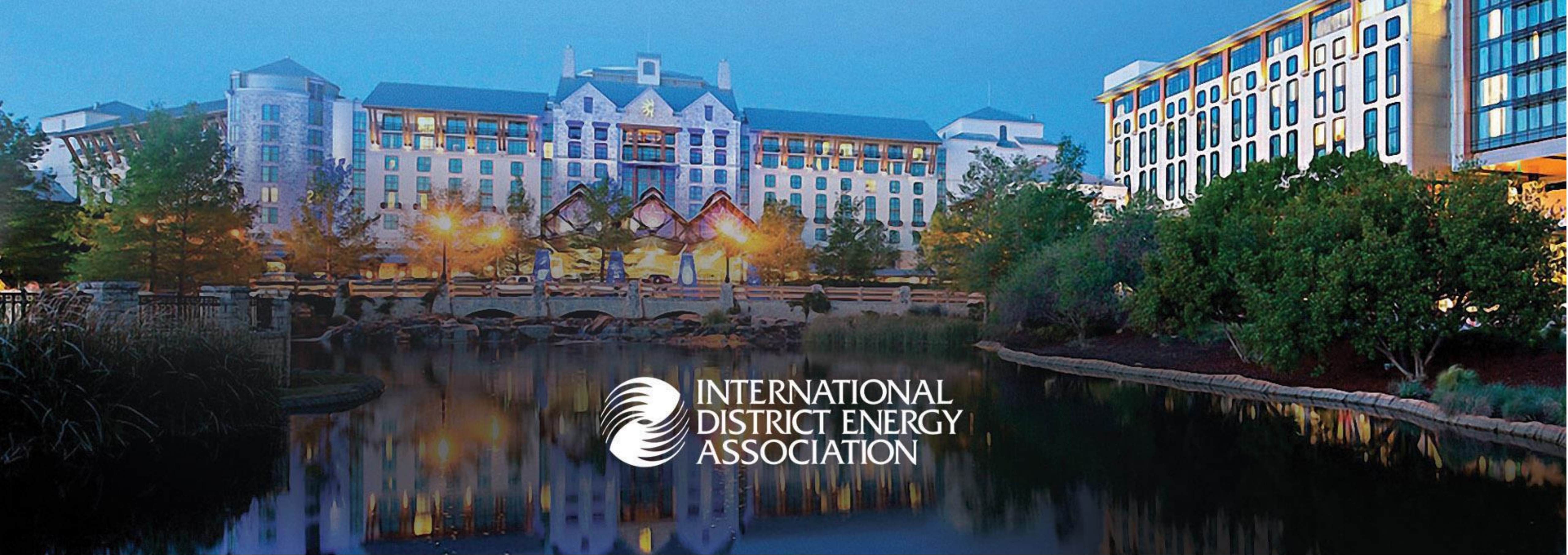
De-Carbonizing the Campus: Planning, Tools & Technologies

CampusEnergy2023

February 27 – March 2, 2023

Gaylord Texan Resort & Convention Center | Grapevine, Texas



Decarbonization of an Industrial Campus

Track 5A3 Decarbonizing with District Energy / Escondido

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+ architecture

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INTERNATIONAL DISTRICT ENERGY ASSOCIATION

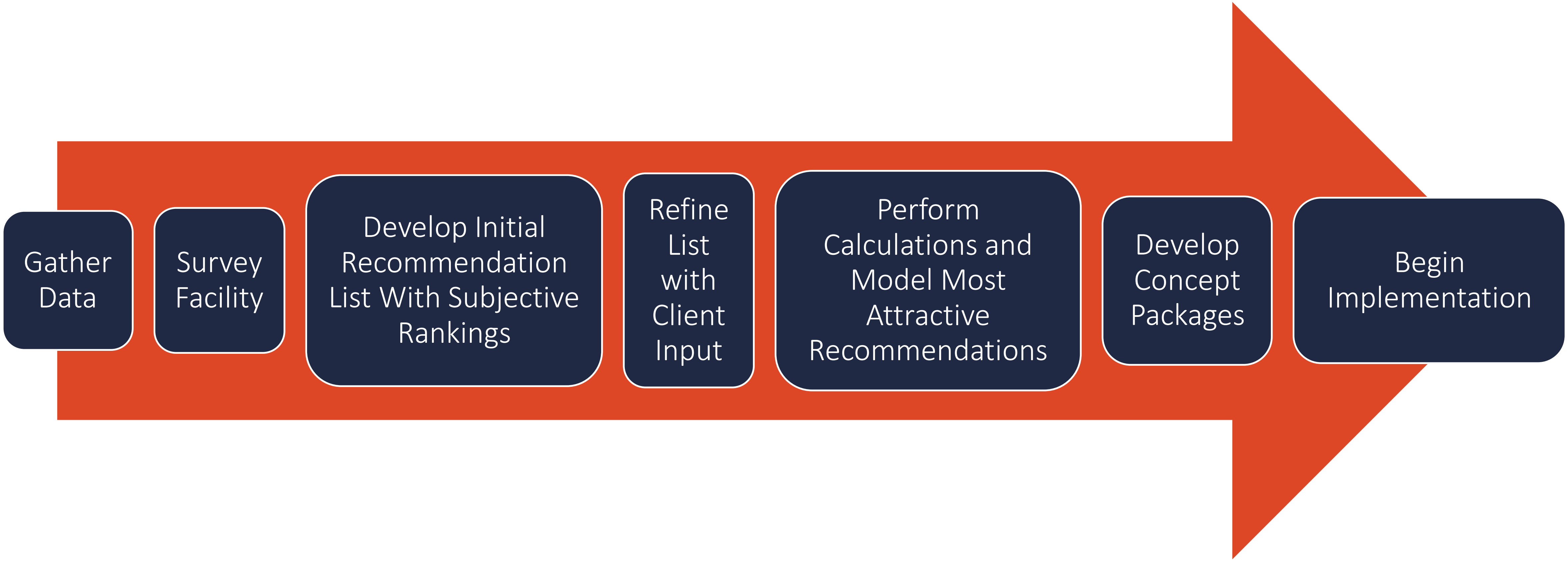
Help client achieve 30% carbon reduction by 2030 and net-zero emissions by 2050.

Precis evaluated four of the top 15 carbon-emitting sites to develop a list of recommendations to reduce carbon footprint.

Case Study / Project – Pharmaceutical Client

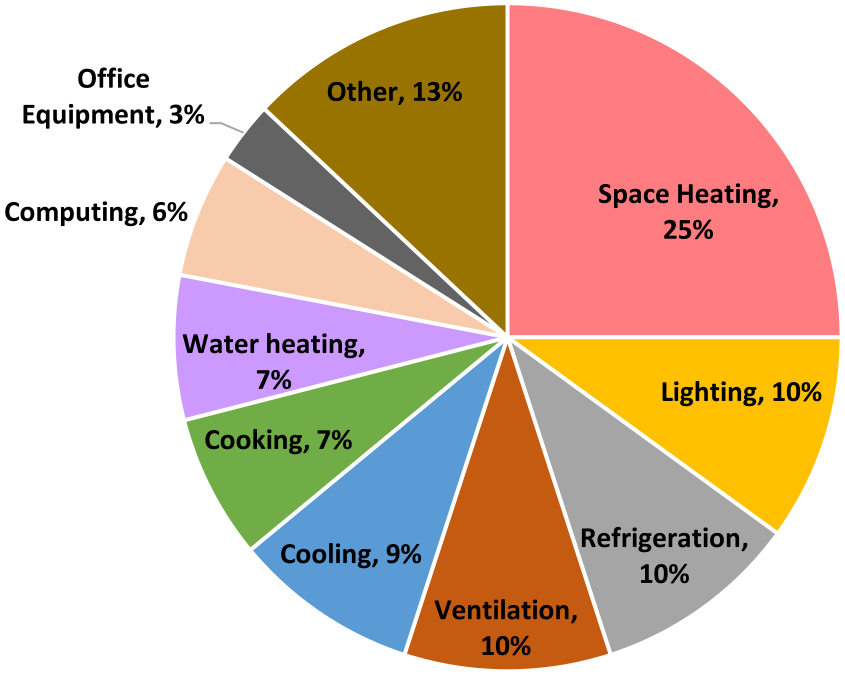
- Eastern United States
- Contract development and manufacturing organization (CDMO)
- Campus consists of 8 main buildings, 1.5 million s.f. interior space
  - Cleanrooms
  - Laboratories
  - Office
  - Warehouse
- Major Systems:
  - Two chilled water plants
  - Central steam boiler plant
  - Central compressed air plant
  - Building HVAC Systems

Project Process



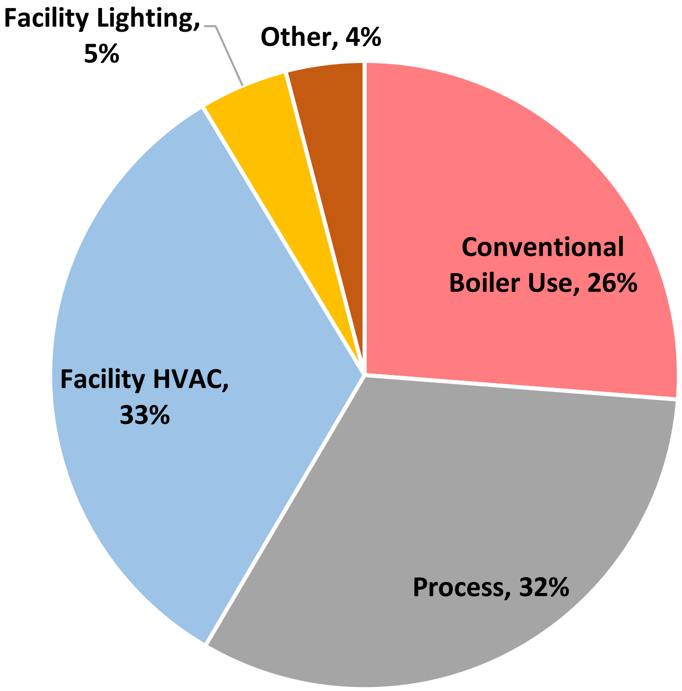
Project Process

2012 CBECS Energy Consumption by End Use - Commercial



EUI = 81.4 kBTU/ft^2

2018 MECS Energy Consumption by End Use - Pharmaceuticals & Medicines



EUI = 1210 kBTU/ft^2

ECO Number	Energy Conservation Opportunities (ECO) – Recommendations Pursued
S-1	Electrify high-pressure steam system.
S-2	Increase condensate return percentage on high pressure steam system.
S-5	Eliminate steam leaks.
HW-17	Provide central heating hot water system in lieu of utilizing central steam system for reheat. Utilize heat pump chillers in "side car" arrangement with existing chilled water system.
HW-21	Convert B1 HHW skid to variable speed with a resetting static pressure setpoint.
CHW-25	Integrated variable primary/variable secondary pumping arrangement for B4 CHW system.
CHW-27	Reset B4 secondary CHW system static pressure setpoint based on outside air temperature.
CHW-28	Reset B4 supply chilled water temperature based on outdoor air temperature.
CHW-30	Fix low delta T issues on secondary CHW systems in B4.
CHW-33	Reset B16 CDWS setpoint.
CHW-40	Repair or replace the cooling tower wet-bulb temperature transmitter to allow B4 cooling tower fans to control to appropriate set point.
CA-41	Utilize dew point demand switching option on existing B4 compressed air dryers.
CA-43	Eliminate air leaks on B4 and B16 compressed air systems.
HVAC-46	Challenge air change requirements in classified spaces.
HVAC-47	Replace fans with fan walls.
HVAC-49	Install VFDs to allow modulation of supply/return/exhaust fan speed instead of using IGV.
HVAC-66	Convert kitchen exhaust hoods to VAV with Melink or Captiveaire controls.
P-82	Reduce hot WFI sent to drain during use cycle through controls (i.e. timer).
R-85	Install solar array over parking lot space.
R-86	Utilize energy storage to reduce peak usage and maximize capabilities of renewable energy.
O-91	Utilize existing cogeneration system year-round as opposed to only for peak loading.
O-92	Install plug load controllers to turn off desktop electronics on a time-based schedule.

ECO Number	Energy Conservation Opportunity (ECO) – Recommendations Not Pursued
S-4	Implement automatic steam trap monitoring.
S-7	Utilize parallel positioning controls for new boiler O2 control.
S-8	Provide new boilers with VFD-driven combustion air fans.
S-10	Recover flash steam from deaerator for space heating.
CHW-29	Provide a CHW booster pump for B7 to reduce loop pressure.
HVAC-48	Replace filters with high efficiency HEPA filter media.
HVAC-67	Convert AHU2-21 from hot deck/cold deck to VAV.
HVAC-69	Replace failed terminal units on B16 AHUs to allow system to operate as a VAV system.
HVAC-75	Challenge data center temperature requirements.
P-78	Utilize vapor compression still instead of multi-effect still.
L-83	Utilize photocells to optimize use of daylighting.
R-87	Evacuated Tube Solar Collectors.

Case Study/Project Challenges

- Scale of electrification projects required major service upgrades.
- Simple payback periods were not attractive.
- Site growth worked counter to decarbonization goals.
- Focus on reliability increased implementation costs.
- Utility carbon generation rates were estimated.
- Unknown capabilities of future technologies.

Recommendation:

Central heating hot water (HHW) system with water-source heat pumps.

Estimated Annual Savings	
Electric	-10,841,000 kWh/yr
Natural Gas	2,370,000 therm/yr
Carbon Reduction	9,040 mTon/yr
Implementation Cost	$41,800,000

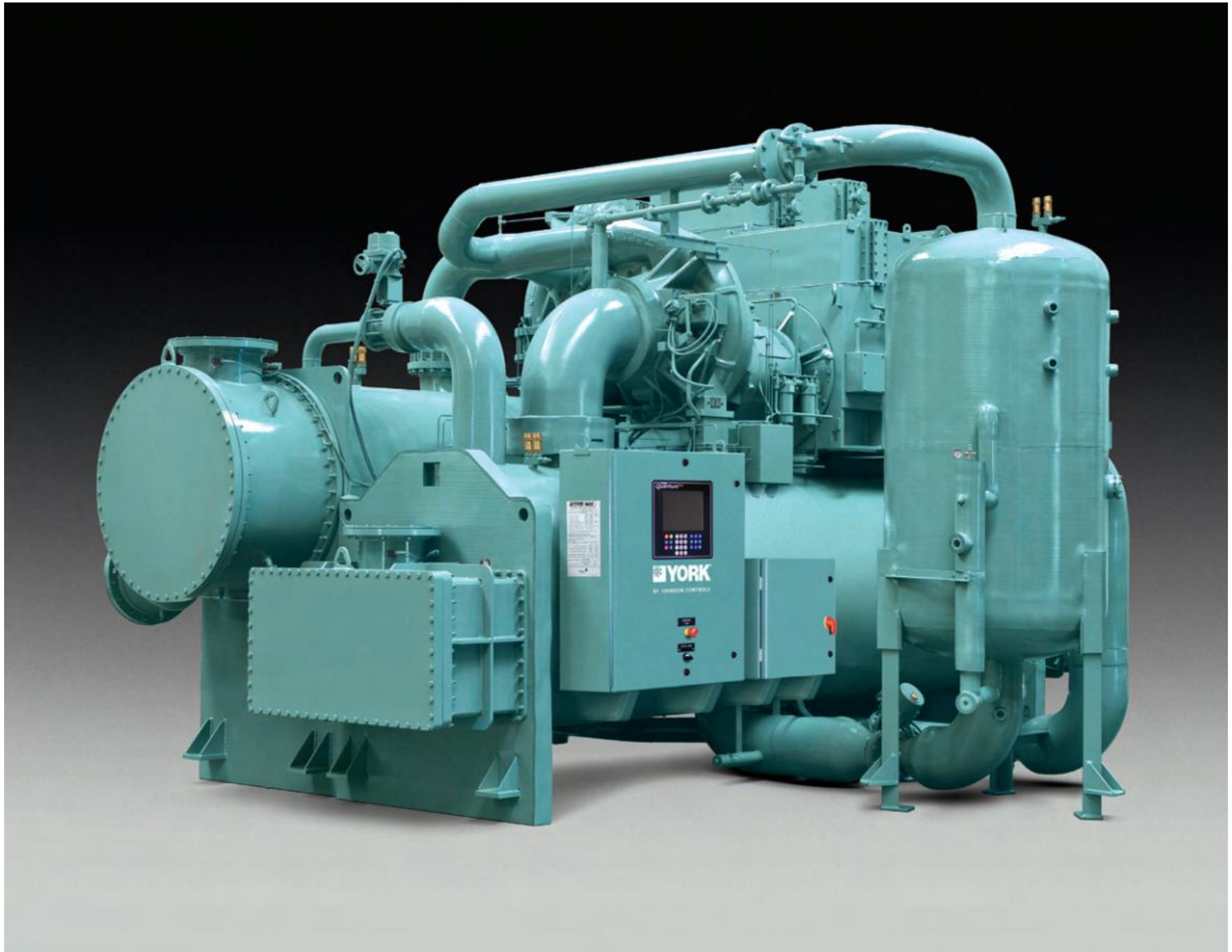


Image © York by Johnson Controls

Recommendation:

Chiller pumping arrangement modification.

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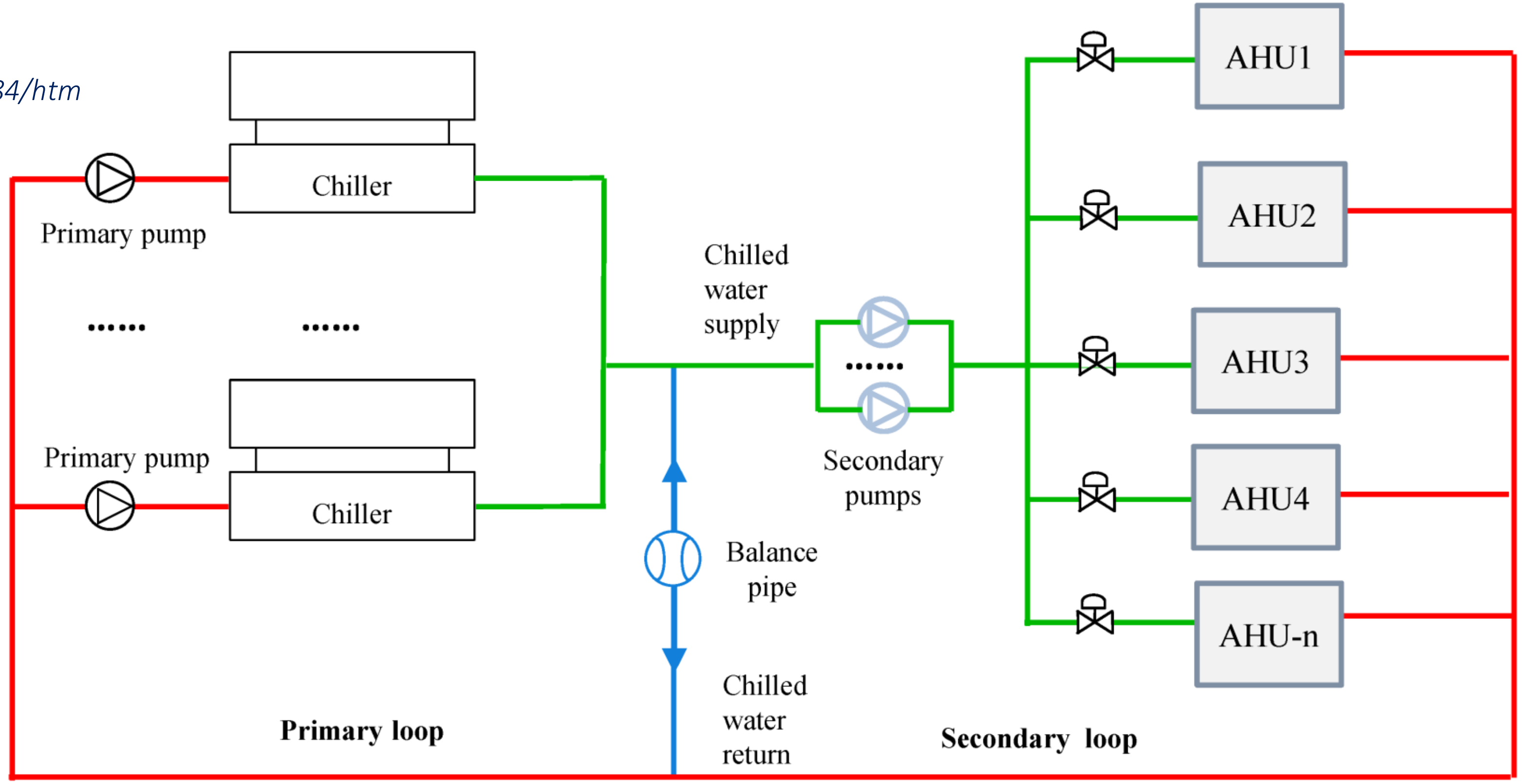
Estimated Annual Savings	
Electric	2,403,000 kWh/yr
Carbon Reduction	785 mTon/yr
Implementation Cost	$934,000



Recommendation:

Chiller replacement.

Estimated Annual Savings	
Electric	2,810,000 kWh/yr
Carbon Reduction	915 mTon/yr
Implementation Cost	$5,200,000

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Recommendation:

Steam boiler electrification.

Estimated Annual Savings	
Electric	-125,485,000 kWh/yr
Natural Gas	4,805,000 therm/yr
Carbon Reduction	-15,390 mTon/yr
Implementation Cost	$38,400,000

Image © Precision Boilers

Recommendation:

Steam condensate optimization including steam traps and condensate pump repairs.

Estimated Annual Savings	
Natural Gas	131,000 therm/yr
Carbon Reduction	695 mTon/yr
Implementation Cost	$665,000

Recommendation:

Cogeneration system rehabilitation.

Estimated Annual Savings	
Electric	31,219,000 kWh/yr
Natural Gas	-1,703,000 therm/yr
Carbon Reduction	1,130.0 mTon/yr
Implementation Cost	$7,000,000

Images © Precis

Recommendation:

Air-handling unit primary-secondary conversion.

Estimated Annual Savings	
Electric	256,000 kWh/yr
Natural Gas	56,284 therm/yr
Carbon Reduction	380 mTon/yr
Implementation Cost	$1,280,000

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Recommendation:

Controls optimizations.

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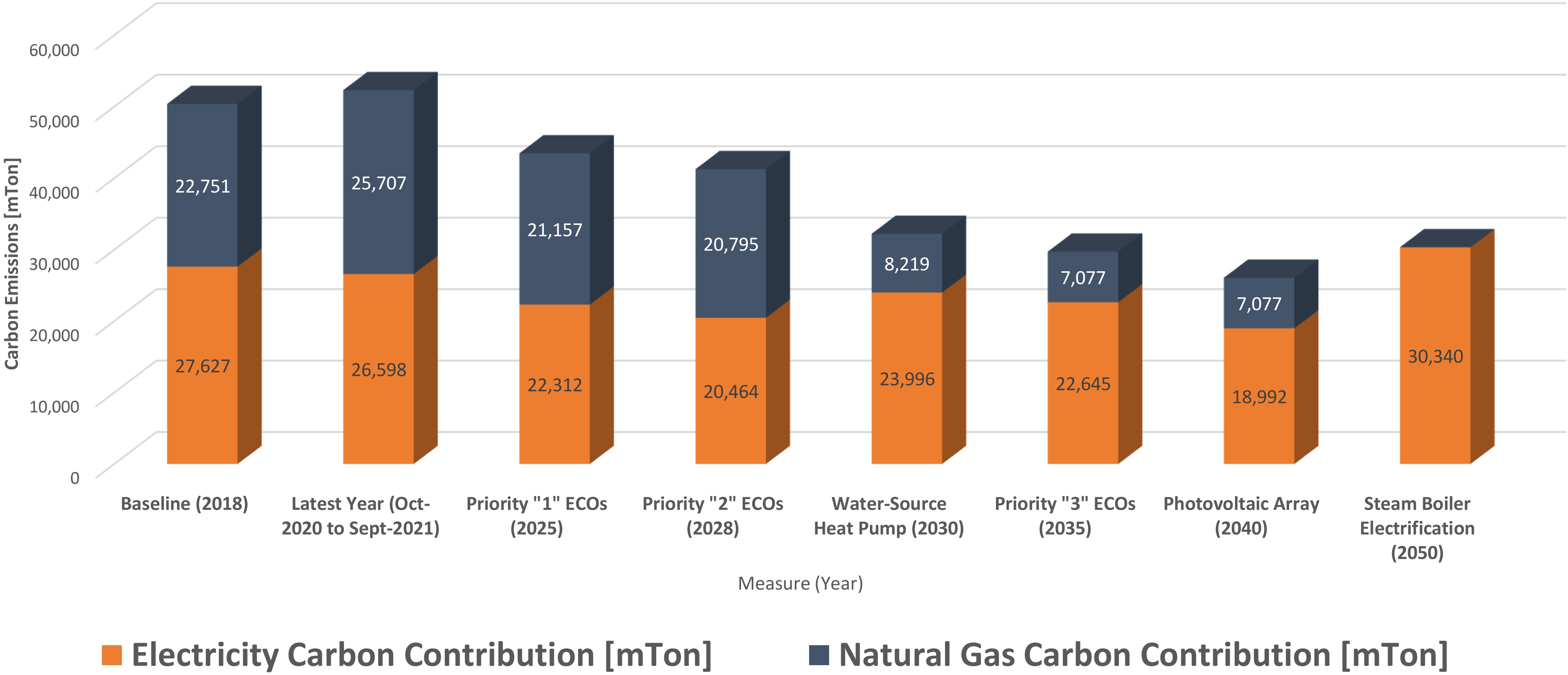
Current Path Forward: Site Carbon Footprint



Lessons Learned

- Implementation cost and ROI still drive which improvements are selected.
- Focus on measures that provide additional benefits (e.g., maintenance reduction, reliability improvement, etc.) in addition to a carbon reduction.
- Access to BAS is critical to understanding actual system operation.
- Be targeted in data gathering.

Questions?

Thank You!

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engineering
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