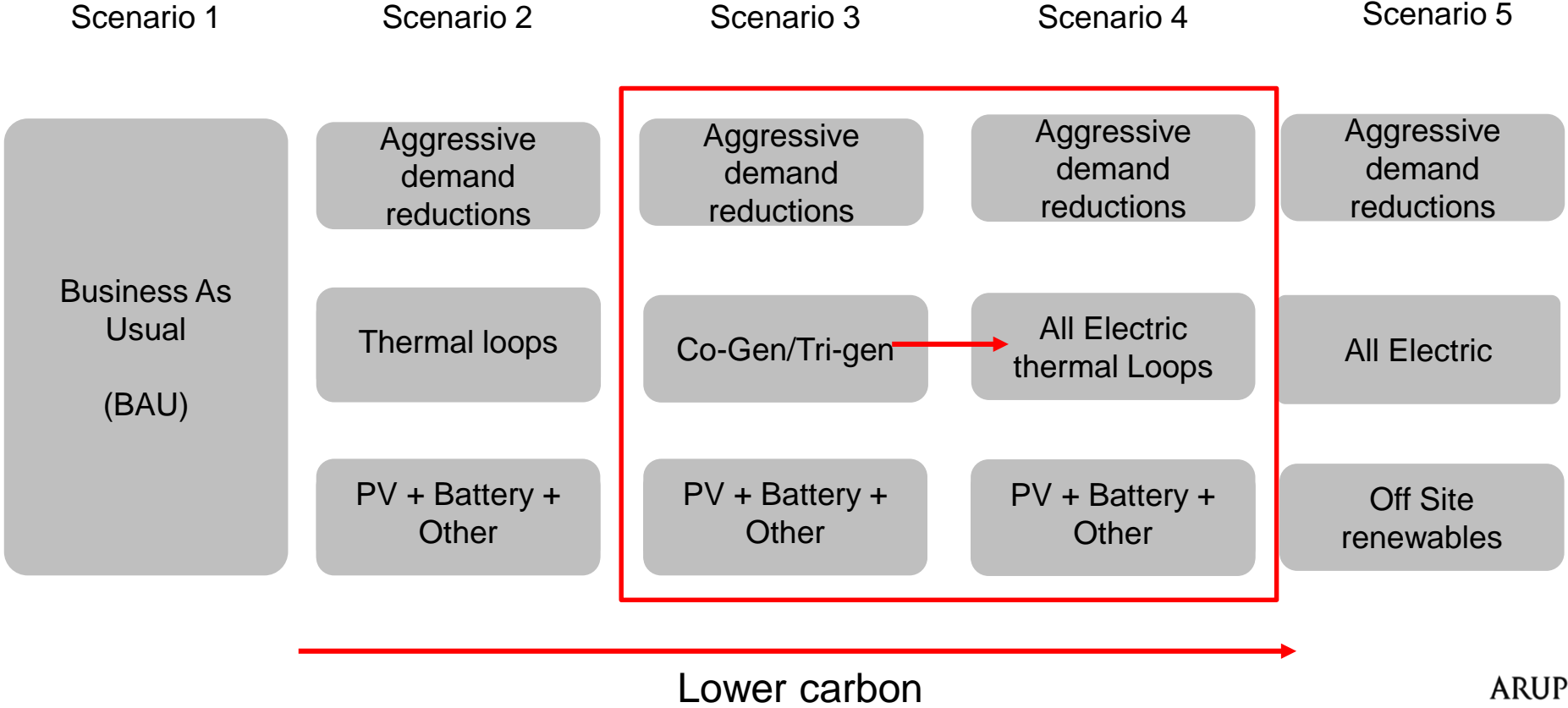




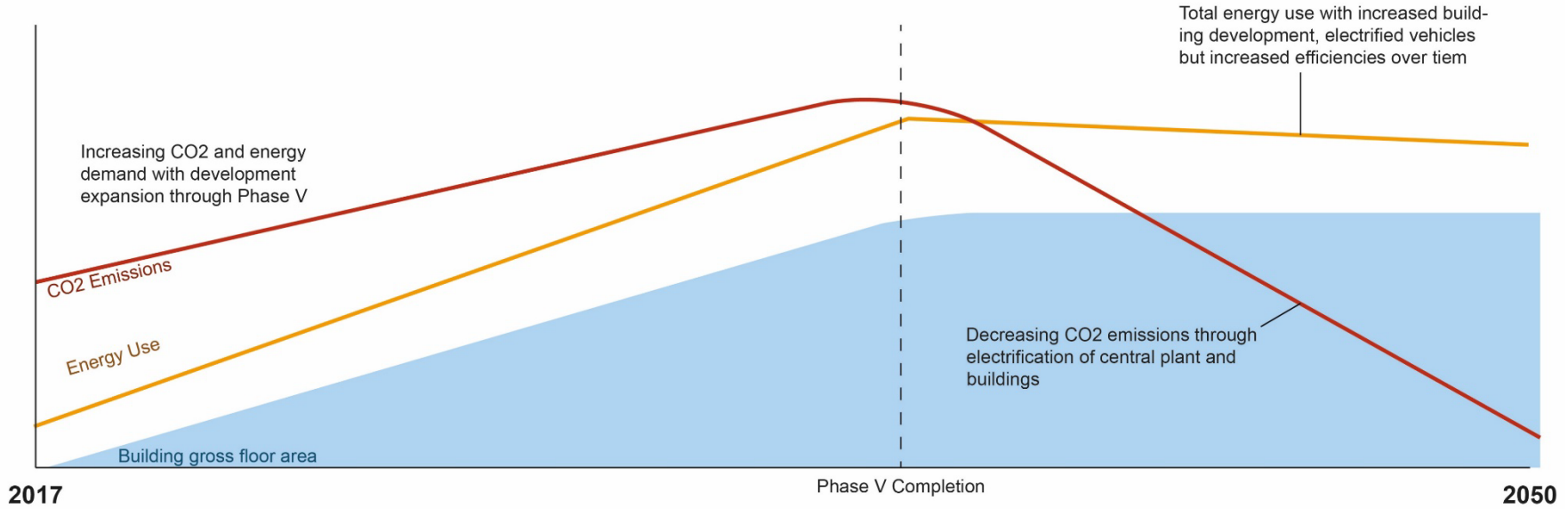
# OPTION COMPARISON - CARBON



# SCENARIOS



# TRANSITION TO ZERO CARBON



## DE System: CHP

*Natural gas fuelled*

4-Pipe hot and chilled water system

Centralized boilers and chillers  
Cogeneration/trigeneration  
Heat pump heat recovery

## Microgrid

Cogeneration from CHP plant  
Renewables  
Generators  
Grid connection

## DE System: All Electric

*Electrified utility grid*

4-Pipe hot and chilled water system  
Centralized heat pumps

## Microgrid

Renewables  
Grid connection

# HEAT PUMPS



## **Air**

Air Source Heat Pumps (ASHPs)  
Variable Refrigerant Flow (VRF)  
Variable Refrigerant Volume (VRV)  
Mini-Split  
DX



## **Water**

Water Source Heat Pumps (WSHPs)  
Ocean/Lake Cooling and Heating  
Wastewater Heat Recovery



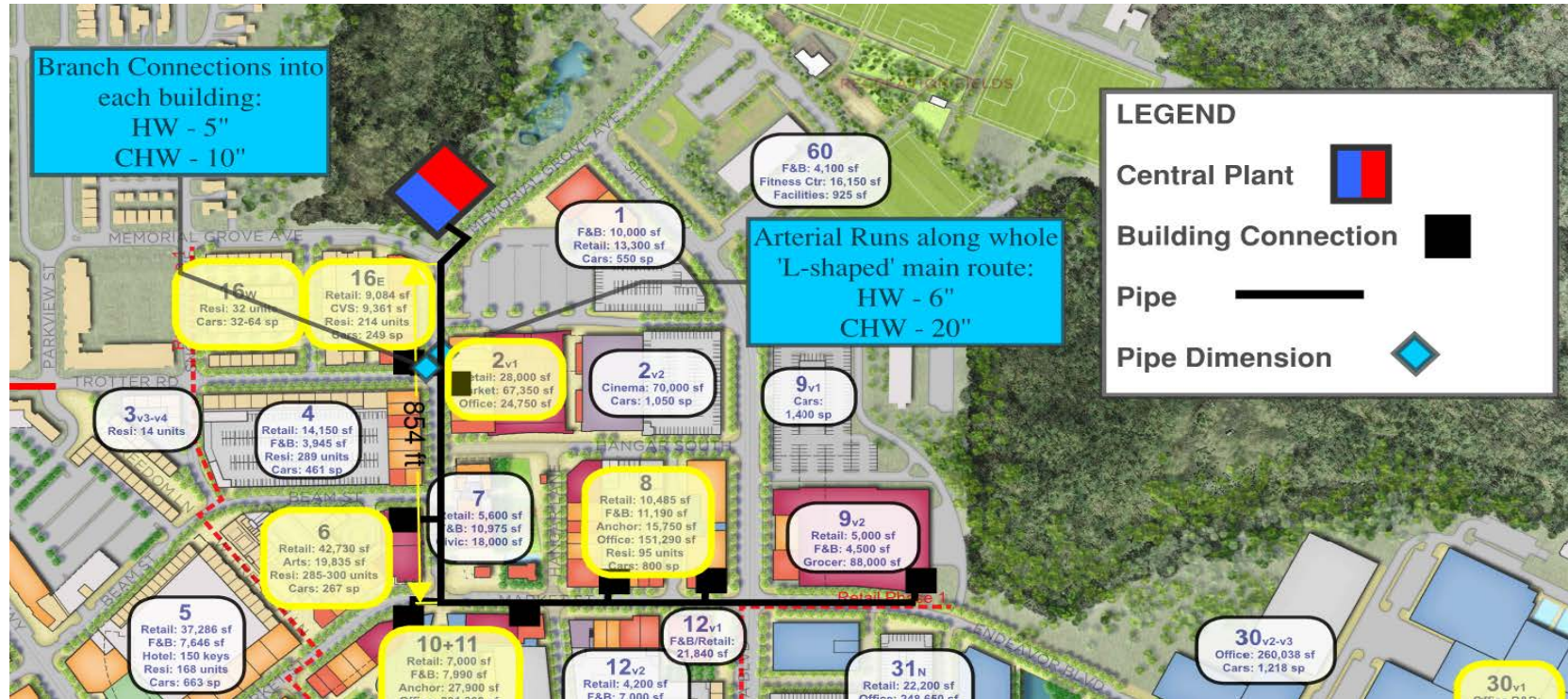
## **Ground**

Ground Source Heat Pumps (GSHPs)  
Geothermal  
Geo-Exchange Heating

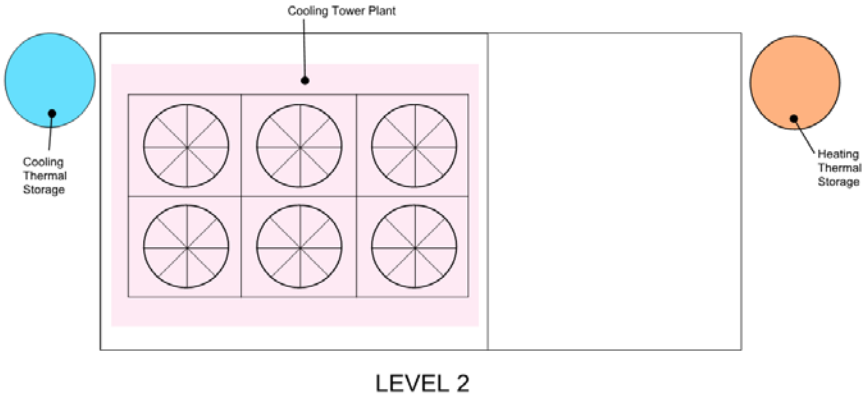
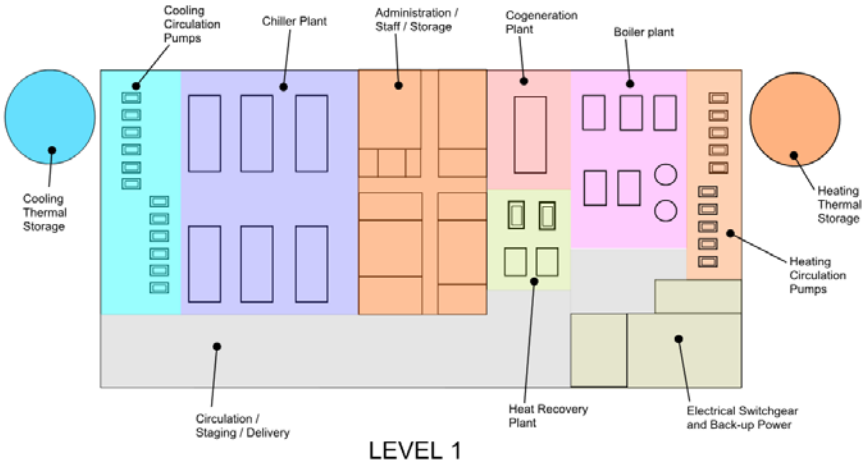


First Phase

# Co-Gen, Heating Hot Water & Chilled Water



# Heating Hot Water & Chilled Water – Plant and Equipment



Boilers



CHP



Distribution Piping



Chillers



Cooling Towers



Pumps

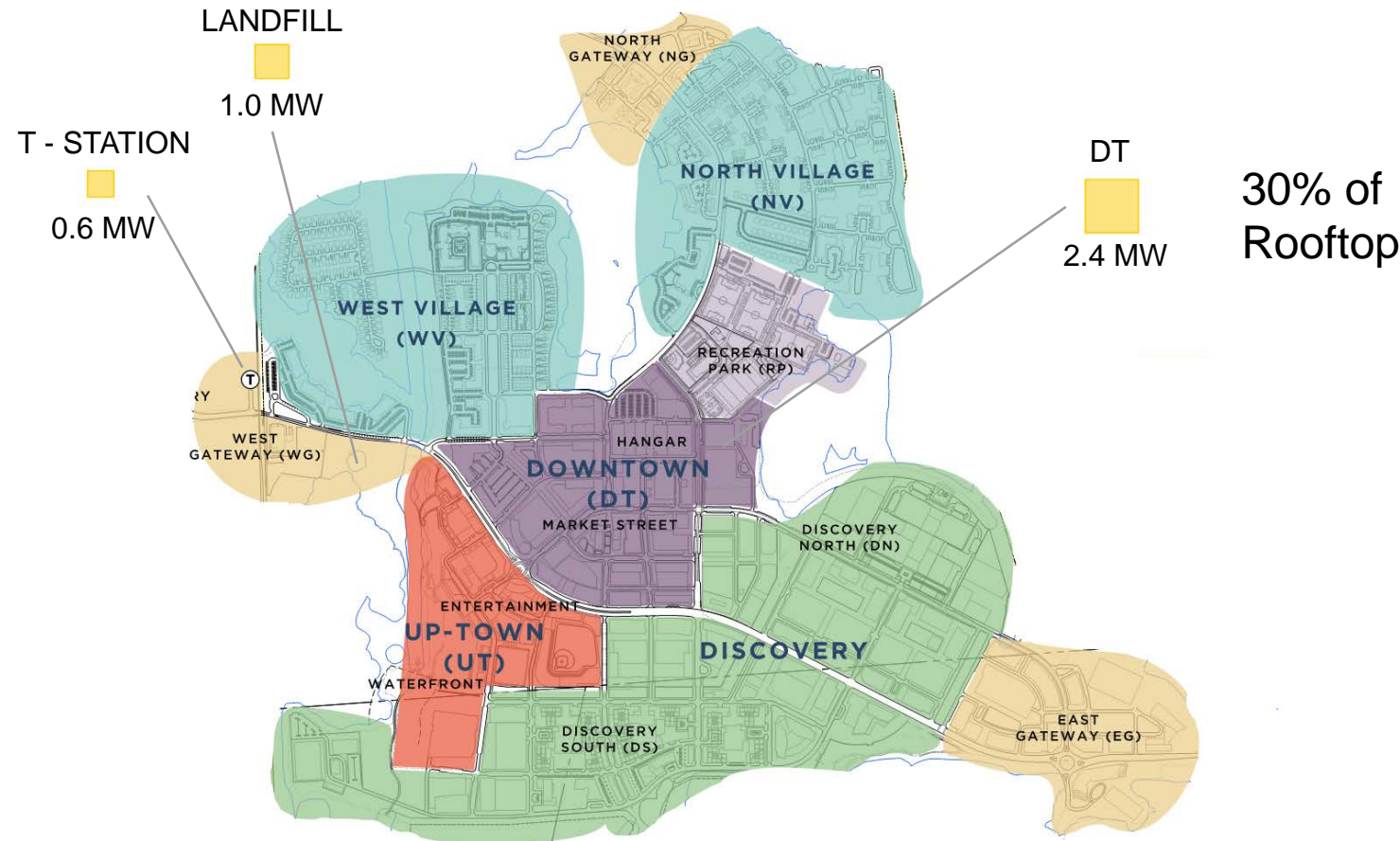


Energy Transfer Station



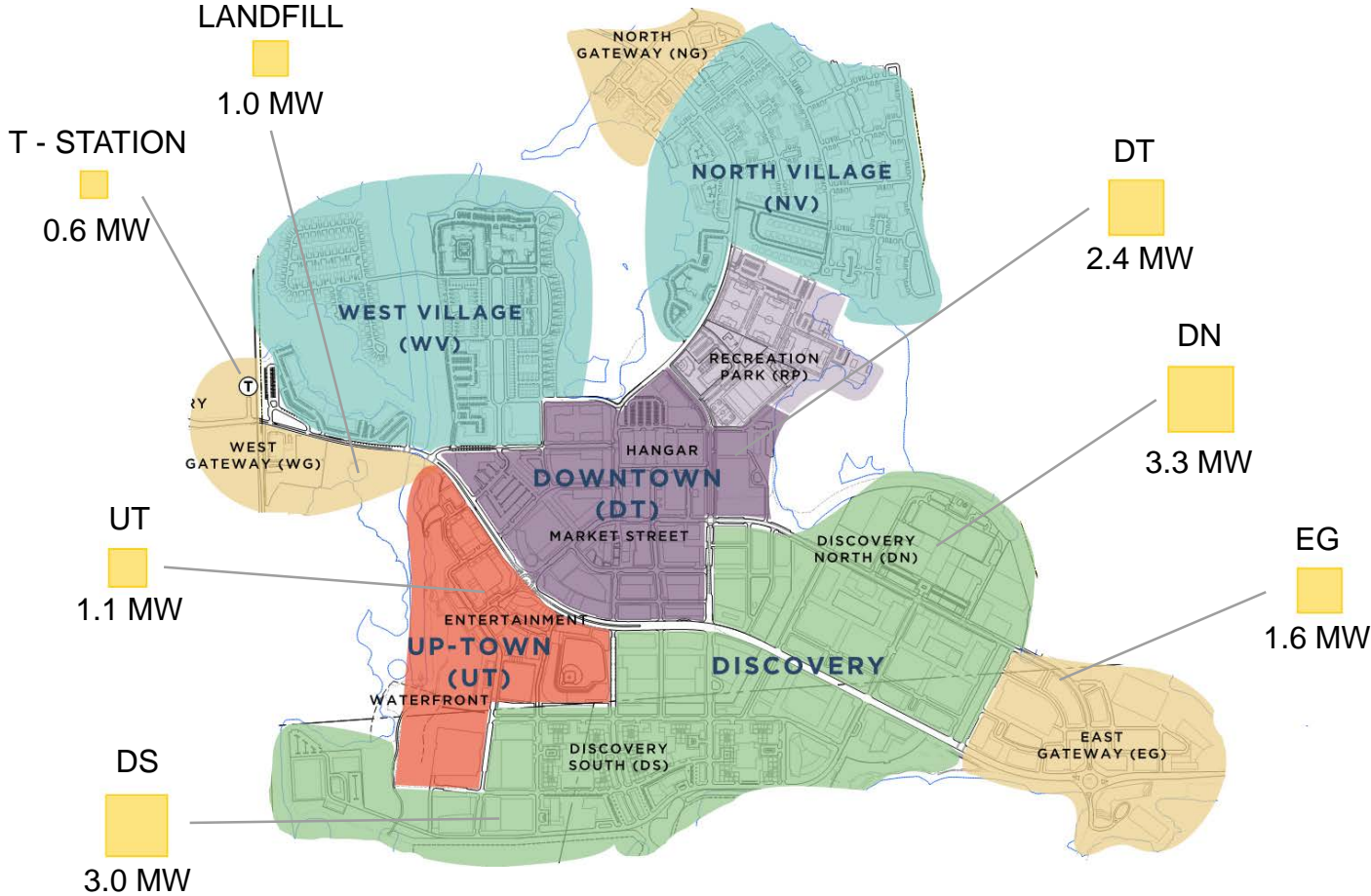
Thermal Storage

# SOLAR PV | PHASE 1 ARRAY SIZES

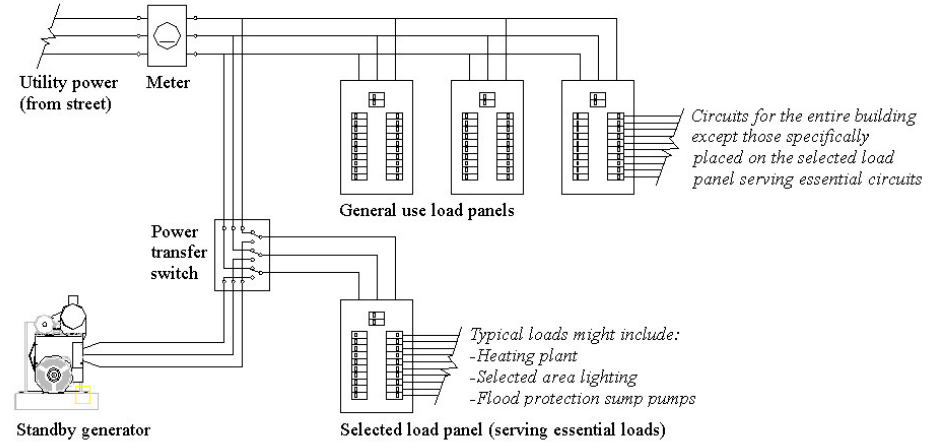




# SOLAR PV | AGGREGATE ARRAY SIZES



# Consolidated Back-up Generation in Main Plant



# Network Operating Center and Smart Grid



What next?

- Market testing
- Discussion with the Utility
- Construct pilot projects
- Continued testing and reevaluation
- Continue to innovate