Energy & Store Development Conference

E+SD 2013

FMI™

THE VOICE OF FOOD RETAIL

Energy & Store Development Conference

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Executing a Net Zero Energy Design for Retail

Introduction

Photo Courtesy of Camburas and Theodore Architects

This presentation is about firsts

- First Net Zero Energy Retail application of its size
- First R744 refrigeration, heating and cooling system
- First time geothermal, solar and wind were combined on a Walgreen's project
- This is a showcase of innovation and clean technology

WALGREEN'S MISSION STATEMENT

1. Create a showcase for innovative, sustainable, high-performance design at a retail location without altering the operational characteristics of the building in order to make it as highly-scalable as possible.

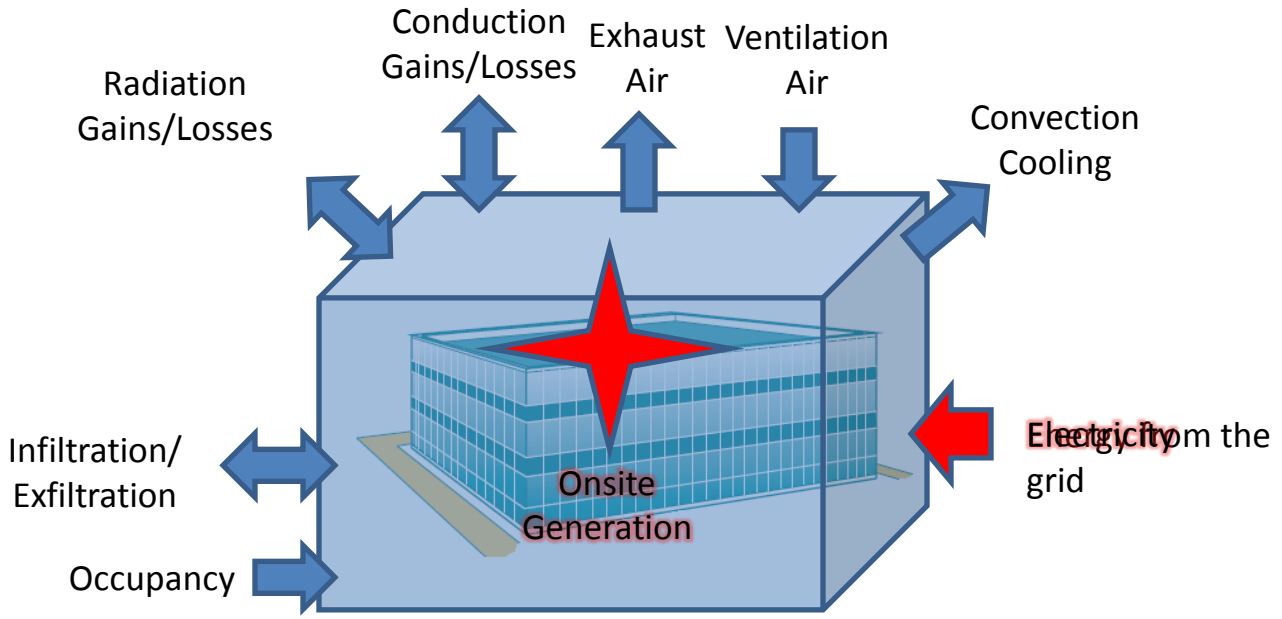
WALGREEN'S MISSION STATEMENT

2. Share this information with the sustainability, architecture, and retail communities in a completely transparent fashion as a means of encouraging the adoption of green building practices wherever reasonably feasible.

Agenda

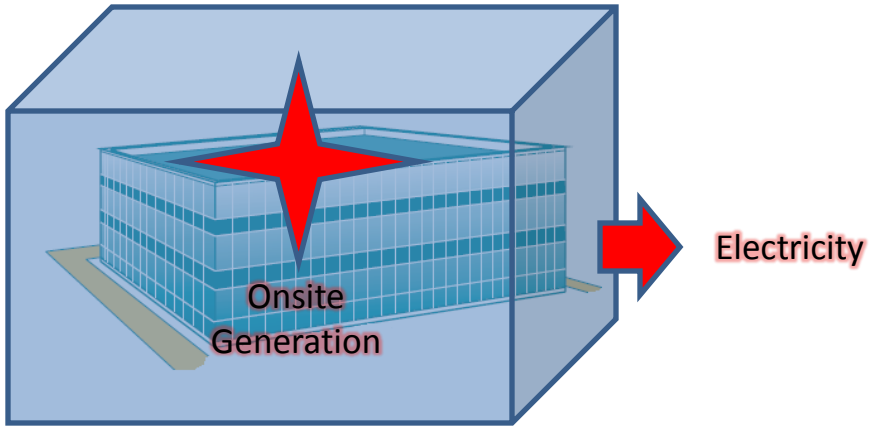
- What is Net Zero?
- Discuss the Evanston, IL project.
  - Evaluating the feasibility of Net Zero.
  - Building on vendor partnerships.
  - Arriving at the final design
- Summarize key take-aways
- Questions

What is Net Zero Energy?



Onsite Generation > Onsite Energy Consumption Over 1 Year

What is Net Zero Energy?



- Electric energy is generated by Solar PV and Wind
- 2-way connection with the utility meter
- Excess production is paid for by the utility

Evanston Annual Results

1. Solar generates 212,260 kWh
   - 849 x 265W Panels
2. Wind generates 7,219 kWh
   - 2 x 2000W Turbines
3. Building requires - 200,571 kWh
   - 14.3 kWh/SF

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4. Returned to the grid 18,908 kWh

Section 1

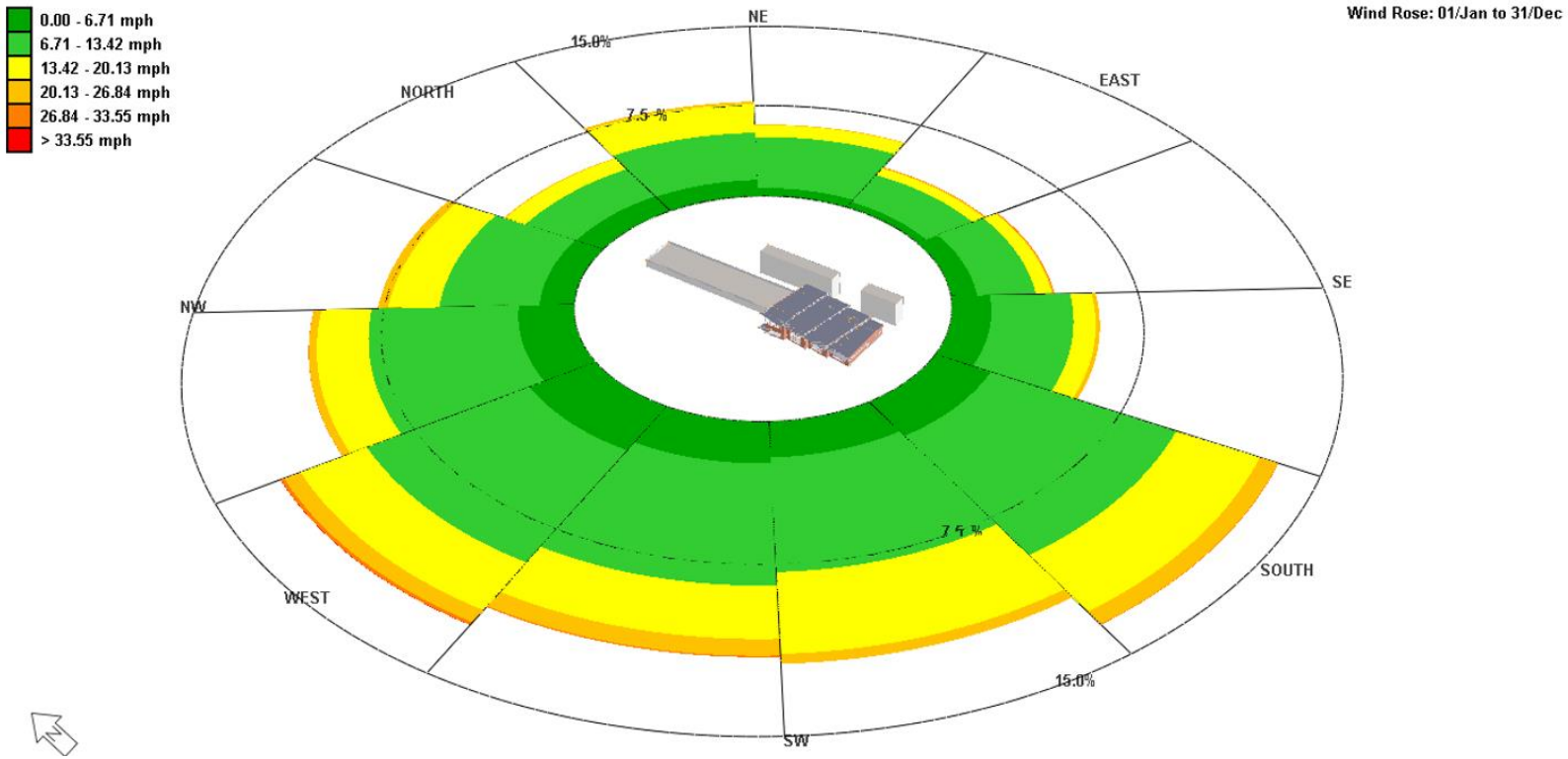
THE PROCESS OF DESIGNING FOR NET ZERO

Multi-faceted modeling

- Renewable generation capacity
- Envelope and load minimization analysis
- Evaluation of highest efficiency systems
  - HVAC
  - Lighting
  - Refrigeration

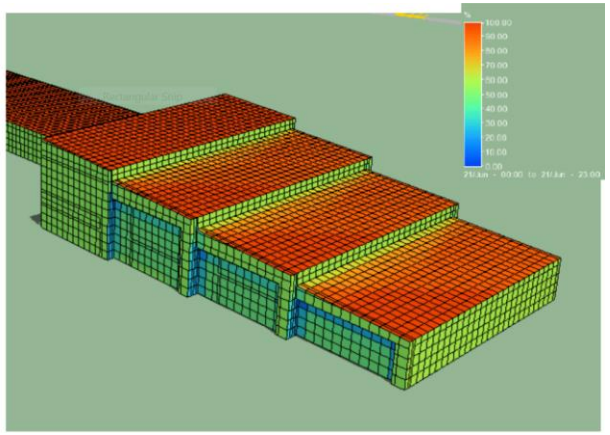
Solar Photo Voltaic Design

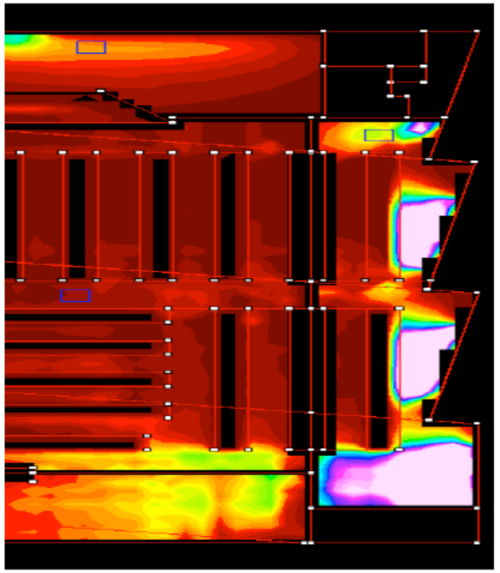
Wind Rose Analysis



Load Minimization

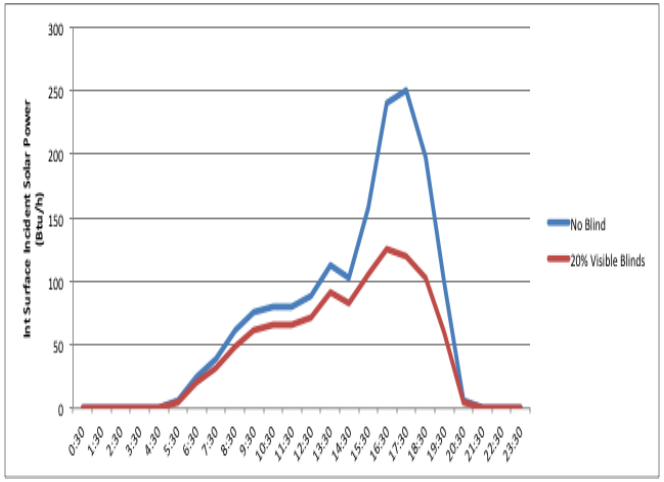
- Step 1- Selecting efficient envelope
- Step 2- Define internal gains (lighting)
  - Daylight harvesting
  - Shading controls
- Step 3- Apply loads to a selected alternate HVACR systems



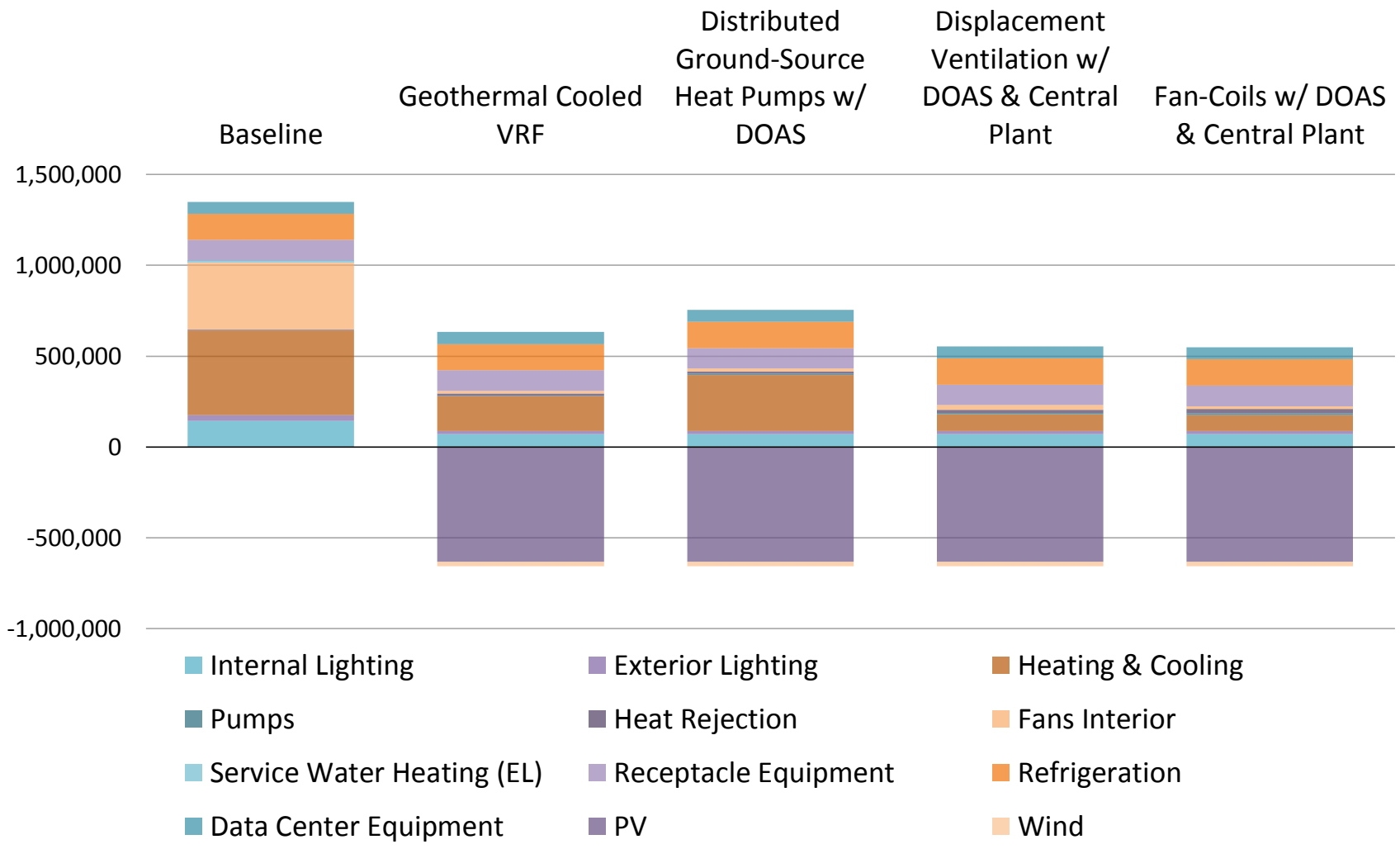


Energy Model Results

- Load reduction efforts: (14.3 W/SF)
  - .41 U-Value/ .26 SHGC
  - R-19 Wall Assembly/R-26 Roof
  - Revolving door at entry
- Daylight harvesting:
  - Reduce energy 17,402 kWh
- Shading controls:
  - Reduce load 50 %



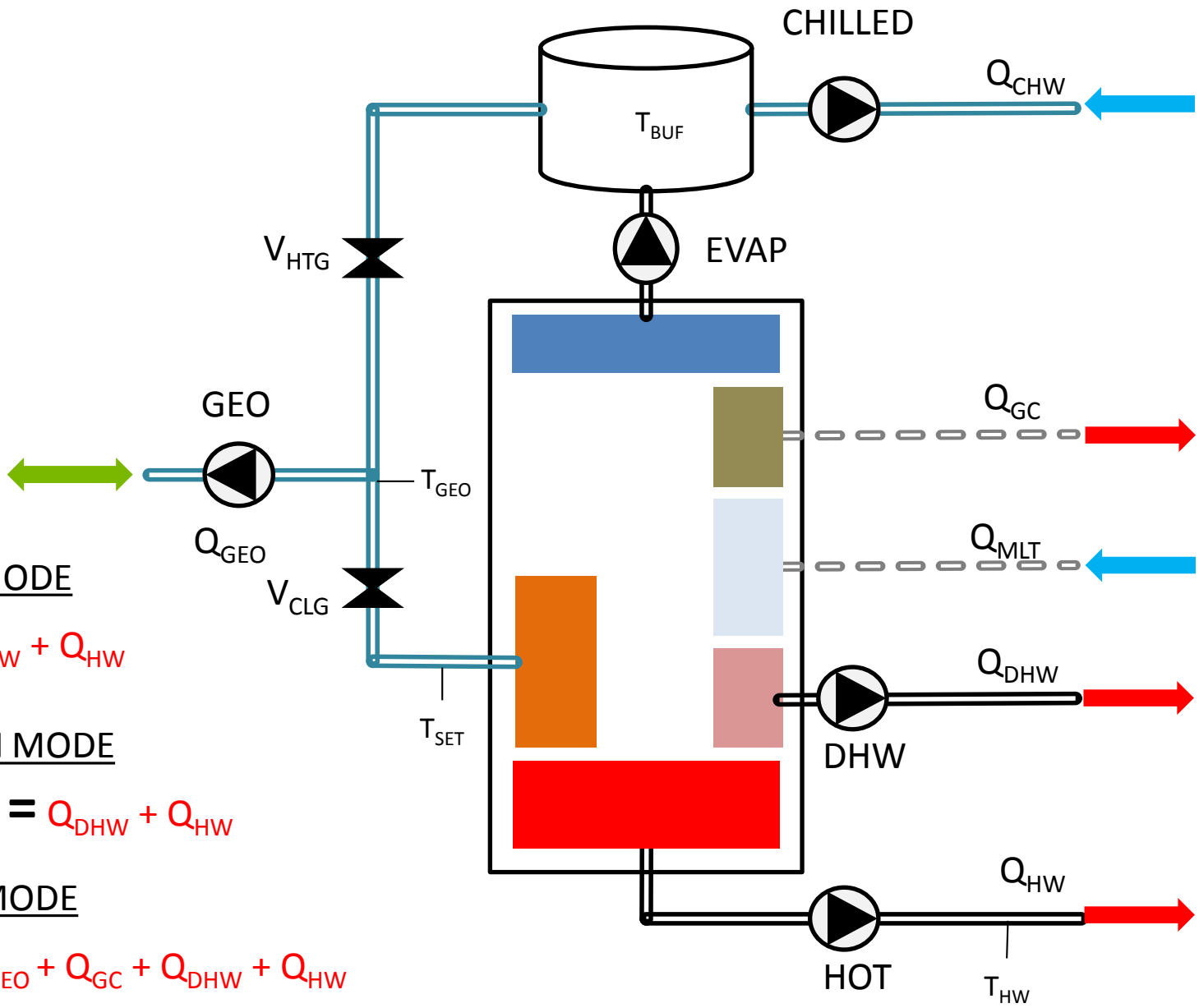
Energy Model Results



Commissioning is Vital

- Cloud-based contractor functional testing
- Wi-fi enabled device scans each systems QR Code label
- Sequence of operations is tested and compared to energy model

Functional Testing



HEAT RECOVERY MODE

$Q_{MLT} + Q_{CHW} = Q_{DHW} + Q_{HW}$

HEAT ABSORBTION MODE

$Q_{MLT} + Q_{CHW} + Q_{GEO} = Q_{DHW} + Q_{HW}$

HEAT REJECTION MODE

$Q_{MLT} + Q_{CHW} = Q_{GEO} + Q_{GC} + Q_{DHW} + Q_{HW}$

Role of Owner

- Owner support of load reduction is crucial
- Protect against unnecessary loads:
  - Under shelf lighting
  - Powered end cap display
  - Revolving door rather than foyer
- Staff training

Section 2

BUILDING ON VENDOR PARTNERSHIPS

Owner Project Requirements (OPR)

- Owner input
- Vendor input
- Energy model
- Bid drawings
- Pricing

- Contractor feedback
- Selection
- Energy model
- Bulletins + Addenda

- RFI's
- Submittals
- Finalize model
- Shop drawing

- Cx
- M&V

Design Partners

Camburas and Theodore (Architects)

GI Energy (Geothermal)

Energy Center of Wisconsin (Energy Model)

SoCore (PV Design)

CTA Group (Refrigeration)

WMA Engineering (MEP/FP/ LEED)

Cyclone Energy (LEED Energy Model + Cx)

Build Partners

Osman Construction

GI Energy (Geothermal)

FourStar (Electrical)

SoCore (PV Design)

CTA Group (Refrigeration)

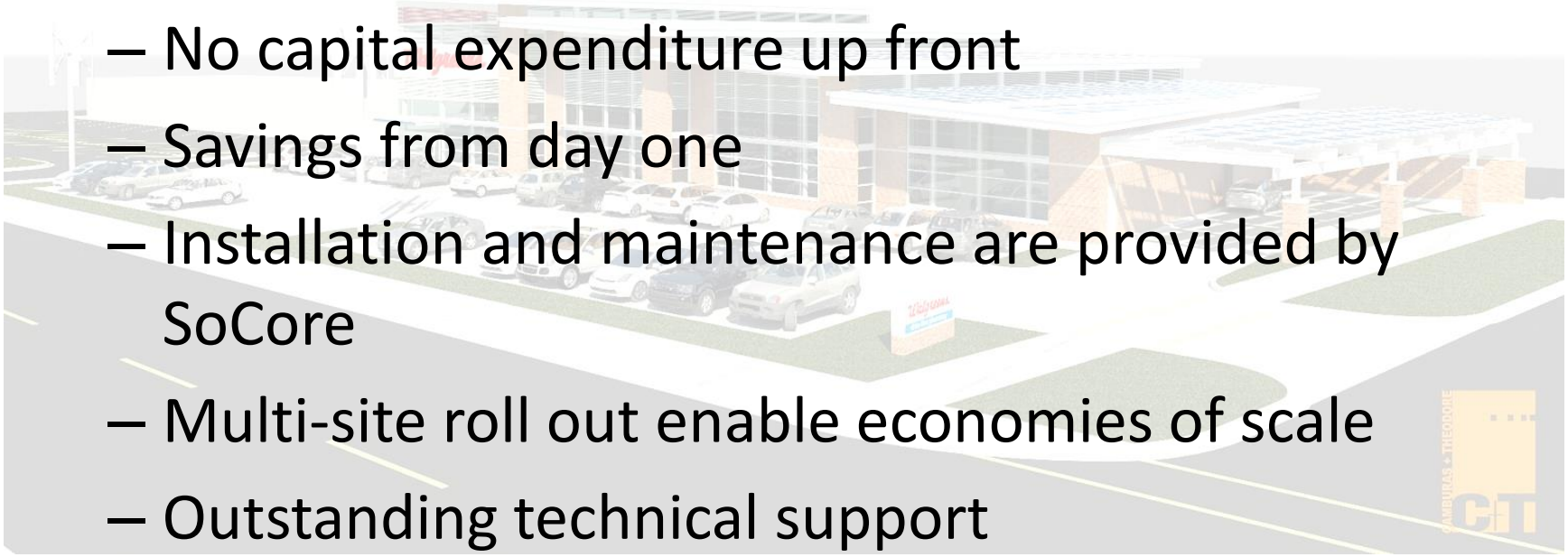
Admiral (Mech)

Trane (BAS)

Fenestration, Shade Controls, Site, Etc.

SoCore Energy– Design/Build/Finance

- Rolling out 200+ Walgreen's sites
- Finance projects via power purchase agreements (PPA)
  - No capital expenditure up front
  - Savings from day one
  - Installation and maintenance are provided by SoCore
  - Multi-site roll out enable economies of scale
  - Outstanding technical support



GI Energy – Turnkey Design/Build

FINANCINGS SOLUTION THAT ELIMINATES UP-FRONT COST

Information Collection

- Feasibility Study
- Budget Pricing
- Conductivity Test
- Grant application
- Tax-credit calculation

Design

- Groundloop Design
- Equipment Specification
- Construction Specification

Installation

- Drilling / Installation into Foundation Piles
- Headering / Manifold Construction
- Flushing / Testing

In-building

- Equipment Supply
- Equipment Testing & Commissioning

Maintenance

- On-going System Maintenance
- System Performance Guarantee

Walgreen's Pilot Geo Project

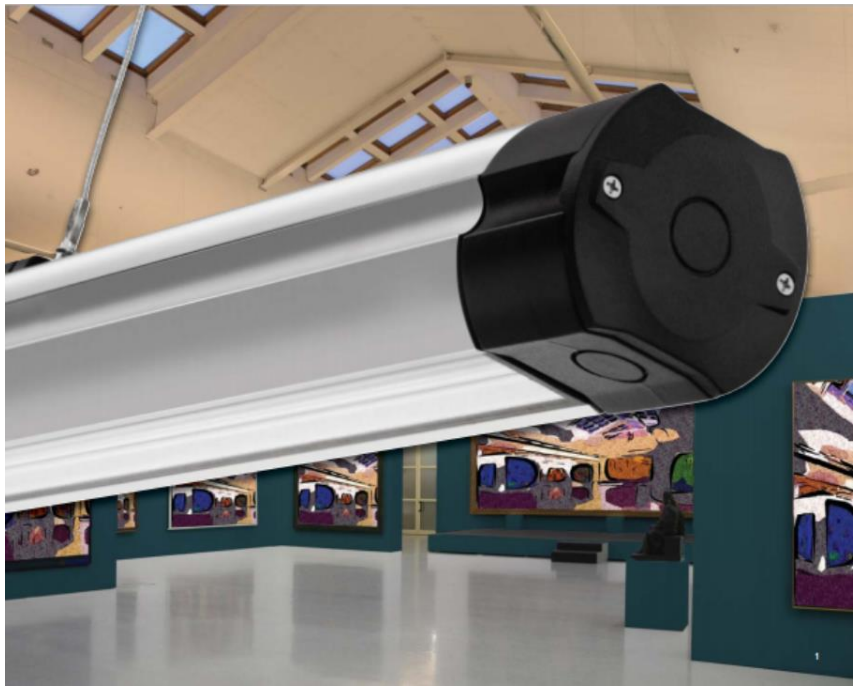
- Combined refrigeration
- Mechanical mezzanine above the coolers
- Hybrid geothermal
- Distributed rooftop heat pumps

Pushing the envelope

- Prime designer for MEP/LEED
- Sourced CO2 compressor pack from Sweden
- Developed custom model in conjunction with LEED modeler and manufacturer
- Install mechanical systems
- Install controls
- Install geothermal field

Lithonia- Product Development

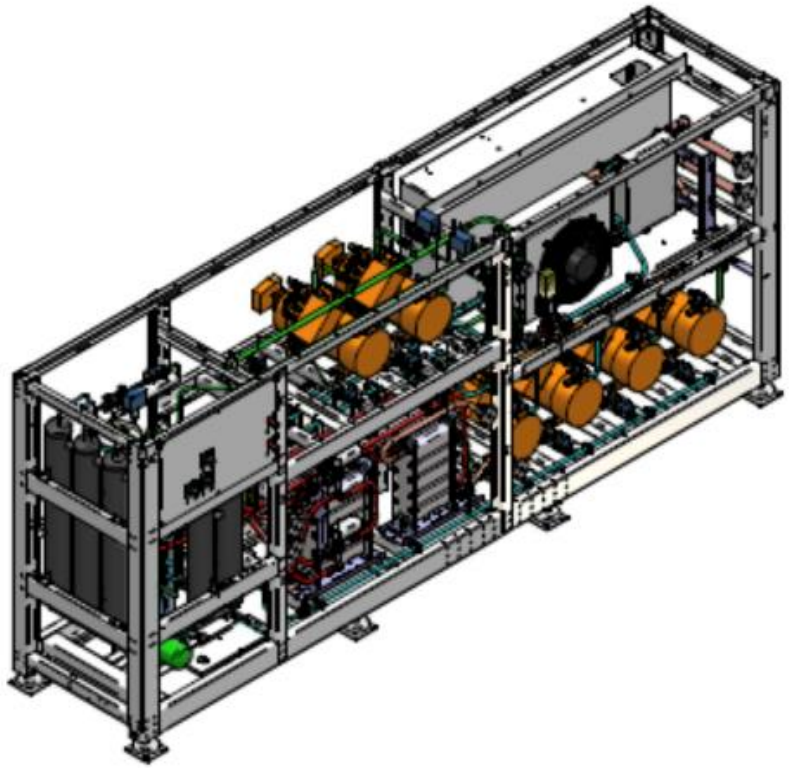
- Initial selection did not have sufficient efficacy
- Achieves .9 W/SF
- 50 foot candles
- <u>System has already been implemented in WAG criteria stores!</u>



Section 3

ARRIVING AT THE FINAL DESIGN

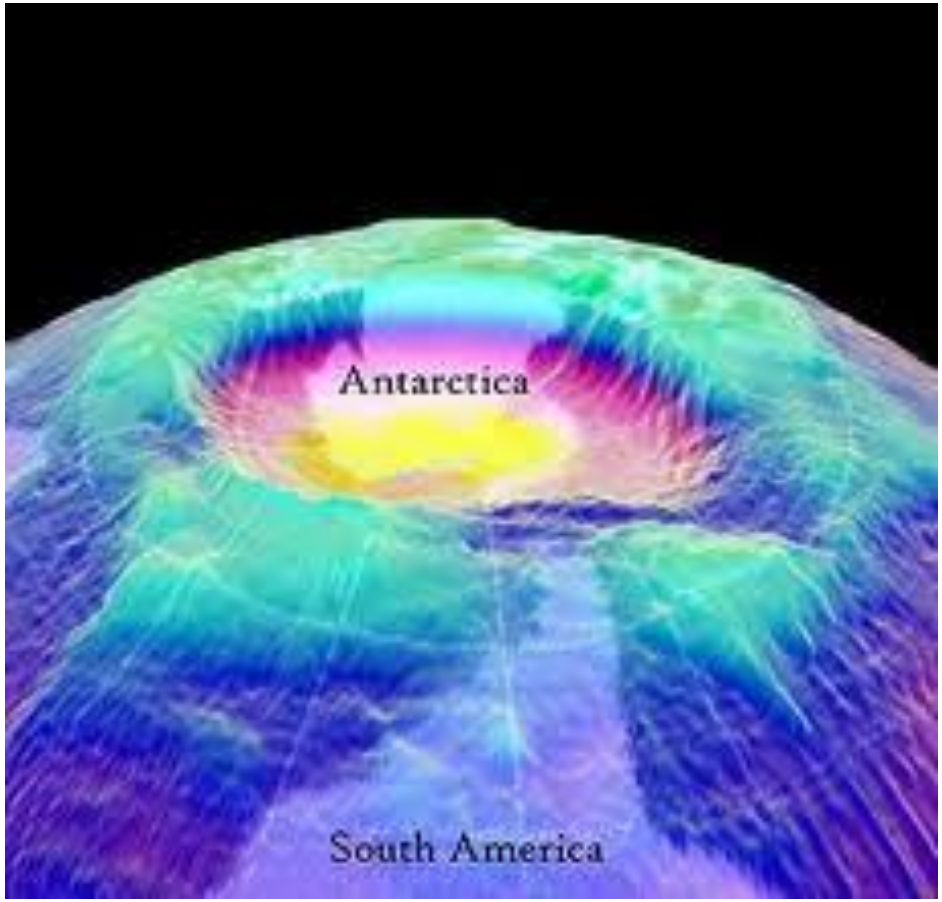
Central CO2 Plant



HANDLES:

- Heating load
- Cooling load (HT)
- Cooler load (MT)
- Freezer load (LT)
- DHW load
- Heat reclaim to building loop and geothermal field

Why CO2?



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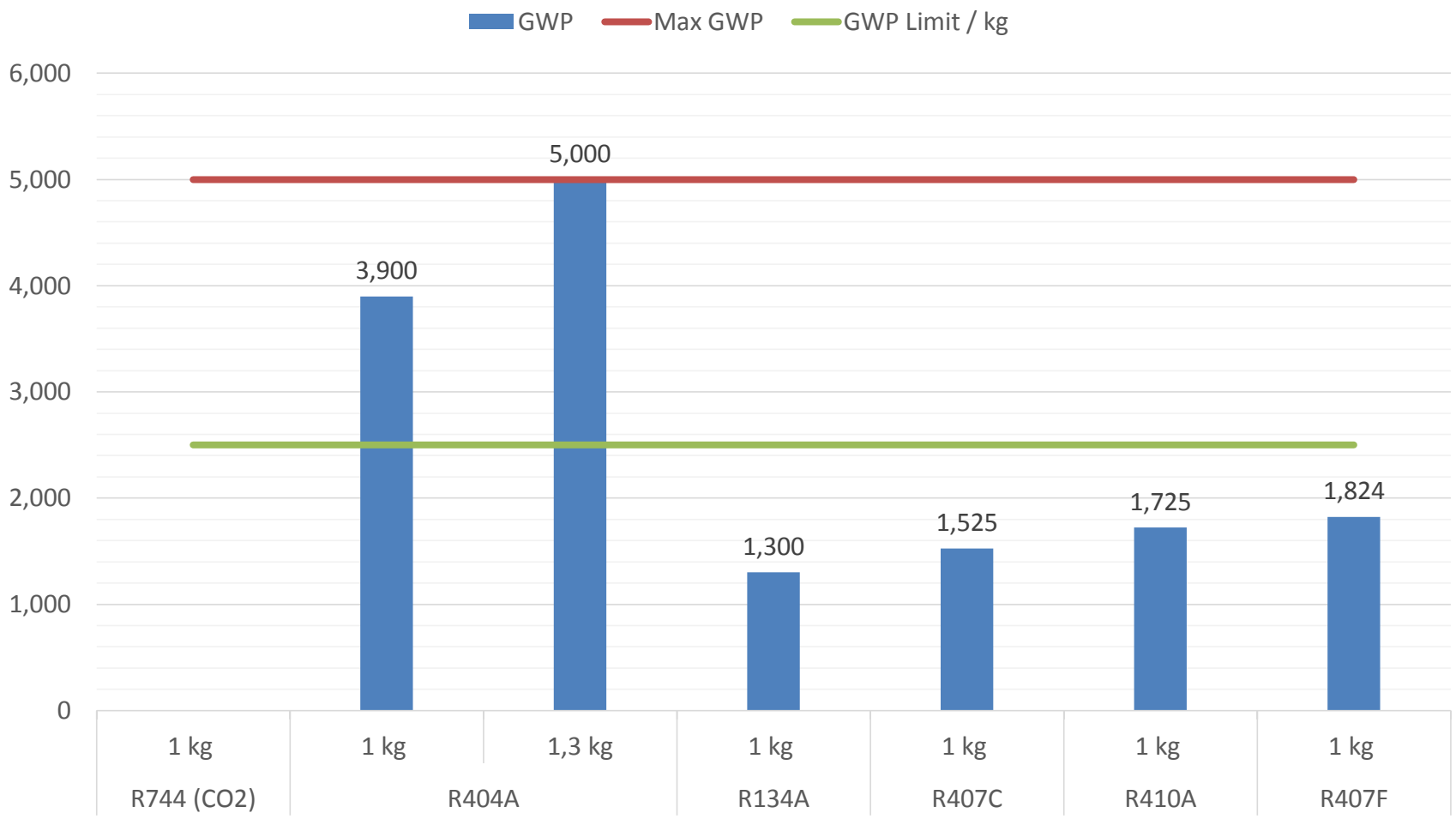
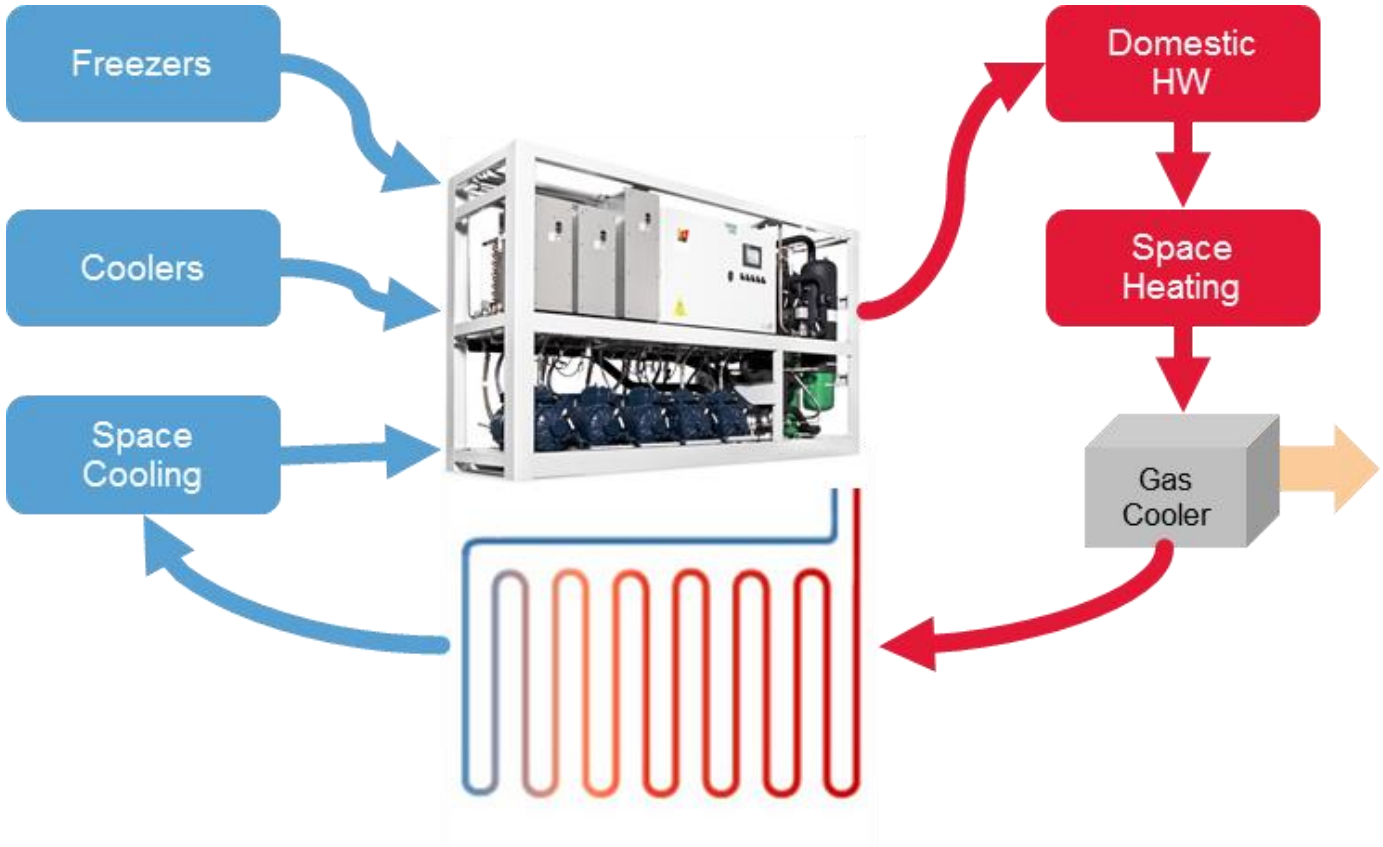
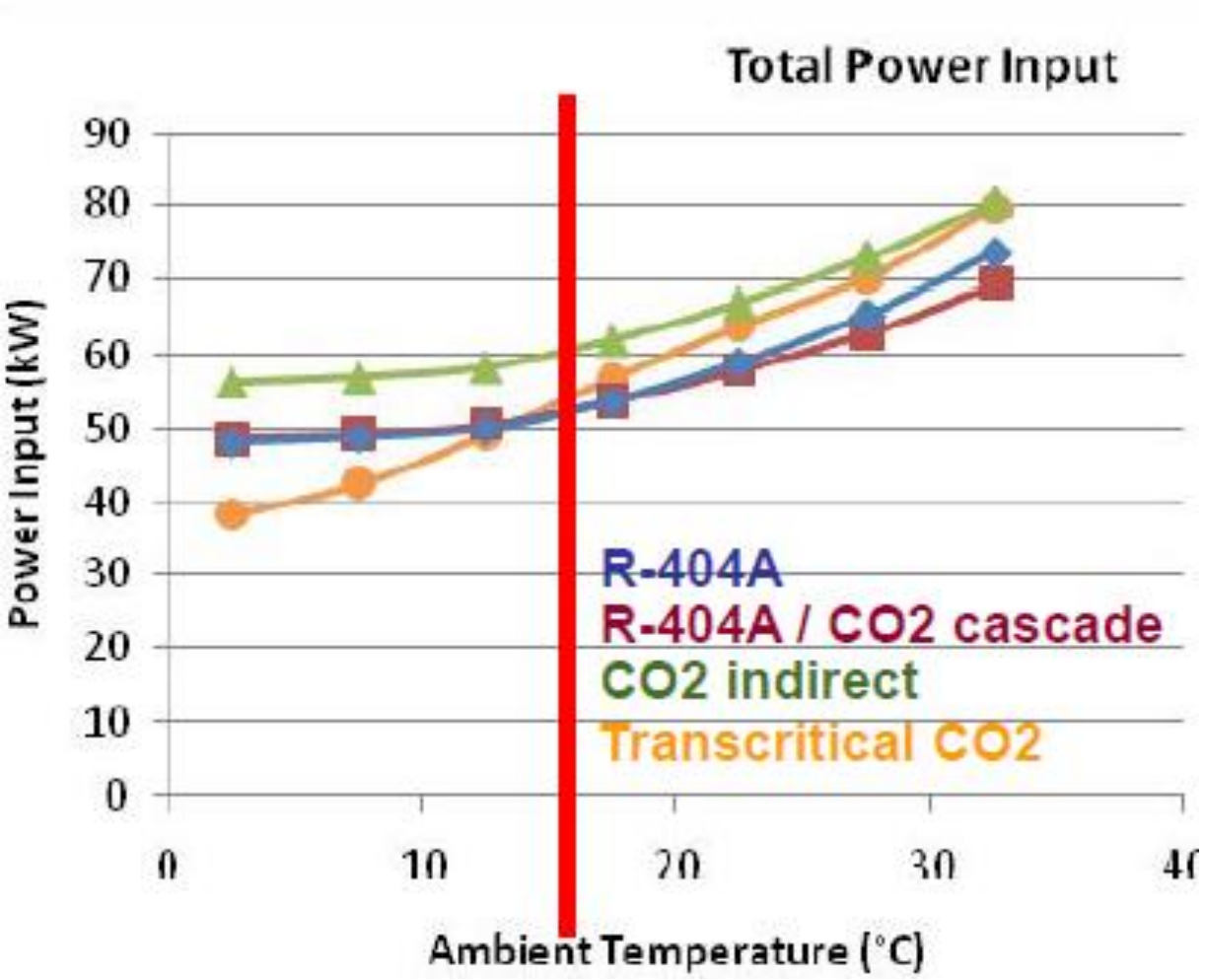

GWP
Max GWP
GWP Limit / kg
6,000
5,000
4,000
3,000
2,000
1,000
0
3,900
5,000
1,300
1,525
1,725
1,824
1 kg
R744 (CO2)
1 kg
1,3 kg
R404A
1 kg
R134A
1 kg
R407C
1 kg
R410A
1 kg
R407F

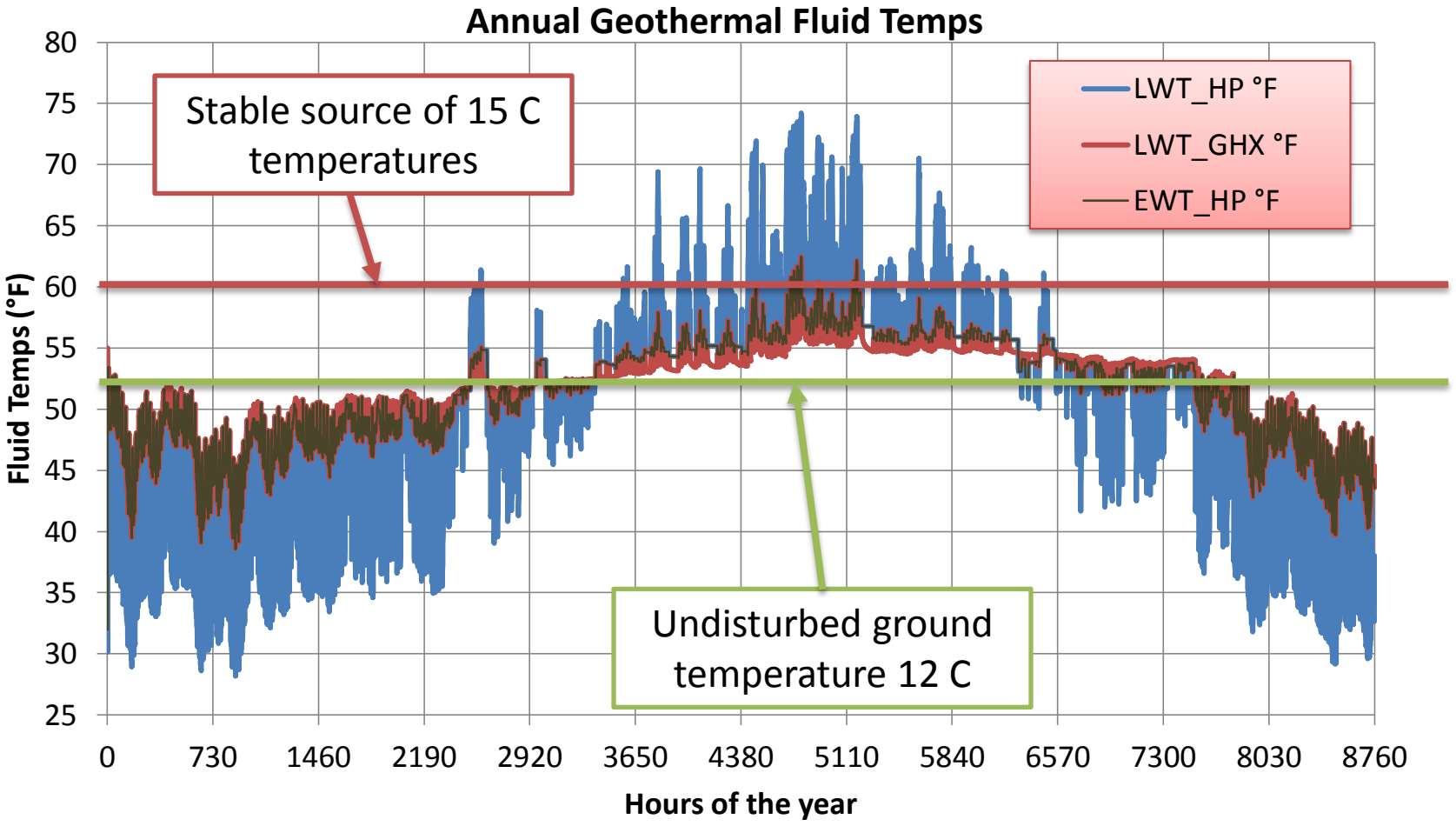
Why CO2 Central Plant?



Why CO2 and Geothermal?



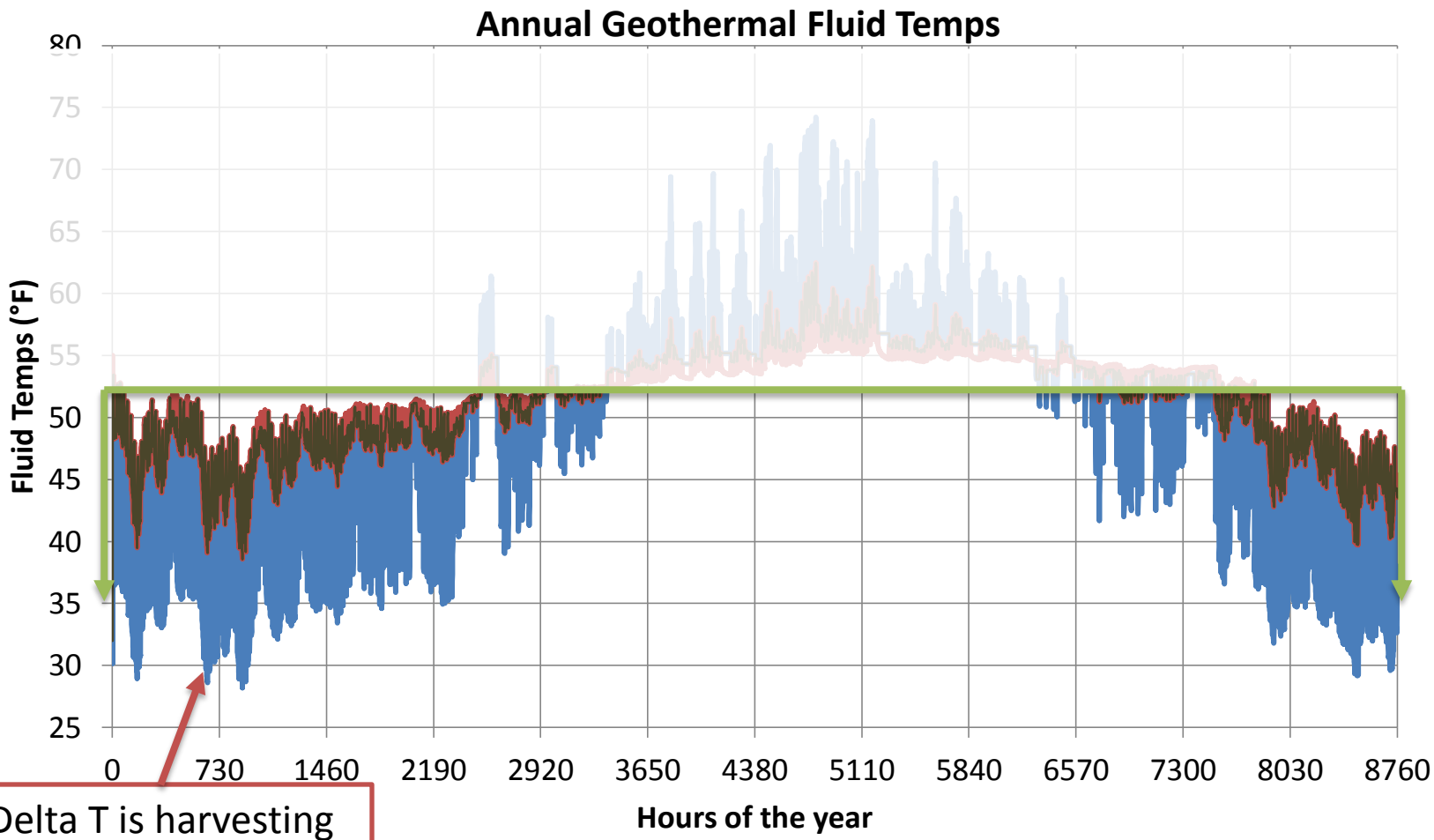
Why CO2 and Geothermal?



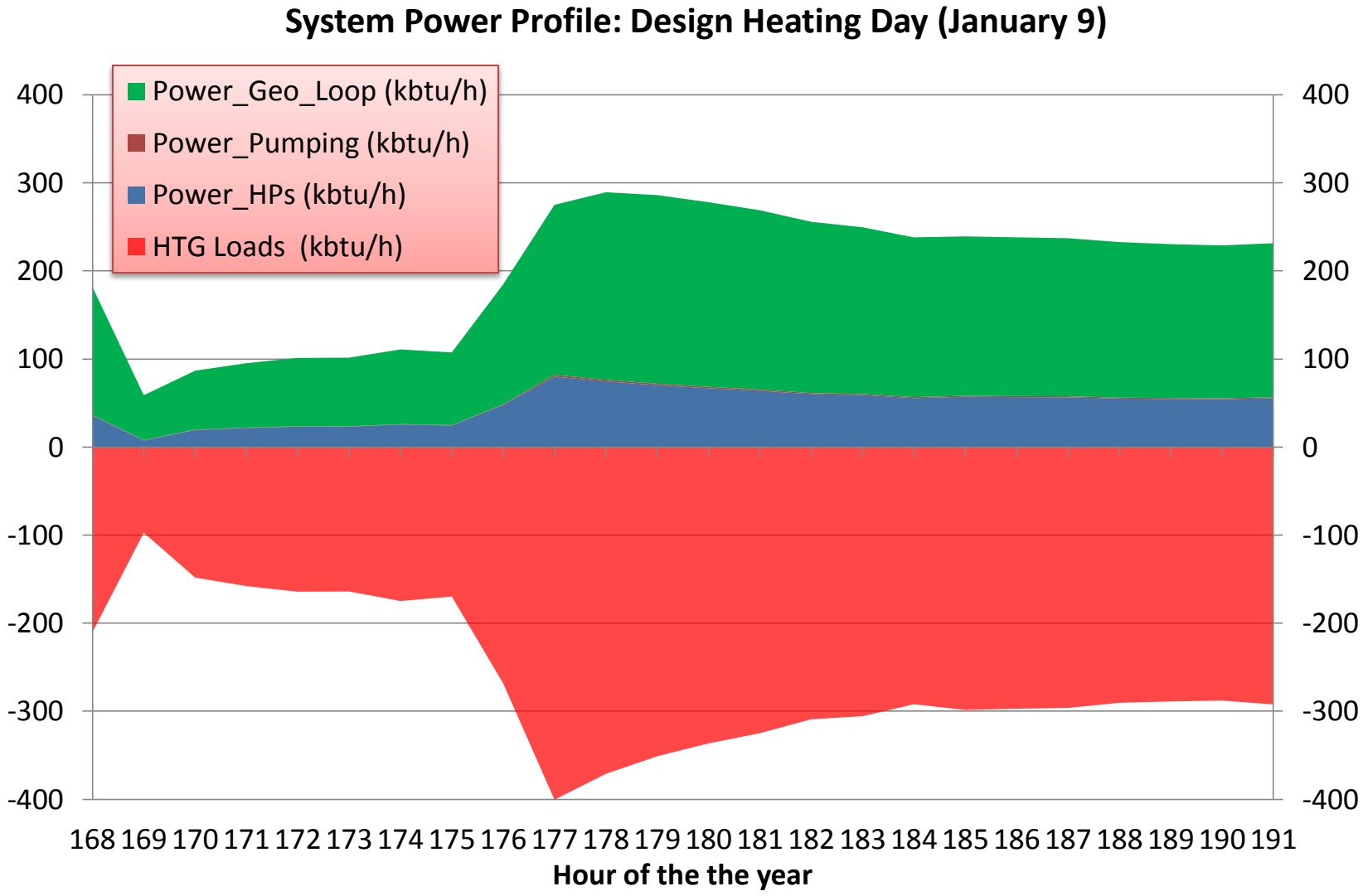
Why CO2 and Geothermal?

- Exceeds standard R410 capacity output temperatures so coils can be smaller.
- Operates at extremely high delta T, which means low flow rates and lower pumping energy
- Enables “hybrid” geothermal design by displacing heat to the gas cooler.

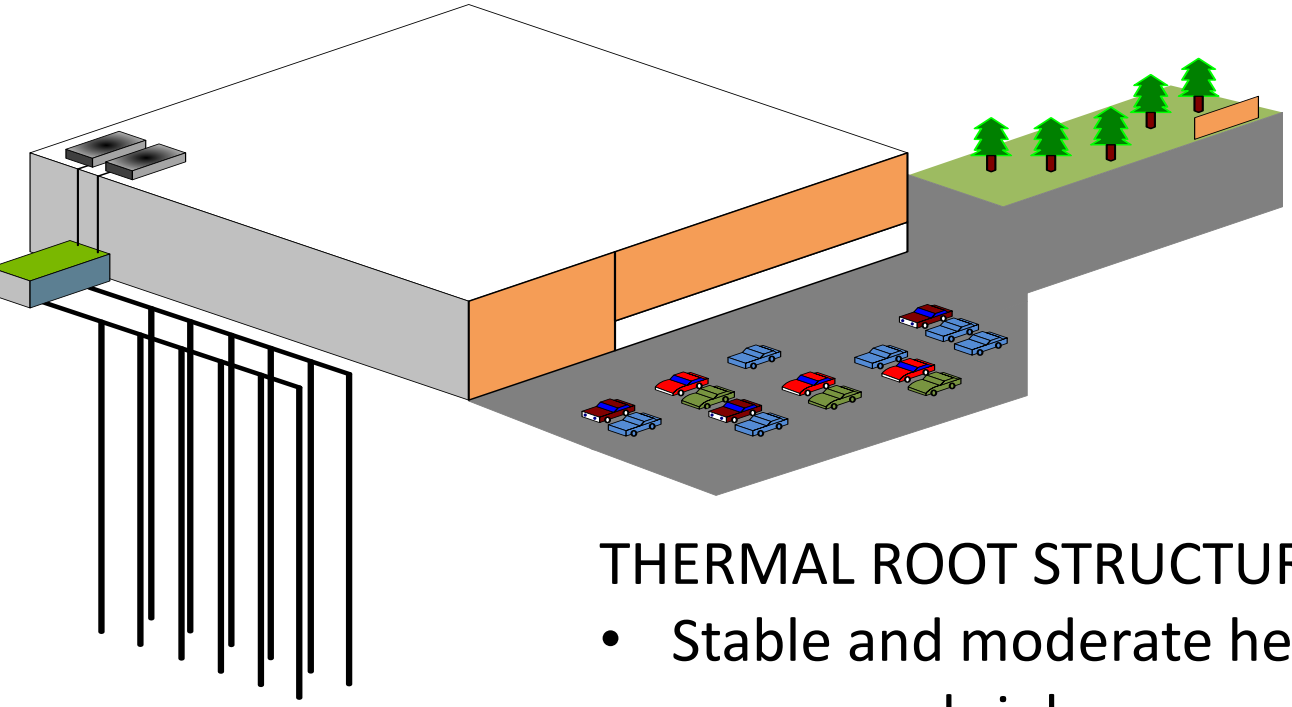
Why Geothermal?

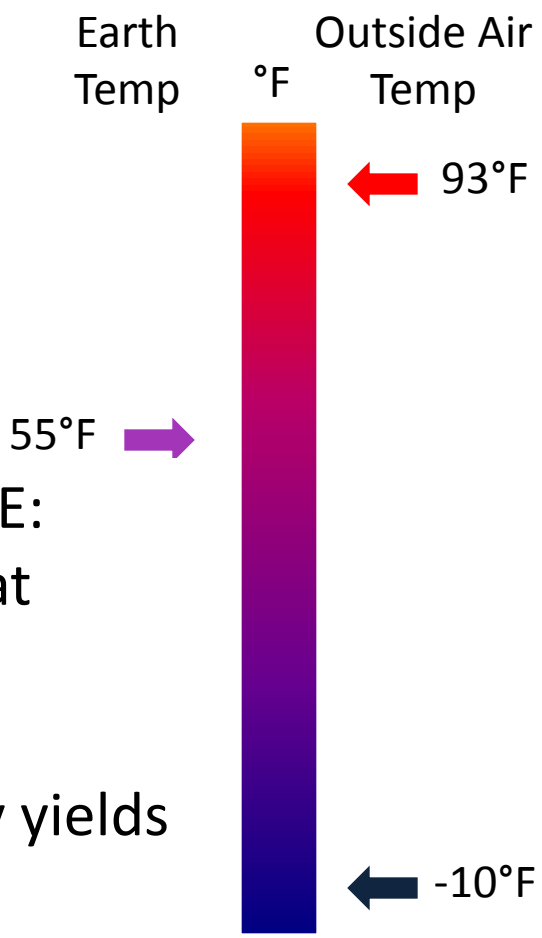


Why geothermal?



Benefits of Geothermal





THERMAL ROOT STRUCTURE:

- Stable and moderate heat source and sink
- Coupled with vapor compression technology yields
  2.5X efficiency in cooling
  5X efficiency in heating

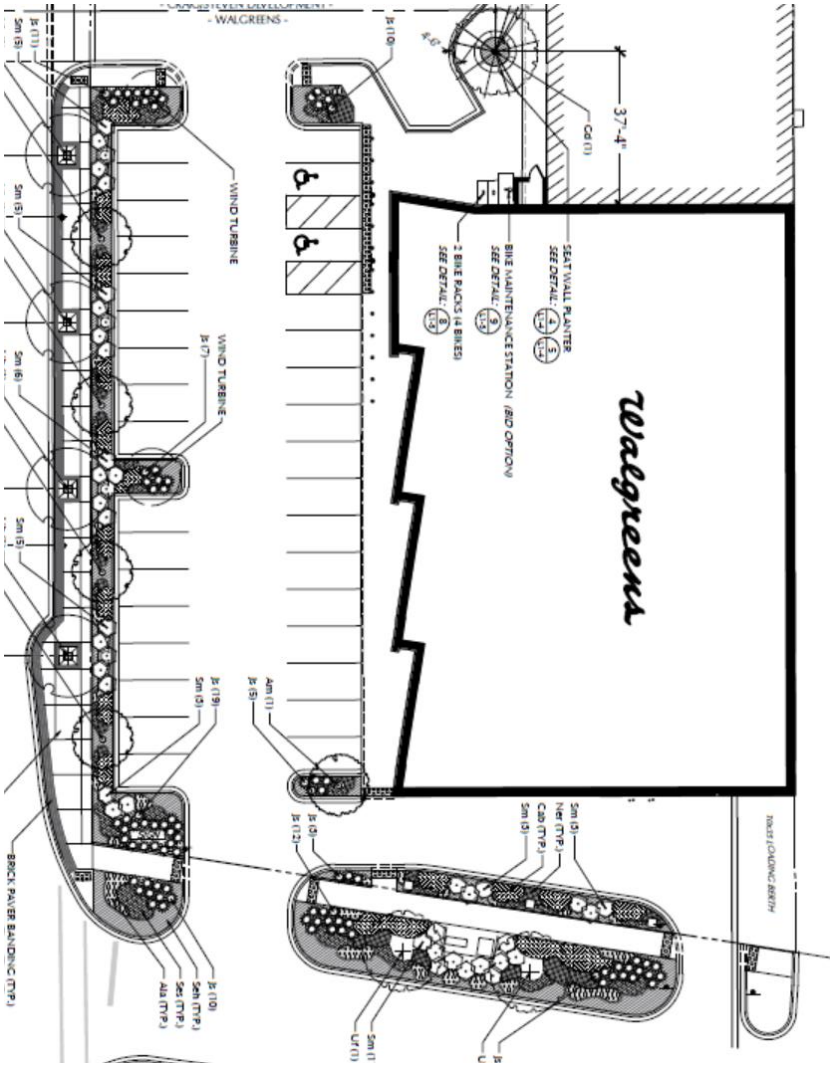
Other Benefits of Geothermal

- Minimal maintenance required.
- Federal tax incentives reduce cost by 50% in the first 5 years.
- Tax equity financing is being developed to provide geothermal similar to PPA's in solar and wind.
- Demand reduction.
- Multiple state and utility incentives.

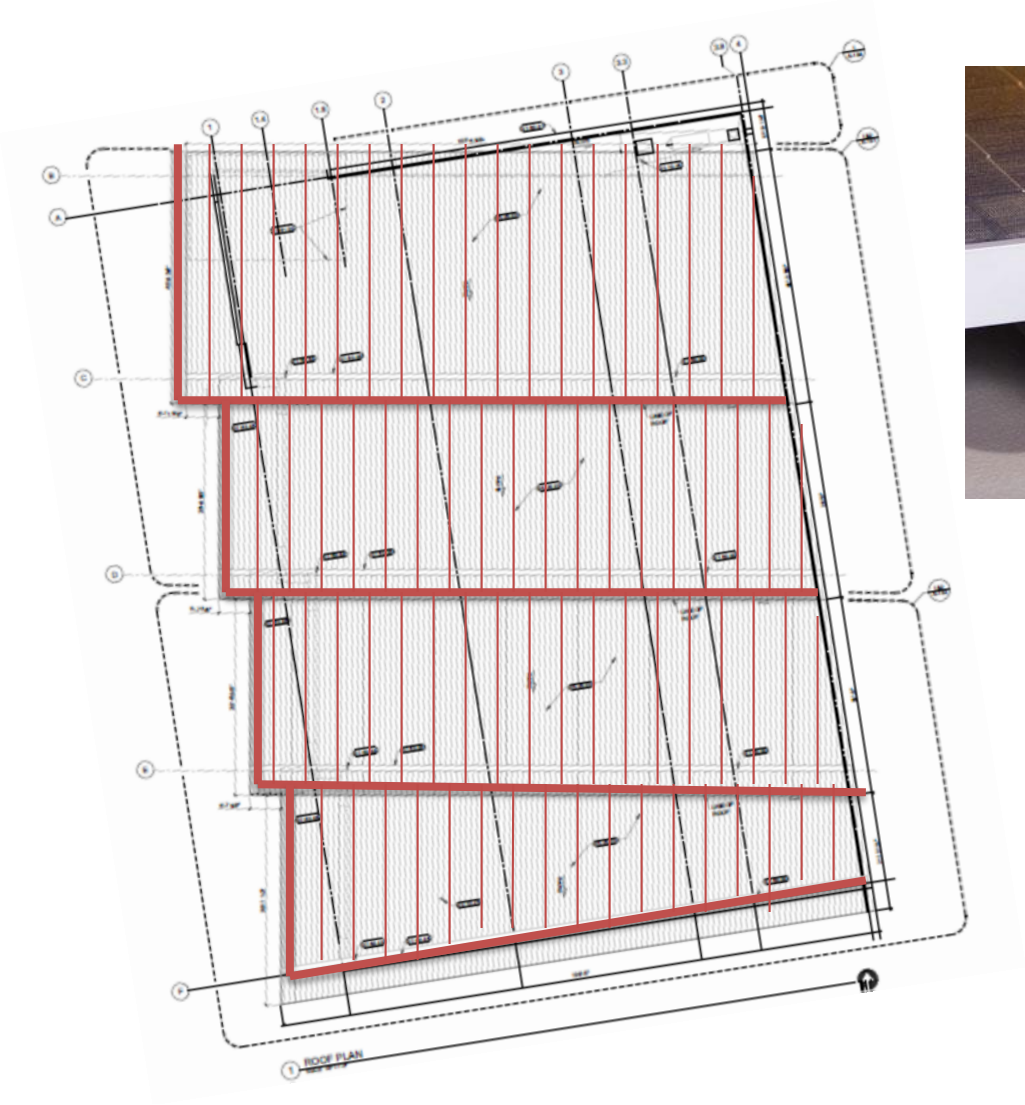
Mechanical Design Elements

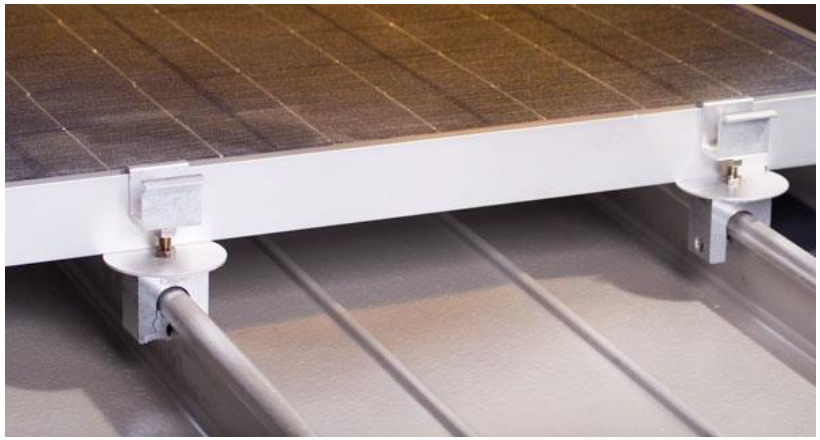
- 100 % outside air system
- Demand control ventilation
- Monitoring CO2 levels
- Ethanol freeze protection reduces pumping energy
- Mechanical equipment is on mezzanine above freezer cooler
- Almost zero rooftop equipment
- Air curtains at each opening

Solar Photo Voltaic Design



Solar Photo Voltaic Design



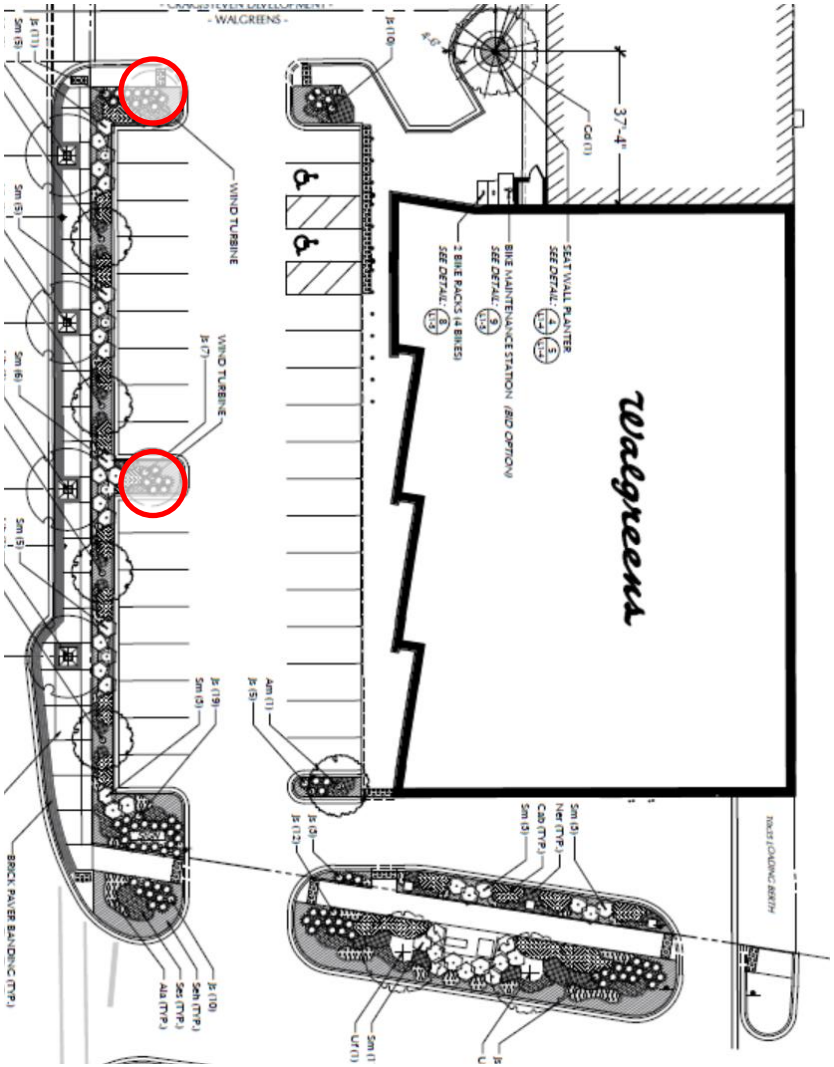


Solar Photo Voltaic Design

- Maximizes roof space for given site
- 3% tilt maintains interior ceiling height
- Standing seam roof design simplifies installation and maintenance
- Bi-directional electric meter
- Conservatively exceeds projected energy consumption to achieve Net Zero

Wind Turbine

- By Wing Power of MA
- 30’ tall
- Visible from public transit
- Contribute ~7,200 kWh



Section 4

CONCLUSION

Take Aways

- Once max renewable capacity is established: Load reduction gets you most of the way.
- Working with partners in the design/build community who go above and beyond
- Stay tuned on the Evanston project!
  - Like “Evanston Net Zero Community” on Facebook!
  - Look for technical white papers, forthcoming.

Making an Impact

- Scalable energy savings from LED innovations applied to multiple Walgreen's projects
- 13,700 kWh of savings per year, just from the LED design implementation in other stores
  - Enough electricity to power 10,000 homes
  - 7.4M gallons of gas
  - 1.7M trees

Final Note: “First Follower”

Questions?