# Assessing District Energy Feasibility for the San Francisco Giants

IDEA Conference | June 30th, 2015

# Overview

1 Background

2 Team and Scope

3 District Energy “Optioneering”

4 District Energy Concepts

5 Business Case

6 Lessons Learned

# Background

GIANTS MISSION ROCK ARUP

# Background

CALIFORNIA STATE LANDS COMMISSION

PORT OF SAN FRANCISCO

bcdc

muni

US ARMY CORPS OF ENGINEERS

GIANTS

MISSION ROCK

ARUP

# Background

# Background


PROGRAM

- 28 acres total
- 8 acres Parks
- 1.3 million sf Office
- 1,500 Residential Units
- 250,000 sf Retail
- 212,000 sf Brewery
- 3,000 Parking Spaces

TIMELINE

- Four Phases
- Est. Construction: 2017-2025

COST

- $1.8 Billion Total

GIANTS MISSION ROCK ARUP

# Team and Scope

GIANTS MISSION ROCK ARUP

# Team

| | |
|---|---|
| Urban Planning & Land Use | Perkins + Will |
| Landscape Planning | CMG Associates |
| Sustainability | Atelier 10, ARUP |
| Geotechnical | Treadwell Rollo |
| Structural | KPFF |
| Marine | Moffatt & Nichol |
| Environmental | Ash Creek Associates |
| Transportation | Bob Harrison, Adavant Consulting |
| Civil | BKF Engineers |
| Utilities | Flak & Kurtz |
| Construction | Hathaway Dinwiddie, Nibbi Bros. |
| Legal | Coblentz Patch Duffy & Bass, Sheppard Mullin |
| Financial | Century Urban |
| Economic | Economic & Planning System |
| Market | CBRE, Knight Frank, Polaris |

GIANTS MISSION ROCK ARUP

# Scope: Sustainability Plan

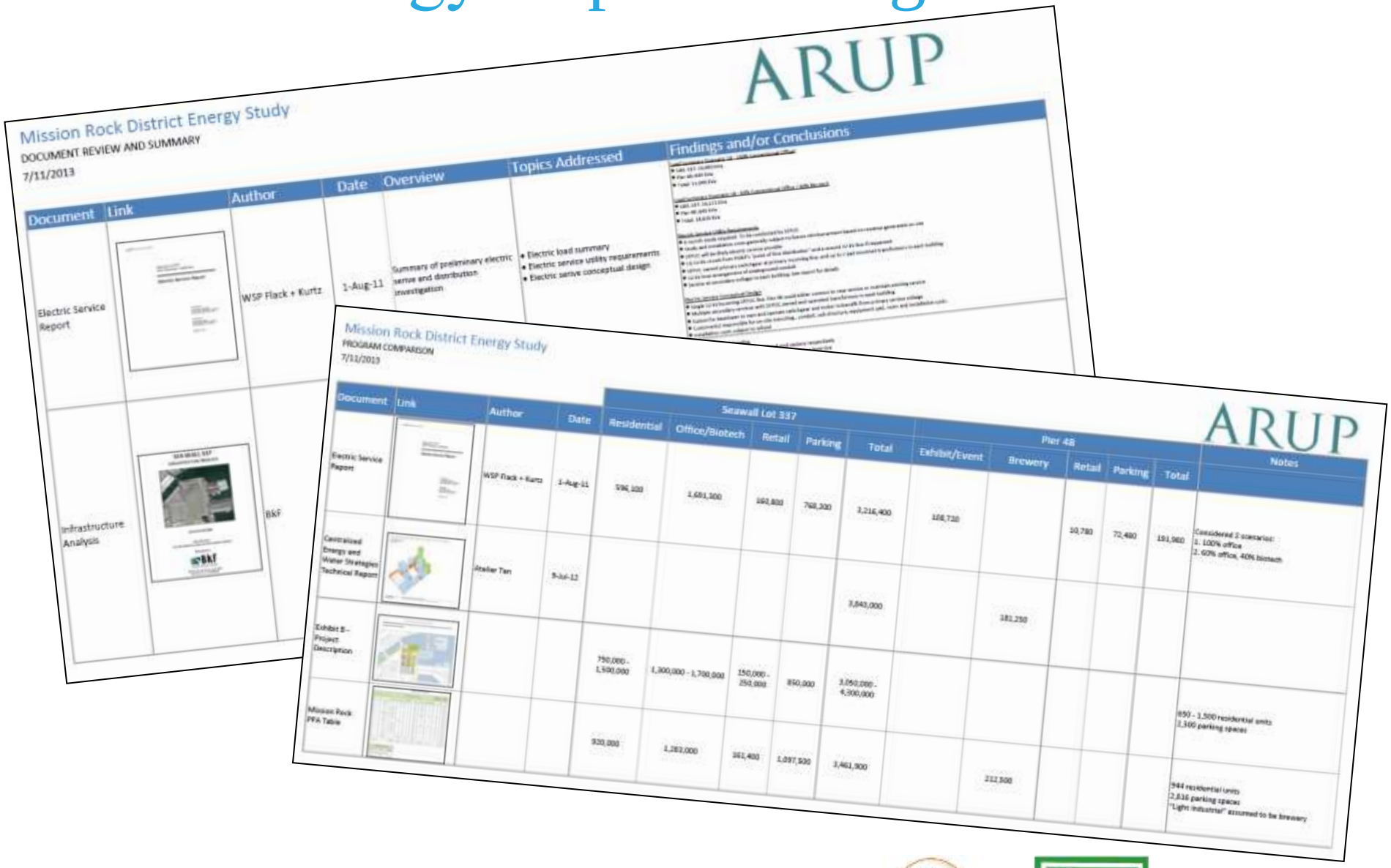
**Lease Disposition and Development Agreement**


GIANTS MISSION ROCK ARUP

# District Energy "Optioneering"

GIANTS MISSION ROCK ARUP

# District Energy "Optioneering"



ARUP

Mission Rock District Energy Study

DOCUMENT REVIEW AND SUMMARY

7/11/2013

| Document | Link | Author | Date | Overview | Topics Addressed | Findings and/or Conclusions |
|---|---|---|---|---|---|---|
| Electric Service Report | | WSP Flack + Kurtz | 1-Aug-11 | Summary of preliminary electric service and distribution investigation | • Electric load summary<br>• Electric service utility requirements<br>• Electric serive conceptual design | |
| Infrastructure Analysis | | BKF | | | | |

Mission Rock District Energy Study

PROGRAM COMPARISON

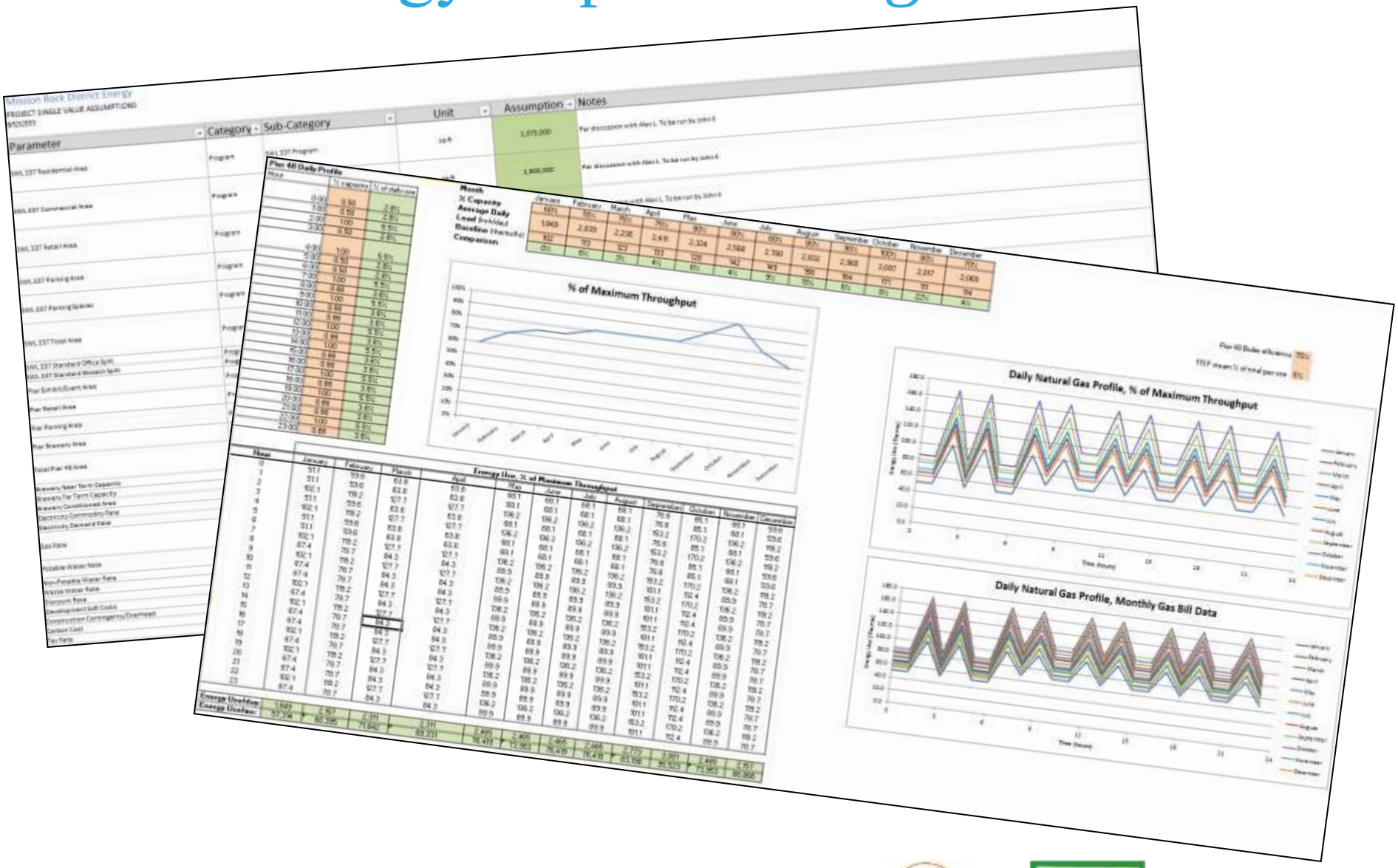
7/11/2013

ARUP

| Document | Link | Author | Date | Seawall Lot 337 | | | | | Pier 48 | | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Residential | Office/Biotech | Retail | Parking | Total | Exhibit/Event | Brewery | Retail | Parking | Total | |
| Electric Service Report | | WSP Flack + Kurtz | 1-Aug-11 | 596,100 | 1,681,300 | 162,800 | 768,300 | 3,216,400 | 108,720 | | 10,780 | 72,480 | 191,980 | Considered 2 scenarios:<br>1. 100% office<br>2. 60% office, 40% biotech |
| Centralized Energy and Water Strategies Technical Report | | Atelier Ten | 9-Jul-12 | | | | | 3,843,000 | | 181,250 | | | | |
| Exhibit B - Project Description | | | | 750,000 - 1,500,000 | 1,300,000 - 1,700,000 | 150,000 - 250,000 | 850,000 | 3,050,000 - 4,300,000 | | | | | | 850 - 1,500 residential units<br>1,300 parking spaces |
| Mission Rock PPA Table | | | | 920,000 | 1,282,000 | 161,400 | 1,097,900 | 3,461,300 | | 212,500 | | | | 944 residential units<br>2,816 parking spaces<br>"Light industrial" assumed to be brewery |

GIANTS MISSION ROCK ARUP

# District Energy "Optioneering"

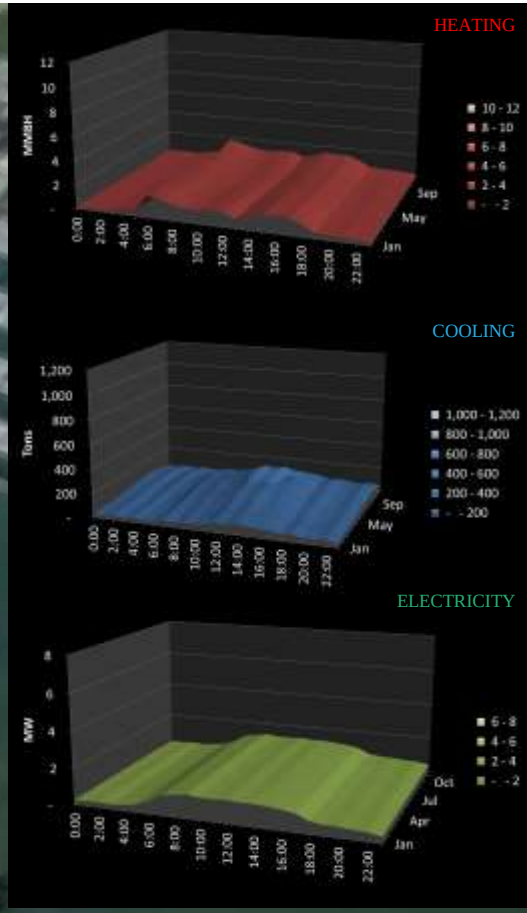



GIANTS

MISSION ROCK

ARUP

# District Energy “Optioneering”

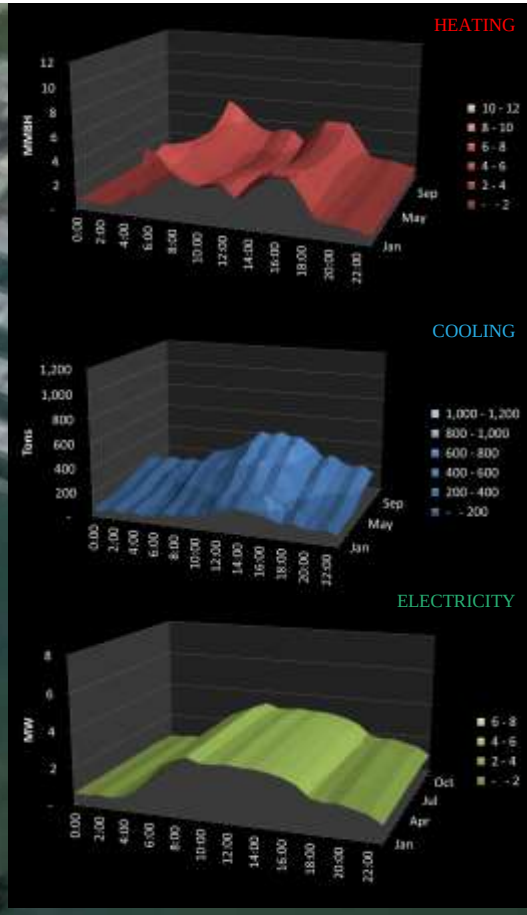





| 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|

NOTE: OUTDATED MASSING

# District Energy “Optioneering”

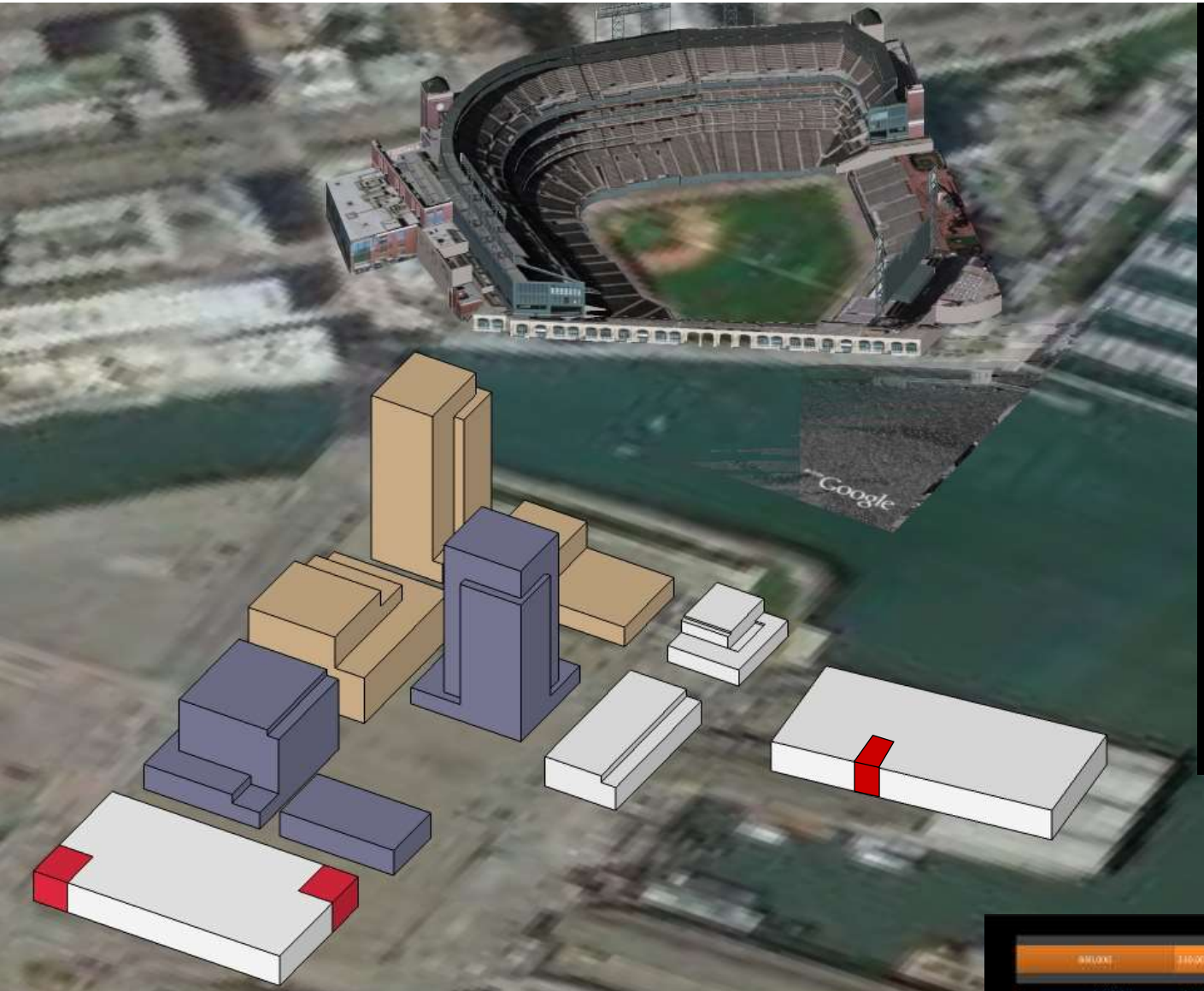



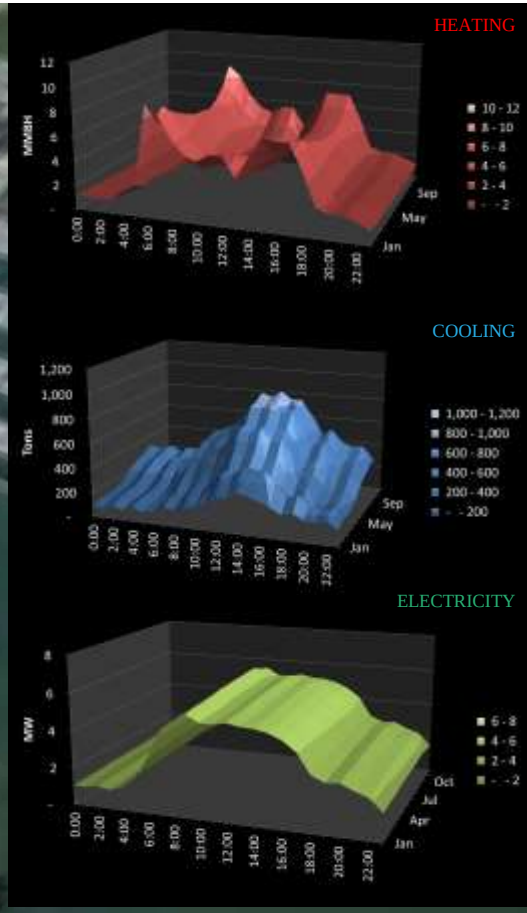


| 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|

NOTE: OUTDATED MASSING

# District Energy “Optioneering”



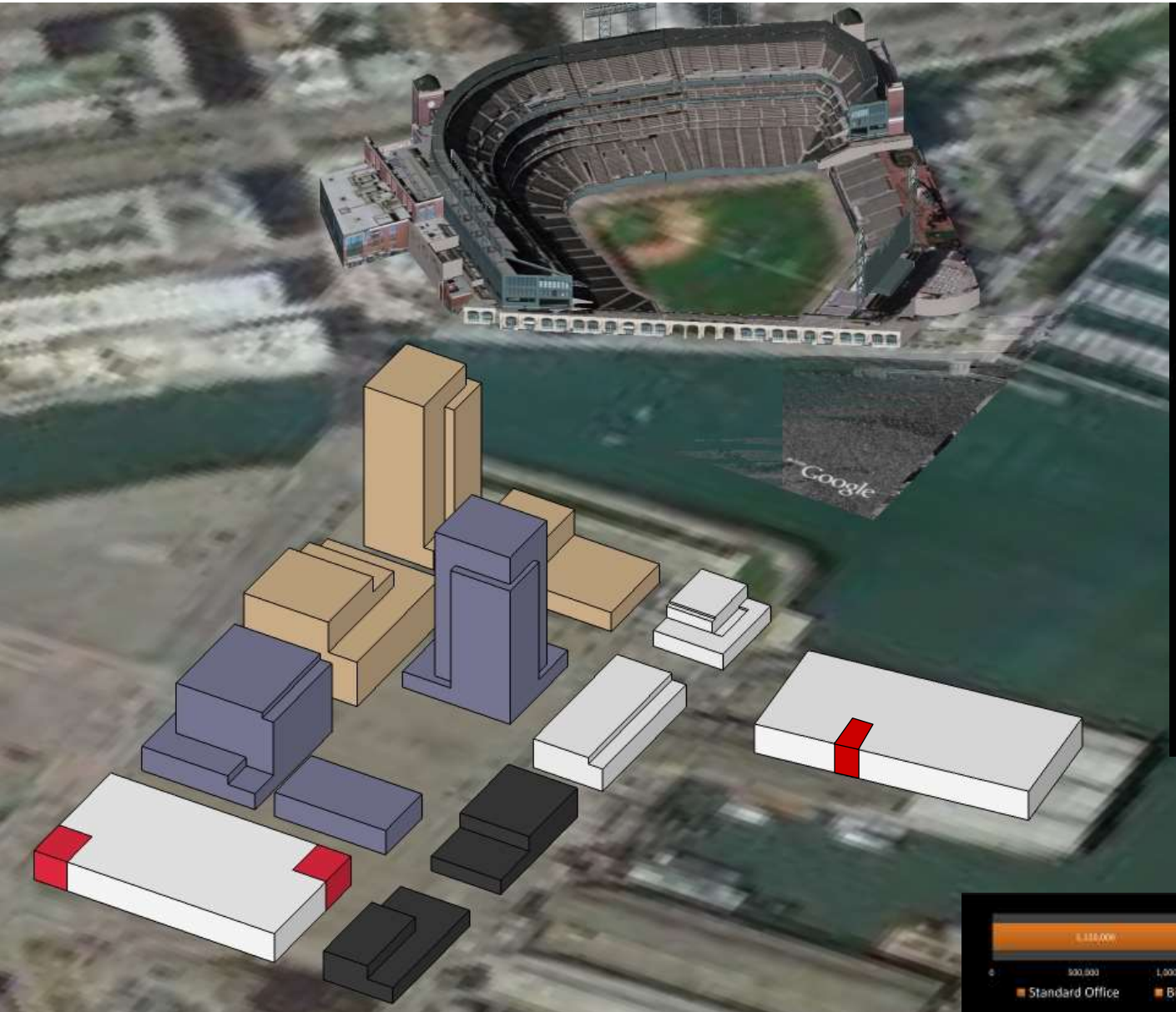



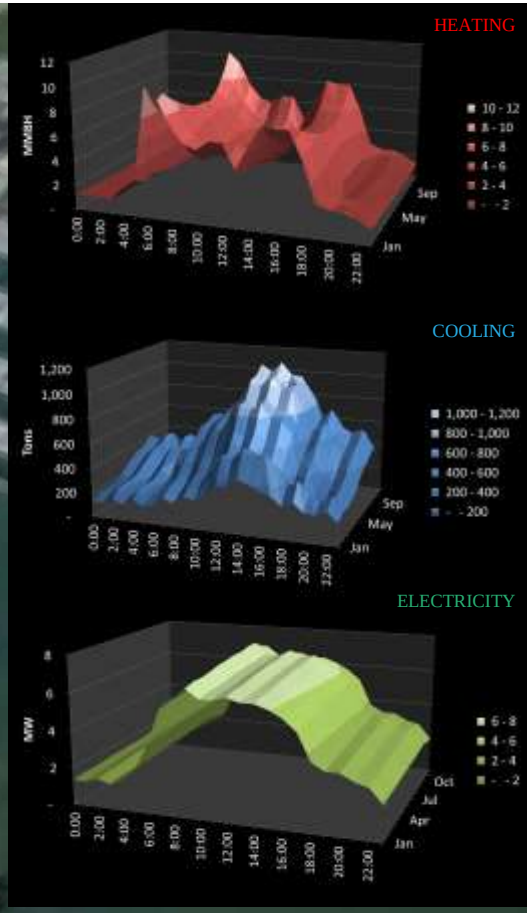


| 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|

NOTE: OUTDATED MASSING

# District Energy “Optioneering”



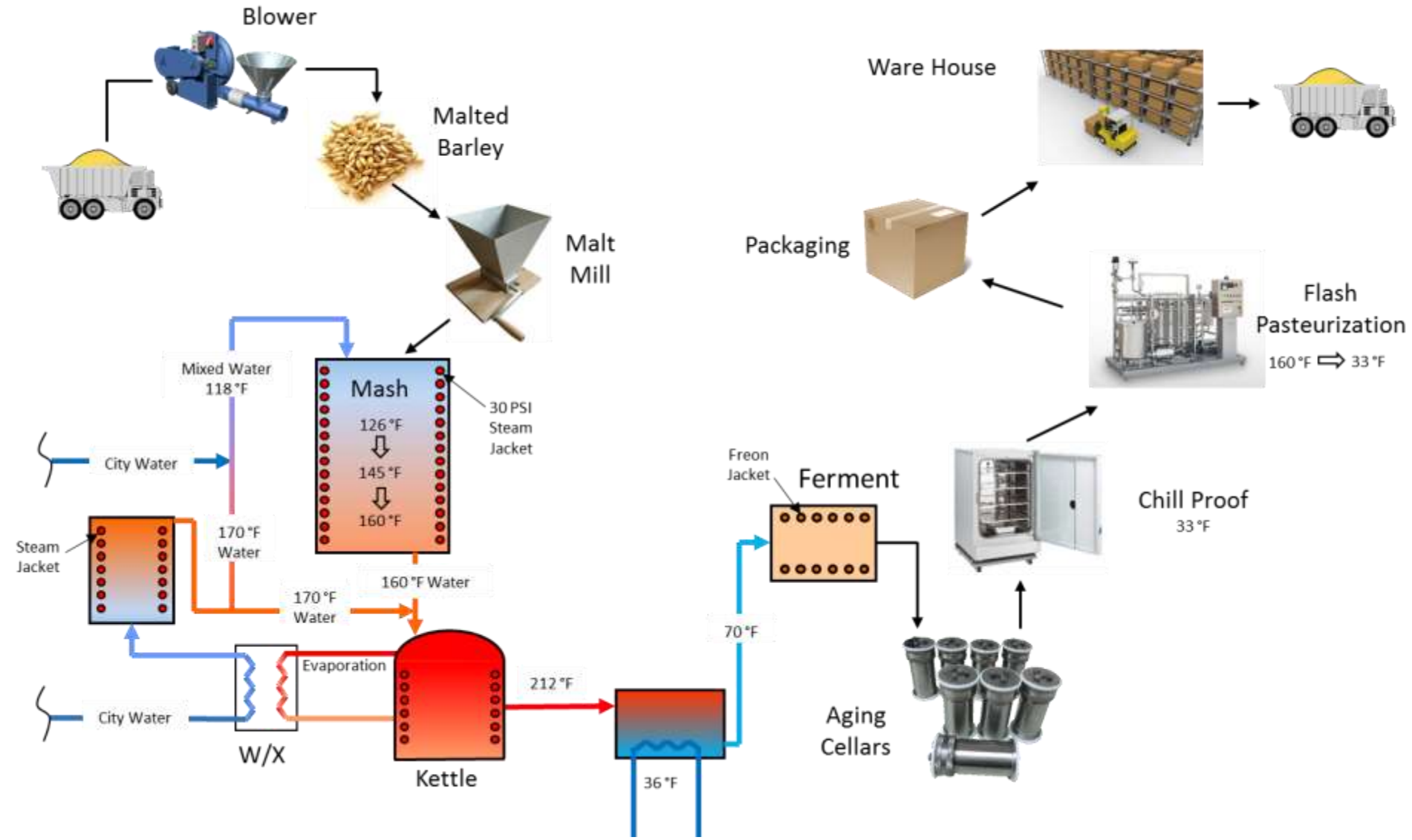





NOTE: OUTDATED MASSING

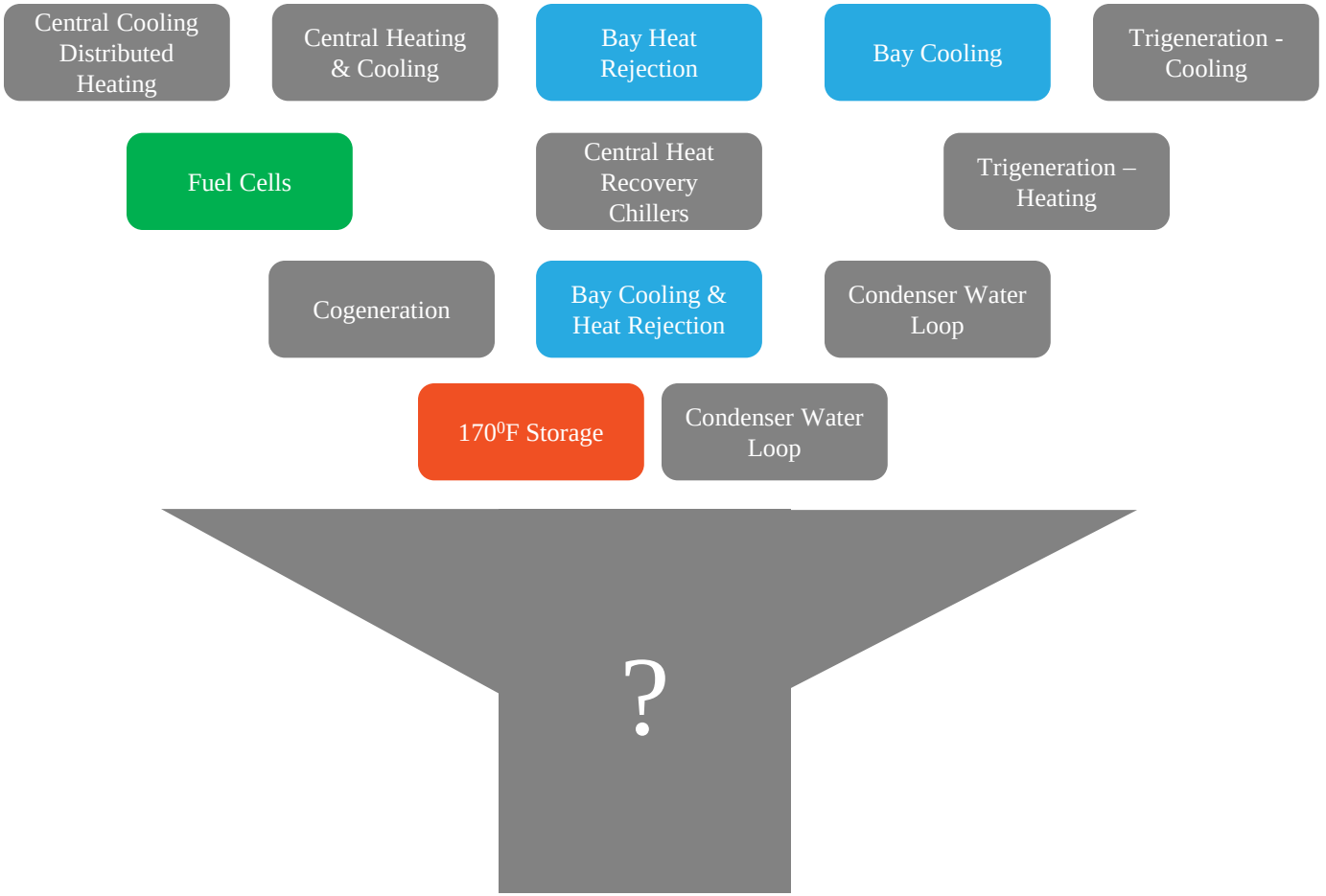
| 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|

# District Energy "Optioneering"




GIANTS MISSION ROCK ARUP

# District Energy "Optioneering"




Business Case Option 1

Business Case Option 2

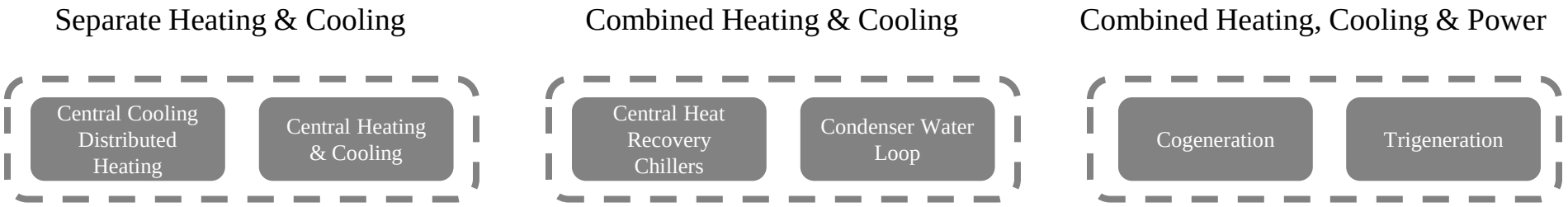
Business Case Option 3

GIANTS

MISSION ROCK

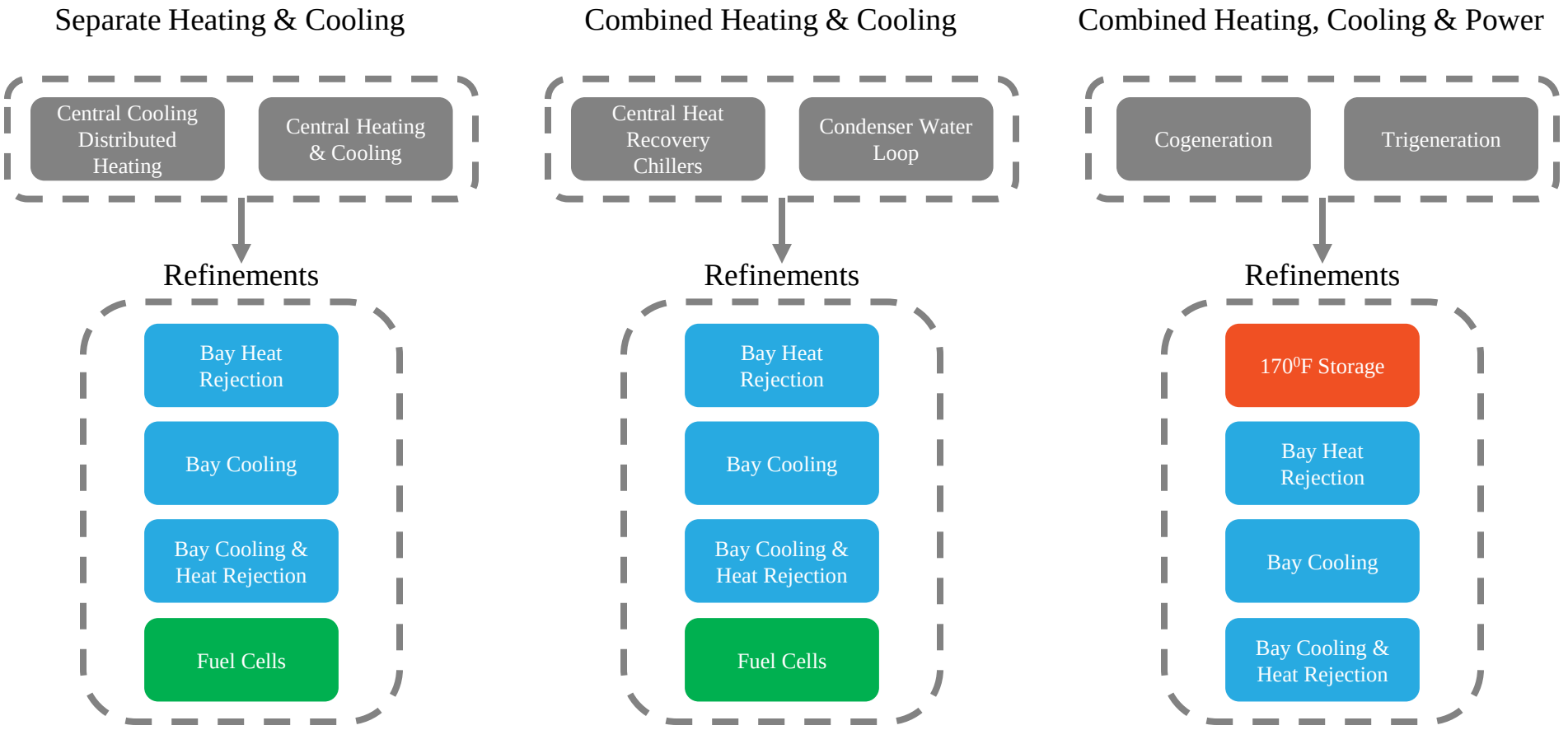
ARUP

# District Energy "Optioneering"



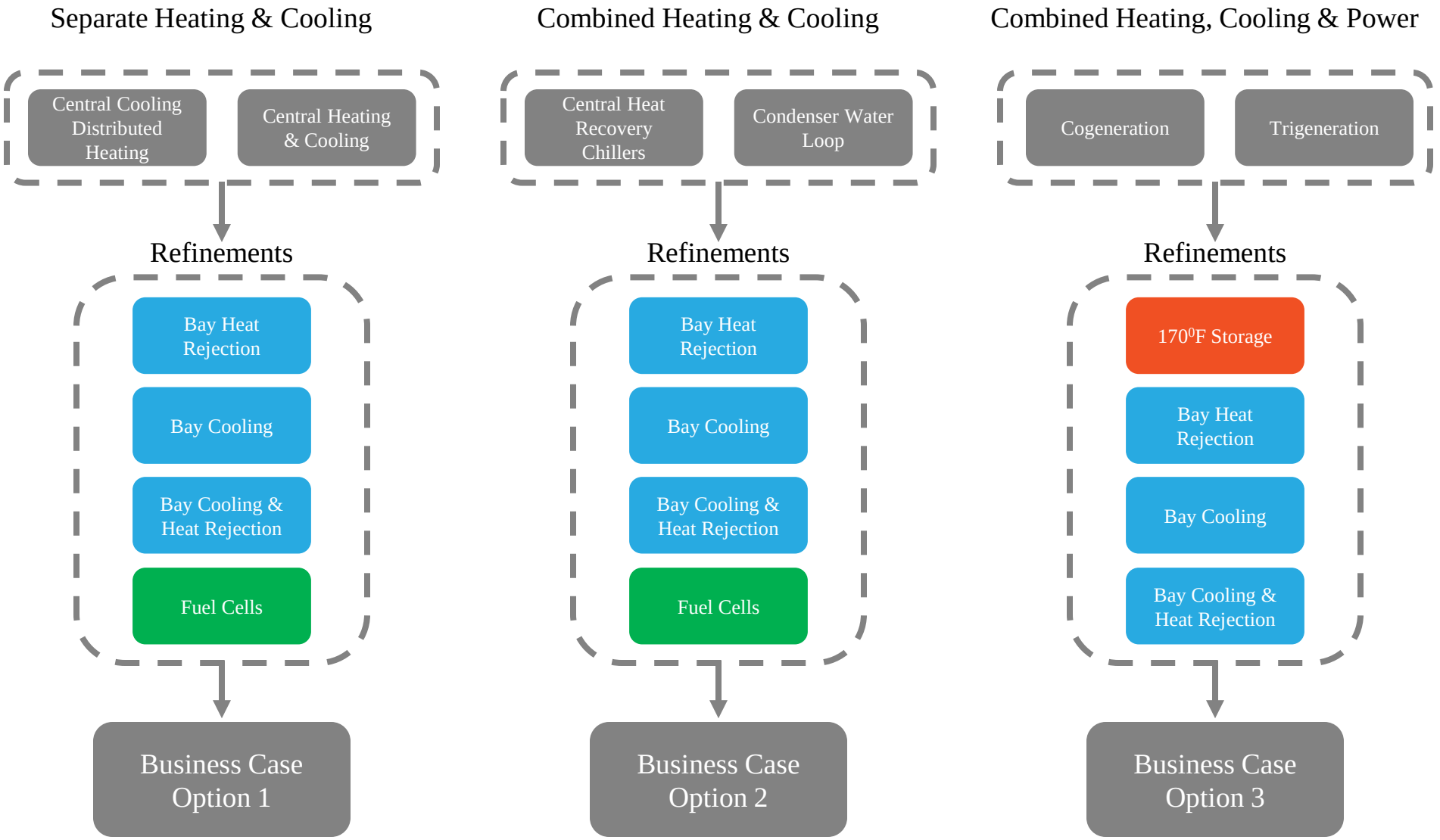

GIANTS MISSION ROCK ARUP

# District Energy "Optioneering"




GIANTS MISSION ROCK ARUP

# District Energy "Optioneering"




GIANTS MISSION ROCK ARUP

# District Energy "Optioneering"

## Mission Rock District Energy

District Options

8/8/2013

Quantitative at this stage

Qualitative at this stage

Separate Heating and Cooling

Combined Heating and Cooling

Combined Heating, Cooling and Power

| Base Strategy | | Refinement | | GHG REDUCTION POTENTIAL | GRID ENERGY REDUCTION POTENTIAL | TOTAL ENERGY COST | ONSITE GENERATION POTENTIAL | WATER REDUCTION POTENTIAL | PERMIT/APPROVAL RISK | CUP SIZE | CUP AESTHETICS | CAPEX | OPERATIONS & MAINTENANCE | DISTRIBUTION COMPLEXITY | LIFE CYCLE COST | RESILIENCE | TECHNICAL RISK | COMMERCIAL RISK | WEIGHTED SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Central Heating and Cooling | | | | | | | | | | | | | | | | | | 148.9 |
| 2 | Distributed Heating, Central Cooling | | | | | | | | | | | | | | | | | | 140.2 |
| | | A | Bay Water Heat Rejection | | | | | | | | | | | | | | | | 131.5 |
| | | B | Bay Cooling | | | | | | | | | | | | | | | | 156.8 |
| | | C | Bay Cooling + Bay Heat Rejection | | | | | | | | | | | | | | | | 137.5 |
| | | D | Fuel Cells | | | | | | | | | | | | | | | | 159.9 |
| | | E | Bay Cooling + Bay Heat Rejection + Fuel Cells | | | | | | | | | | | | | | | | 151.9 |
| 3 | Central Heat Recovery Chillers | | | | | | | | | | | | | | | | | | 133.9 |
| 4 | Condenser Water + Distributed Heat Pumps | | | | | | | | | | | | | | | | | | 138.6 |
| | | A | Bay Heat Rejection | | | | | | | | | | | | | | | | 114.9 |
| | | B | Bay Cooling | | | | | | | | | | | | | | | | 140.8 |
| | | C | Bay Cooling + Bay Heat Rejection | | | | | | | | | | | | | | | | 119.8 |
| | | D | Fuel Cells | | | | | | | | | | | | | | | | 136.8 |
| | | E | Bay Cooling + Bay Heat Rejection + Fuel Cells | | | | | | | | | | | | | | | | 120.0 |
| 5 | Cogeneration + Central Cooling | | | | | | | | | | | | | | | | | | 161.8 |
| 6 | Tri-Generation (Cooling Prioritized) + Central Cooling | | | | | | | | | | | | | | | | | | 158.8 |
| 7 | Tri-Generation (Heating Prioritized) + Central Cooling | | | | | | | | | | | | | | | | | | 163.5 |
| | | A | 170$^0$F Thermal Storage | | | | | | | | | | | | | | | | 153.5 |
| | | B | Bay Heat Rejection | | | | | | | | | | | | | | | | 141.6 |
| | | C | Bay Cooling | | | | | | | | | | | | | | | | 166.0 |
| | | D | Bay Cooling + Bay Heat Rejection | | | | | | | | | | | | | | | | 148.3 |
| | | | WEIGHTING | 5 | 3 | 2 | 5 | 5 | 2 | 3 | 5 | 1 | 3 | 2 | 5 | 3 | 2 | 2 | |

GIANTS

MISSION ROCK

ARUP

# District Energy "Optioneering"

Mission Rock District Energy

District Options

8/8/2013

Quantitative at this stage

Qualitative at this stage

Separate Heating and Cooling

Combined Heating and Cooling

Combined Heating, Cooling and Power

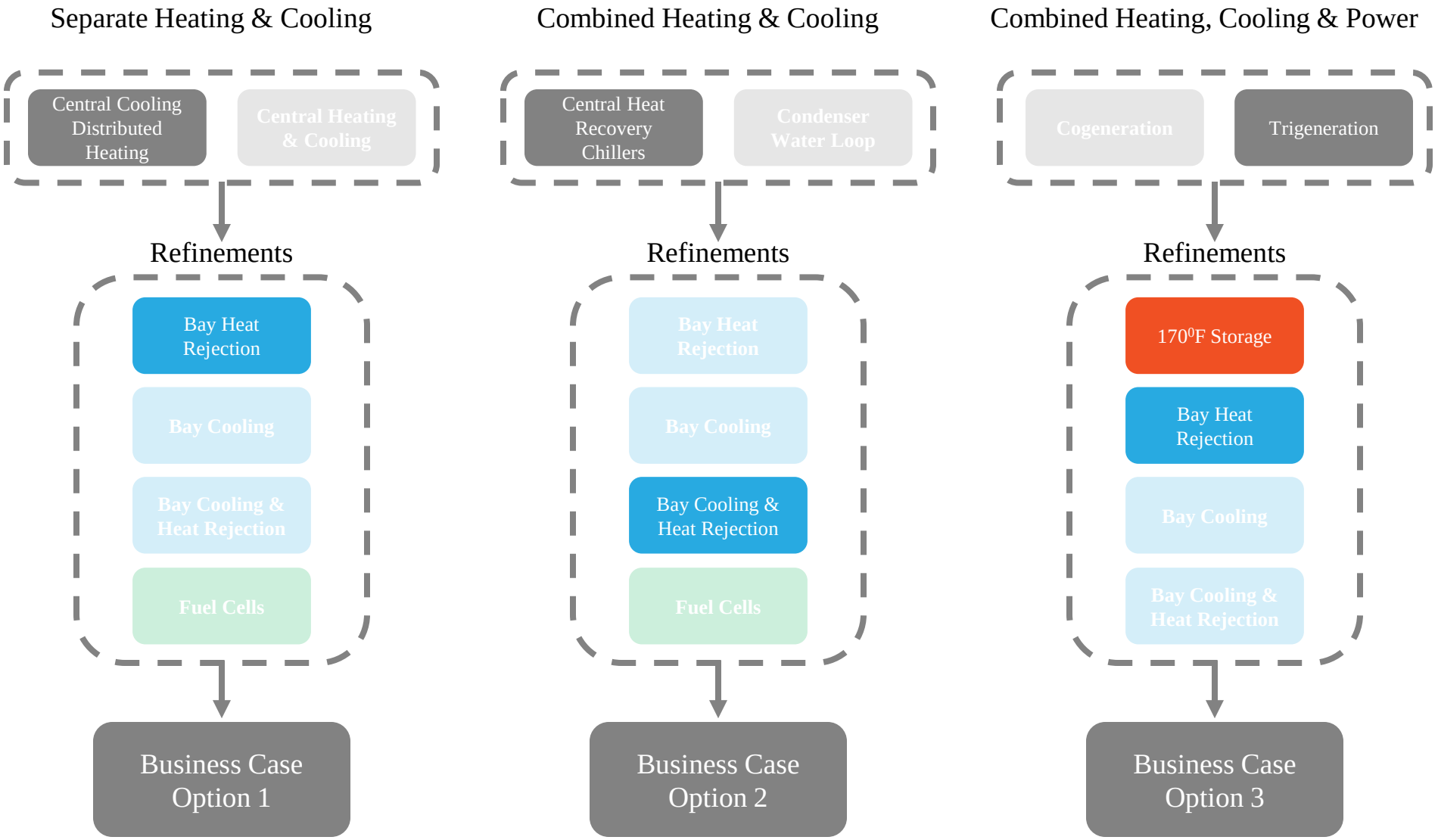
| Base Strategy | | Refinement | GHG REDUCTION POTENTIAL | GRID ENERGY REDUCTION POTENTIAL | TOTAL ENERGY COST | ONSITE GENERATION POTENTIAL | WATER REDUCTION POTENTIAL | PERMIT/APPROVAL RISK | CUP SIZE | CUP AESTHETICS | CAPEX | OPERATIONS & MAINTENANCE | DISTRIBUTION COMPLEXITY | LIFE CYCLE COST | RESILIENCE | TECHNICAL RISK | COMMERCIAL RISK | WEIGHTED SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Central Heating and Cooling | | | | | | | | | | | | | | | | | 148.9 |
| 2 | Distributed Heating, Central Cooling | | | | | | | | | | | | | | | | | 140.2 |
| | | A Bay Water Heat Rejection | | | | | | | | | | | | | | | | 131.5 |
| | | B Bay Cooling | | | | | | | | | | | | | | | | 156.8 |
| | | C Bay Cooling + Bay Heat Rejection | | | | | | | | | | | | | | | | 137.5 |
| | | D Fuel Cells | | | | | | | | | | | | | | | | 159.9 |
| | | E Bay Cooling + Bay Heat Rejection + Fuel Cells | | | | | | | | | | | | | | | | 151.9 |
| 3 | Central Heat Recovery Chillers | | | | | | | | | | | | | | | | | 133.9 |
| 4 | Condenser Water + Distributed Heat Pumps | | | | | | | | | | | | | | | | | 138.6 |
| | | A Bay Heat Rejection | | | | | | | | | | | | | | | | 114.9 |
| | | B Bay Cooling | | | | | | | | | | | | | | | | 140.8 |
| | | C Bay Cooling + Bay Heat Rejection | | | | | | | | | | | | | | | | 119.8 |
| | | D Fuel Cells | | | | | | | | | | | | | | | | 136.8 |
| | | E Bay Cooling + Bay Heat Rejection + Fuel Cells | | | | | | | | | | | | | | | | 120.0 |
| 5 | Cogeneration + Central Cooling | | | | | | | | | | | | | | | | | 161.8 |
| 6 | Tri-Generation (Cooling Prioritized) + Central Cooling | | | | | | | | | | | | | | | | | 158.8 |
| 7 | Tri-Generation (Heating Prioritized) + Central Cooling | | | | | | | | | | | | | | | | | 163.5 |
| | | A 170$^0$F Thermal Storage | | | | | | | | | | | | | | | | 153.5 |
| | | B Bay Heat Rejection | | | | | | | | | | | | | | | | 141.6 |
| | | C Bay Cooling | | | | | | | | | | | | | | | | 166.0 |
| | | D Bay Cooling + Bay Heat Rejection | | | | | | | | | | | | | | | | 148.3 |
| | | WEIGHTING | 5 | 3 | 2 | 5 | 5 | 2 | 3 | 5 | 1 | 3 | 2 | 5 | 3 | 2 | 2 | |

GIANTS

MISSION ROCK

ARUP

# District Energy "Optioneering"




GIANTS MISSION ROCK ARUP

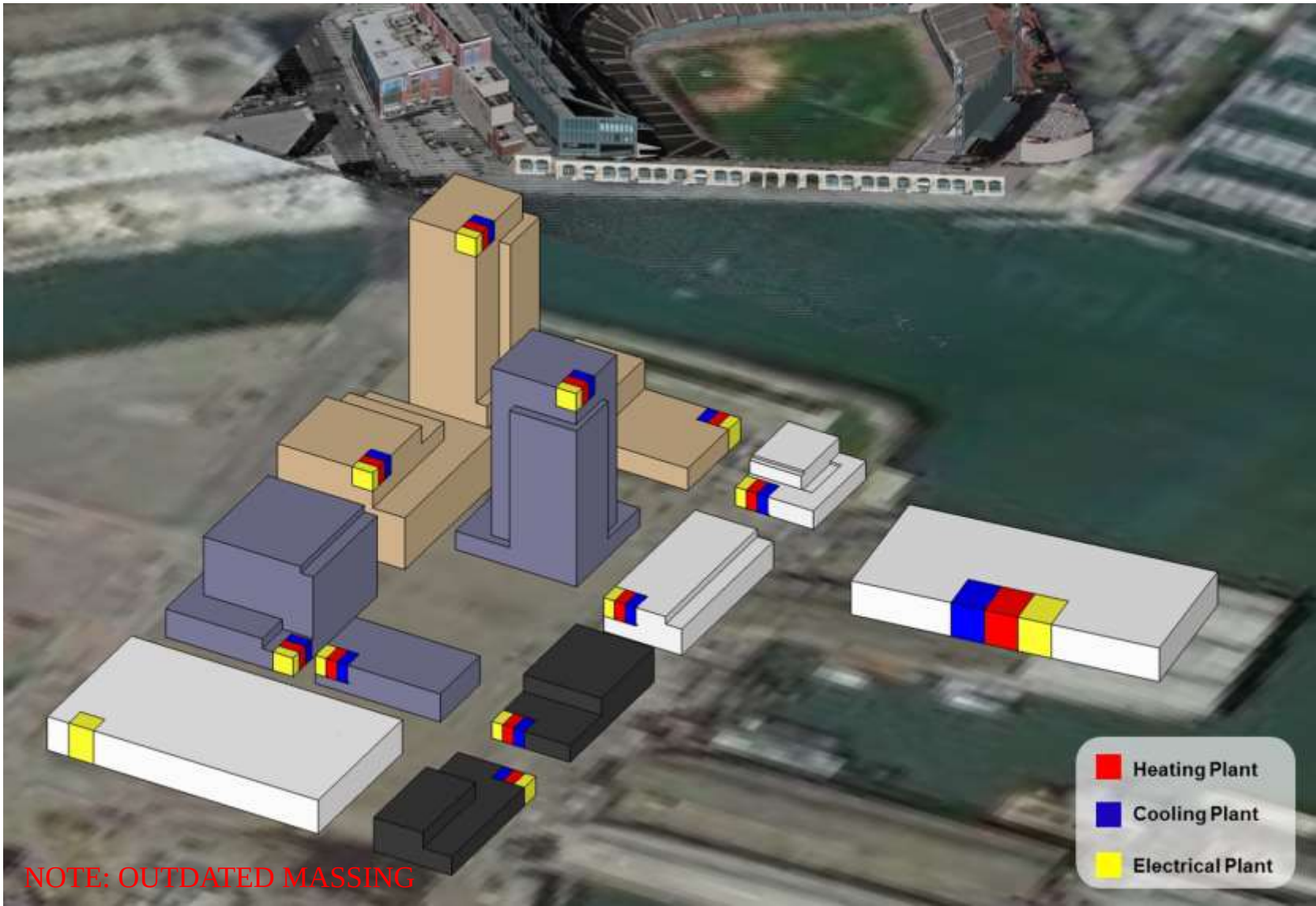
# District Energy Concepts

GIANTS MISSION ROCK ARUP

# District Energy Concepts

BAU ENERGY

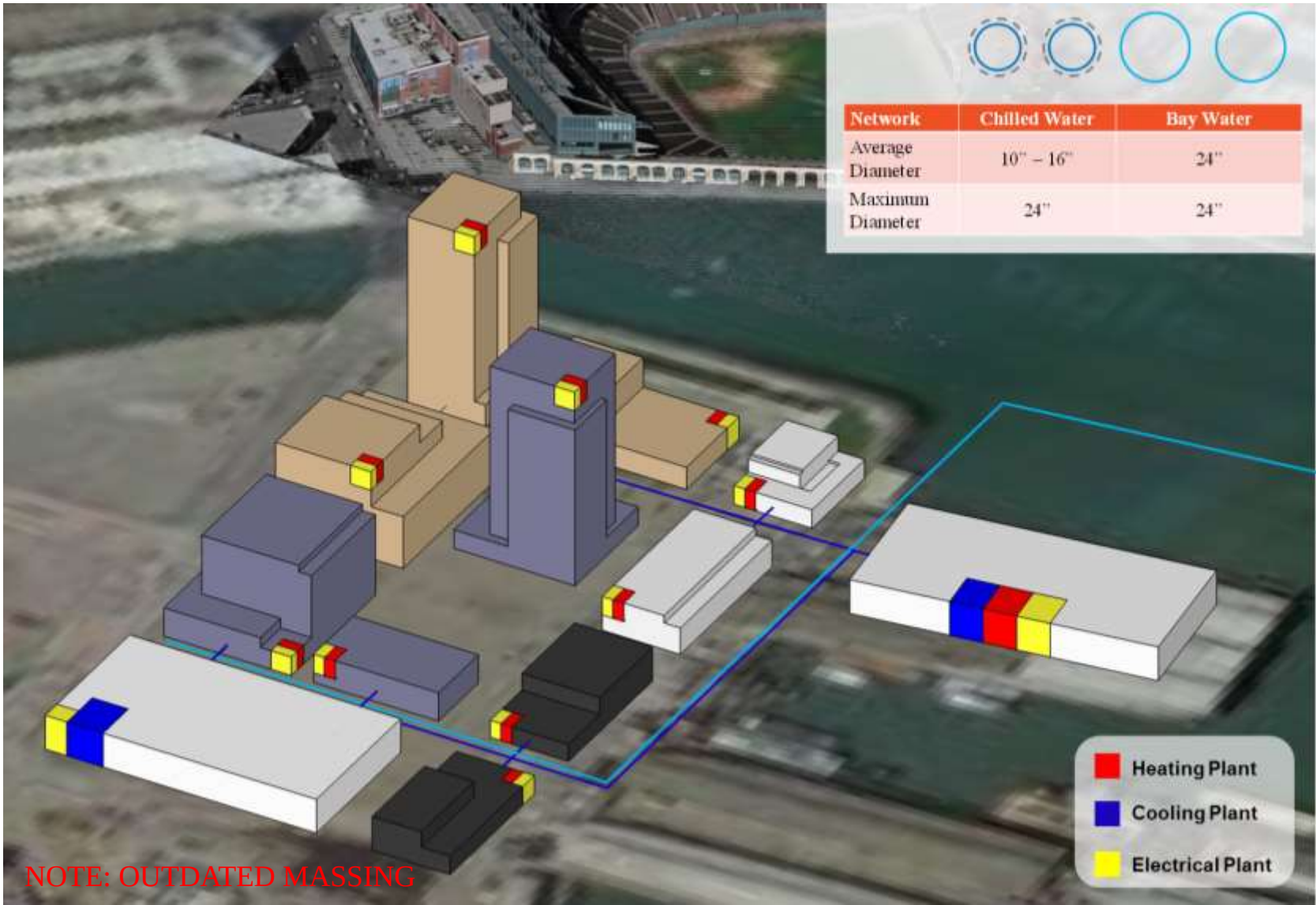
BAU CARBON



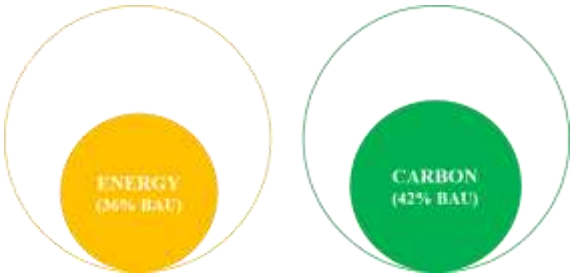
# District Energy Concepts

ENERGY
(96% BAU)

CARBON
(93% BAU)



# District Energy Concepts

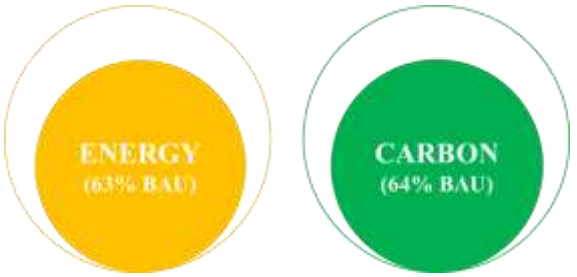


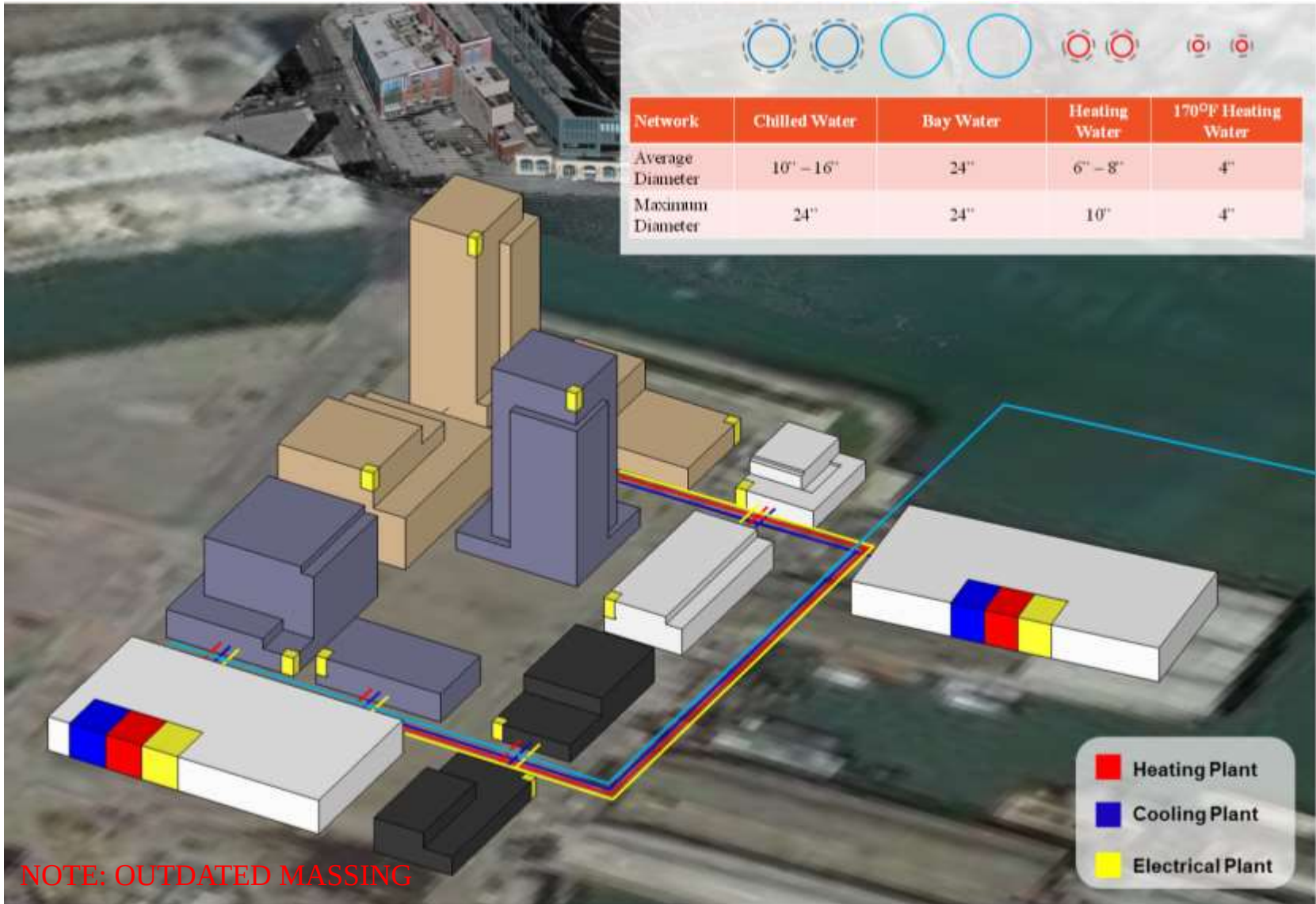

| Network | Chilled Water | Bay Water | Heating Water |
|---|---|---|---|
| Average Diameter | 10" – 16" | 24" | 6" – 8" |
| Maximum Diameter | 24" | 24" | 10" |

Heating Plant
Cooling Plant
Electrical Plant

NOTE: OUTDATED MASSING

# District Energy Concepts

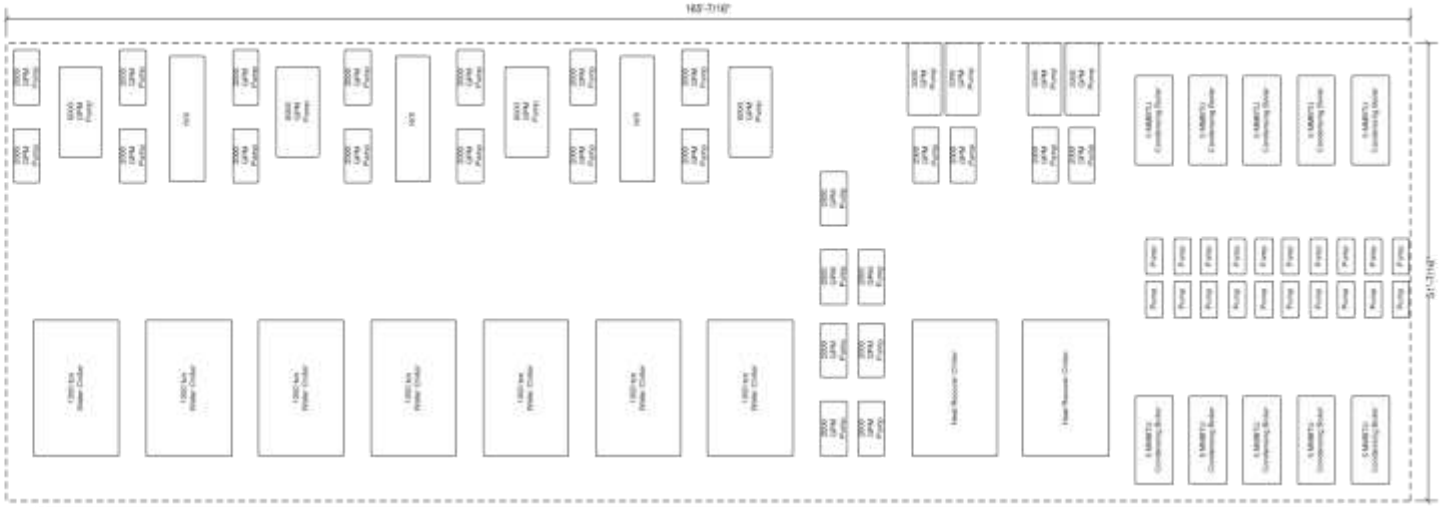


# District Energy Concepts

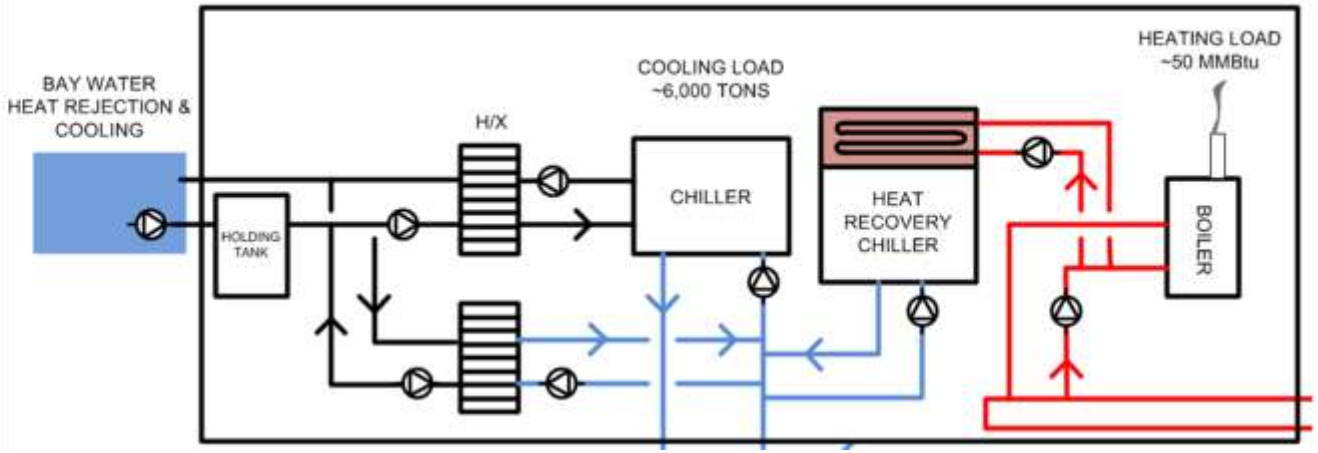
## CUP Size

- CUP area: 8,600
- CUP height: 15 – 20 feet



## CUP Systems

- Chillers
- Heat recovery chillers
- Boilers
- Heat exchangers
- Balance of plant equipment

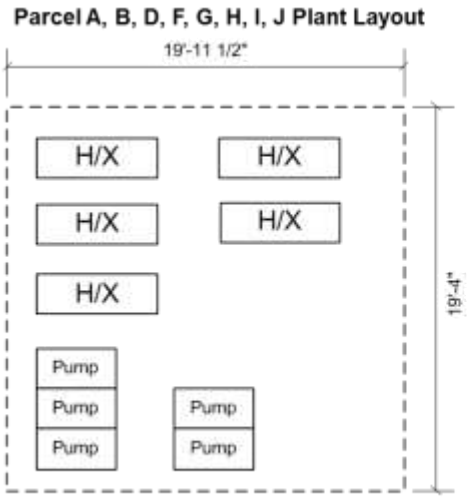


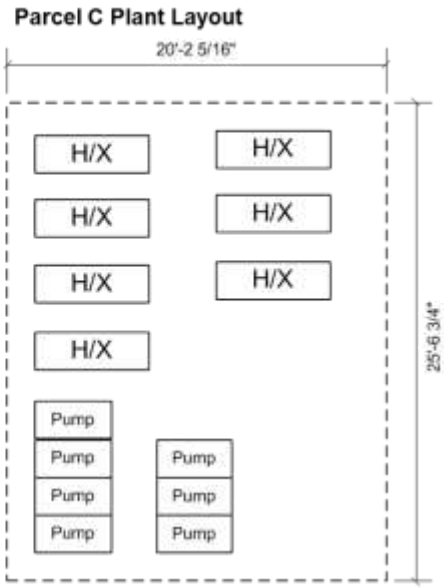

GIANTS MISSION ROCK ARUP

# District Energy Concepts

## Parcel Plant Size

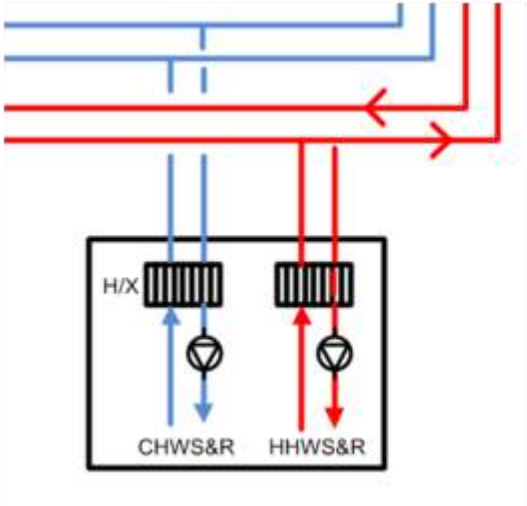
- Plant space: 4,400 sq-ft
- Plant height: 10 – 20 feet



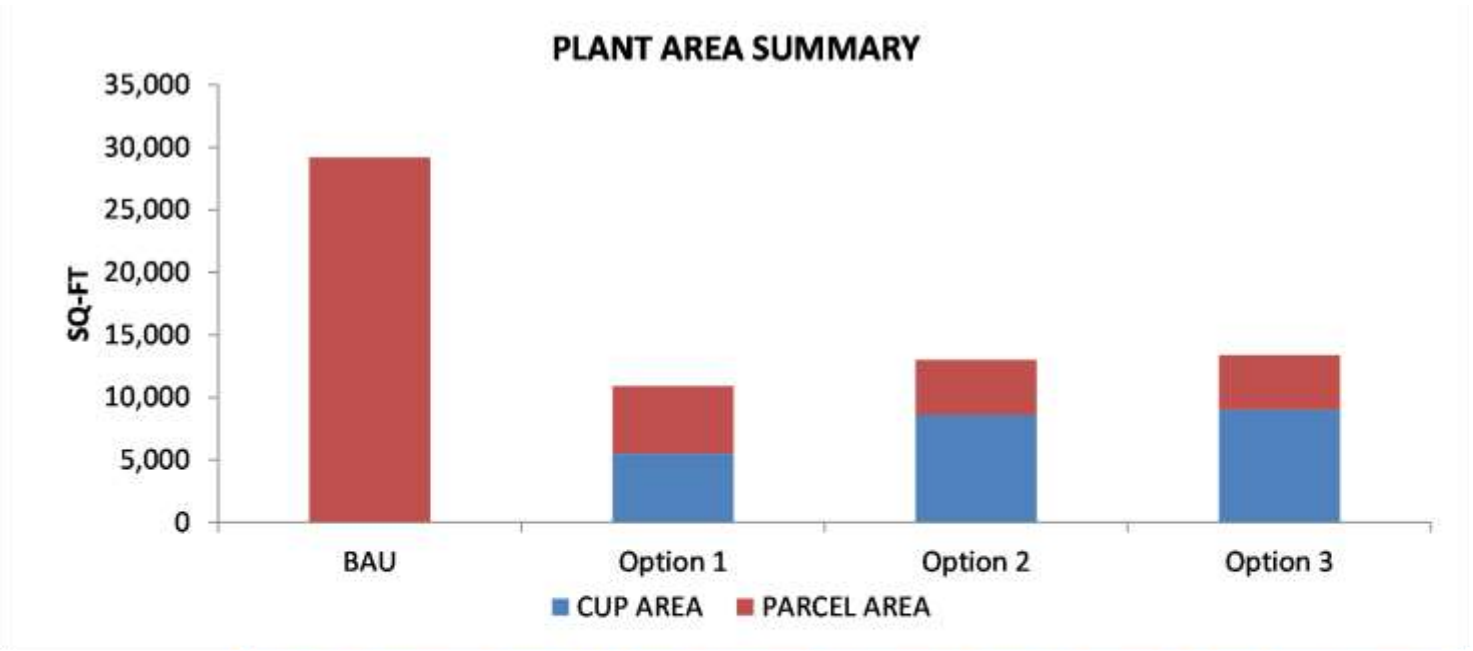

## Parcel Plant Systems

- Heat exchangers
- Electrical connection, transformation and distribution equipment
- Balance of plant components




GIANTS MISSION ROCK ARUP

# District Energy Concepts




| | CUP | PARCEL A | PARCEL B | PARCEL C | PARCEL D | PARCEL E | PARCEL F | PARCEL G | PARCEL H | PARCEL I | PARCEL J | PARCEL K | PARCEL K | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | sq-ft | sq-ft | sq-ft | sq-ft | sq-ft | sq-ft | sq-ft | sq-ft | sq-ft | sq-ft | sq-ft | sq-ft | sq-ft | sq-ft |
| BAU - Plant | - | 1,300 | 1,300 | 2,000 | 1,100 | 900 | 1,100 | 1,100 | 1,100 | 1,100 | 1,100 | 500 | 500 | **13,100** |
| BAU - Roof | - | 1,900 | 1,900 | 2,000 | 1,400 | 900 | 1,400 | 1,400 | 1,400 | 1,400 | 1,400 | 500 | 500 | **16,100** |
| BAU -Total | - | 3,200 | 3,200 | 4,000 | 2,500 | 1,800 | 2,500 | 2,500 | 2,500 | 2,500 | 2,500 | 1,000 | 1,000 | **29,200** |
| Option 1 | **5,500** | 500 | 500 | 500 | 600 | 400 | 500 | 500 | 500 | 500 | 500 | 200 | 200 | **10,900** |
| Option 2 | **8,600** | 400 | 400 | 500 | 400 | 300 | 400 | 400 | 400 | 400 | 400 | 200 | 200 | **13,000** |
| Option 3 | **9,000** | 400 | 400 | 500 | 400 | 300 | 400 | 400 | 400 | 400 | 400 | 200 | 200 | **13,400** |

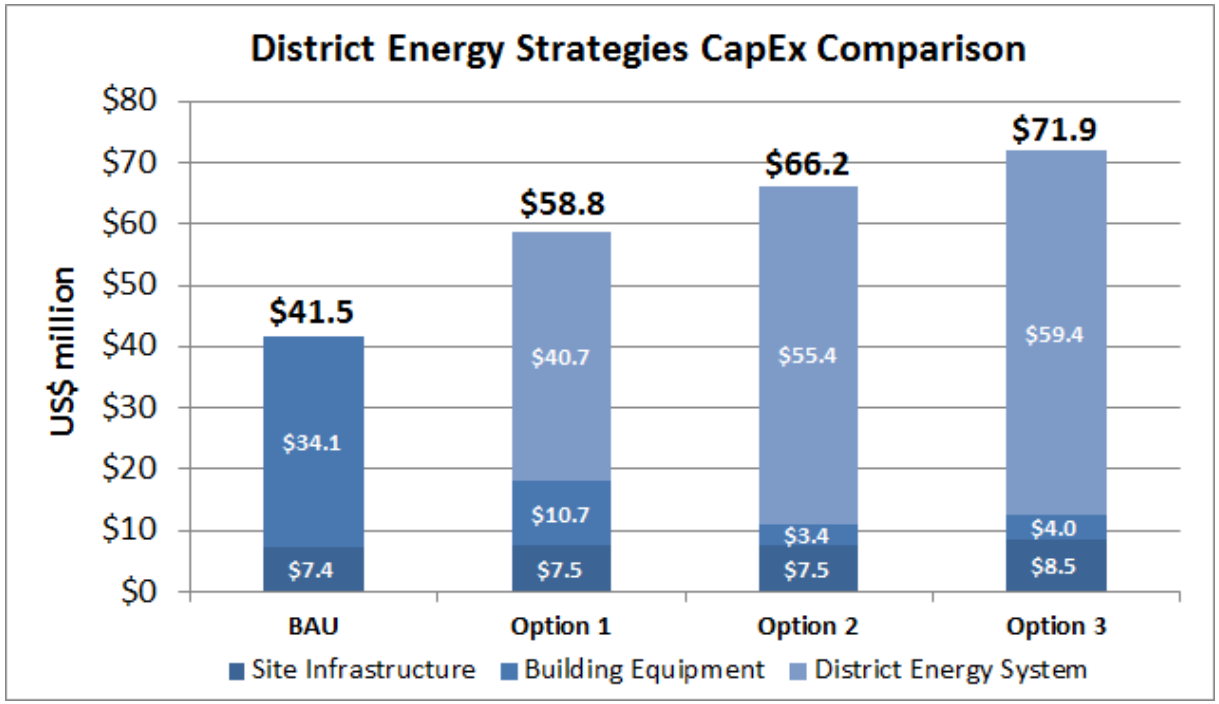
GIANTS MISSION ROCK ARUP

# Business Case

GIANTS MISSION ROCK ARUP

# Capital Costs

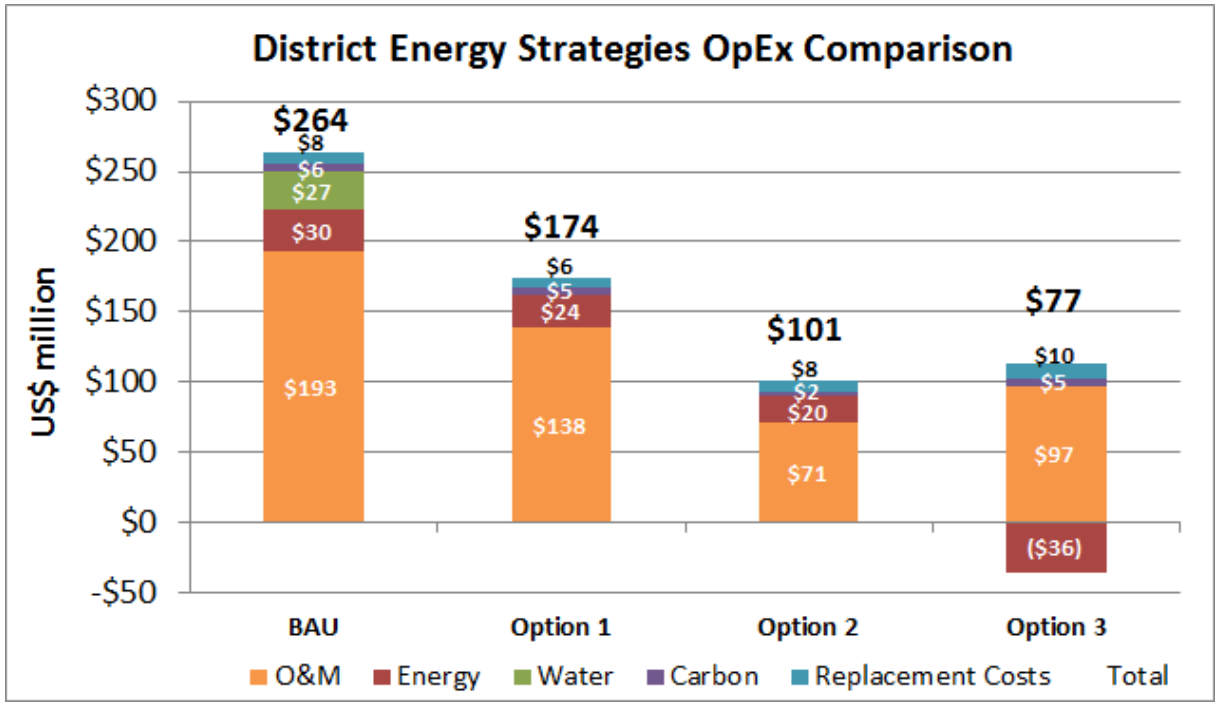
- BAU significantly cheaper
- Distribution of costs will be important
- Will vertical development savings translate into additional parcel value?




GIANTS MISSION ROCK ARUP

# Operating Costs

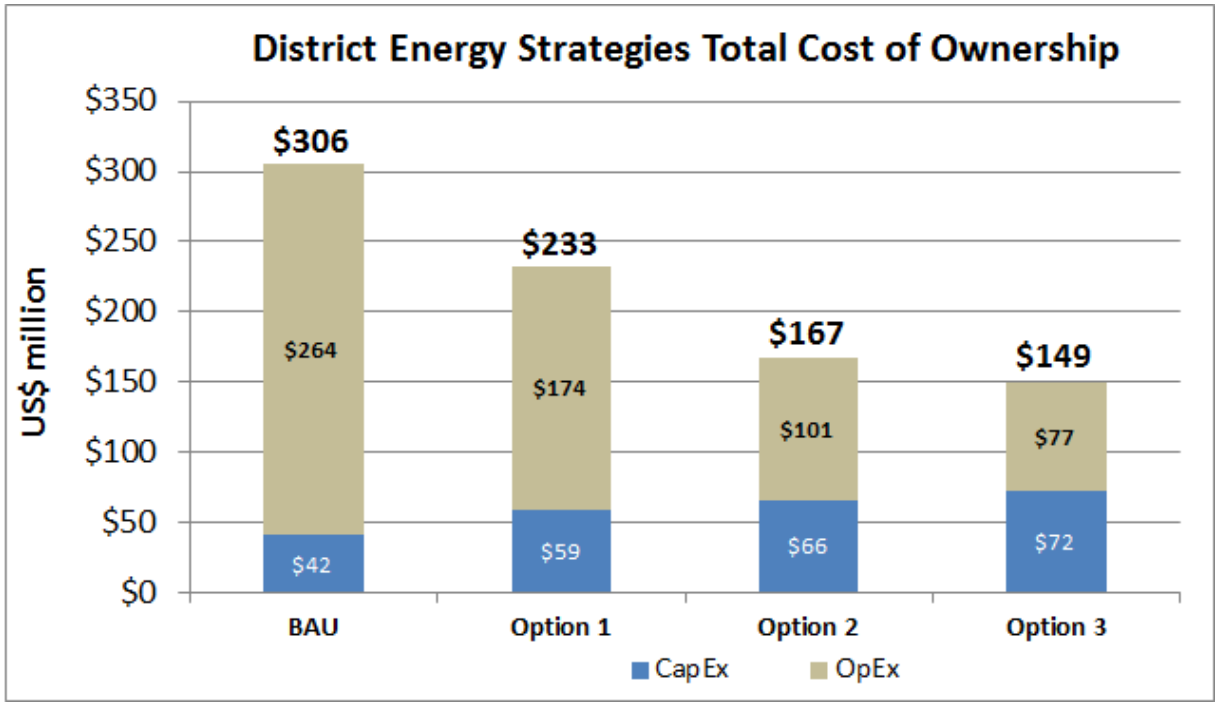
- Significant O&M cost reduction opportunity
- Energy costs greatly reduced in Option 3
- Water is a significant story in BAU
  - Spatial and complexity tradeoffs
- Carbon cost is a small story




GIANTS MISSION ROCK ARUP

# Total Cost of Ownership

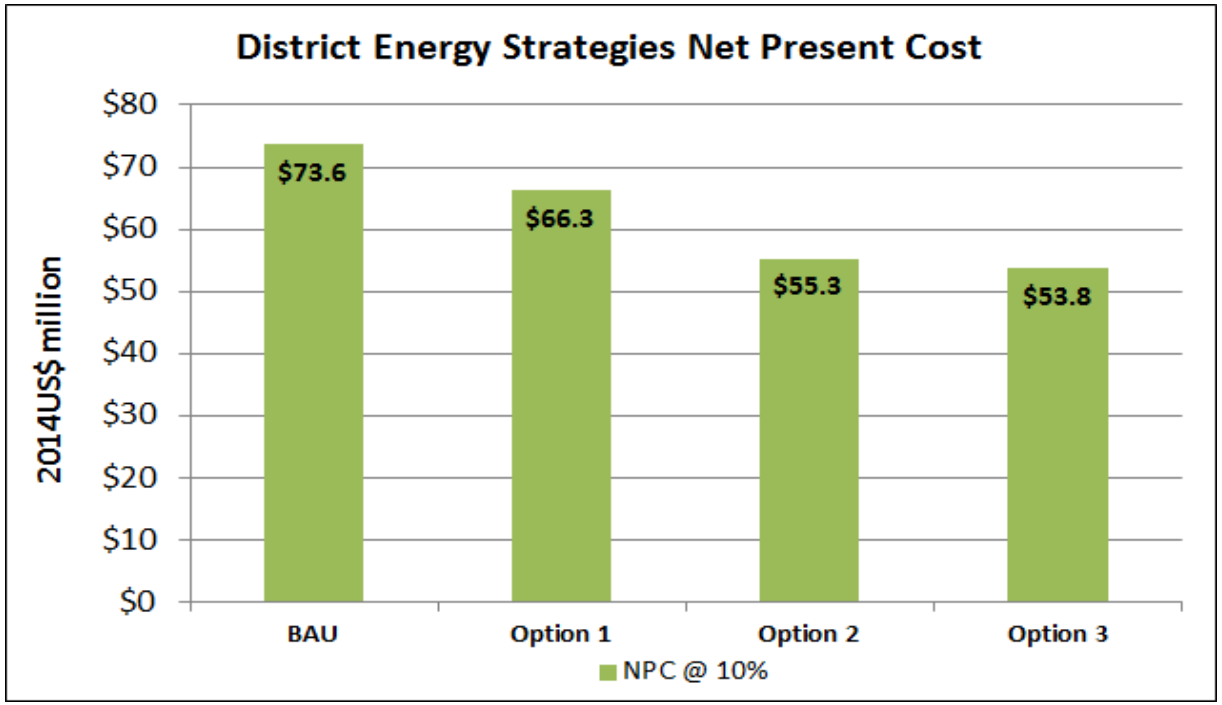
- 1 time capital cost premium vs long term operational cost savings
- Centralization is more economically efficient
- Option 1 can be let go




GIANTS MISSION ROCK ARUP

# Net Present Cost

- IRR on the order of 18%
- Centralization is more economically efficient




GIANTS MISSION ROCK ARUP

# Lessons Learned

GIANTS MISSION ROCK ARUP

# Lessons Learned

- Can never start too early
- Shared investment horizons are critical
- Strong legal framework for mixed ownership developments
- Public financing as a catalyst for private development
- Partnership vs. client/vendor relationship

GIANTS MISSION ROCK ARUP

# Questions