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

District Cooling Utility Cost Optimization at Children's of Alabama

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OpenBlue Connected Assets & Optimization

Johnson Controls

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Children's of Alabama (CoA)

- Non-profit hospital founded in 1911
- 3rd largest medical center dedicated solely to care and treatment of children
- Only Level 1 trauma facility in Alabama
- Long history of efficiency projects and sustainability leadership (LEED Gold 2012)

CoA sought resilience and deeper energy savings

Challenges:

- McWane steam heating plant was nearing end of life
- Campus served by 2 isolated heating plants each on own loop
- Two chilled water and heating plants served by different electricity accounts, meaning different: usage rates, contract minimum demand, and demand charge ratchets

CoA sought resilience and deeper energy savings

Comparing many design options to

- Achieve best return on capital
- Increase resiliency by connecting heating plants
- Reduce fossil fuel use and carbon footprint by electrifying space and water heating (maximize heat pump use)
- Demonstrate sustainability leadership for donor fundraising

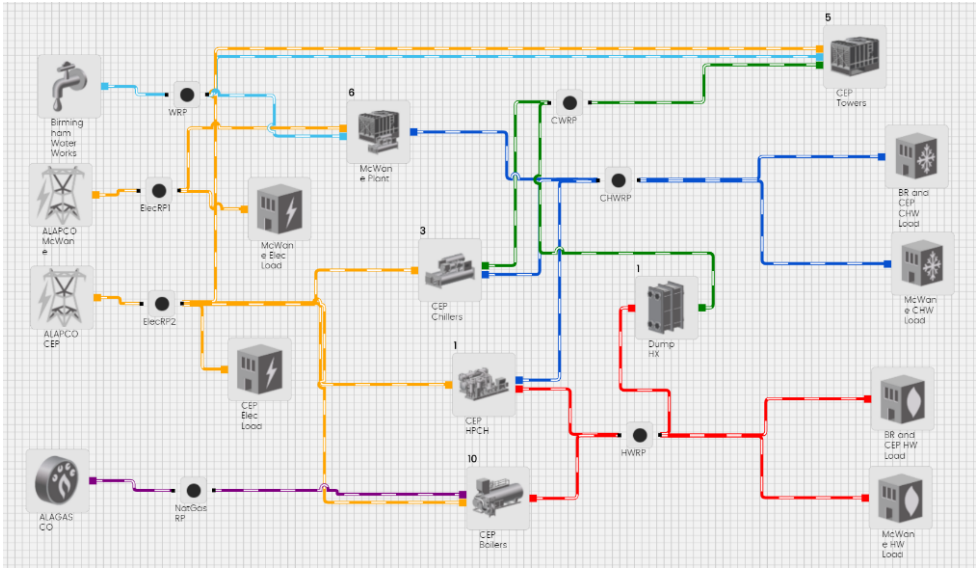
Solution

1. Connect the plants and convert steam to hot water

- Cross connect CEP and McWane plants to one hot water loop
- Add 2 new condensing hot water boilers to CEP and decommission 3 x 9.7 MMBtu/hr steam boilers
- Steam coil to hot water coil upgrades and some full air handler replacements enable higher Chilled Water Design Delta T from 12°F to 16°F

Central Plants overview – post-upgrade

- Cooling capacity: **6,600 tons** - 6 chillers: 5 centrifugal + 1 CYK heat pump chiller (800 ton)
- Heating capacity: **36 MMBtu/hr** - 10 condensing boilers



Digital twin modeling tool

Solution

2. Advanced Supervisory Control software

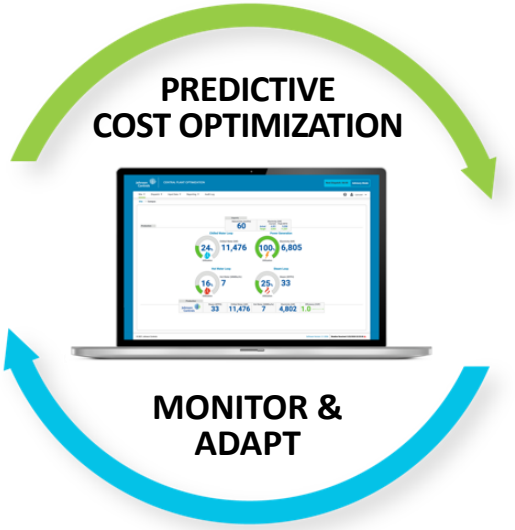
- Plant automation upgrades in older McWane plant
- VFDs installed CW pumps in CEP and SCHW pumps in McWane
- OpenBlue Plant Optimizer sends real-time control commands to stage equipment or adjust setpoints to minimize utility cost

How model-based optimization works at CoA

Control command decisions made every 15 minutes

Inputs & Predictors

- Utility Market Rates
- Load Predictions
- Weather Forecasts
- Equipment Performance
- Calendar/ Maintenance



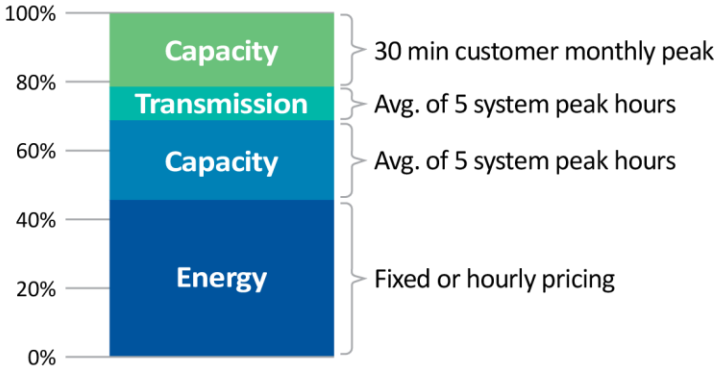
Equipment Dispatch & System Set Points

- Chillers
- Cogeneration
- Boilers
- Pumps
- Cooling Towers
- Heat Exchangers
- Heat Pumps

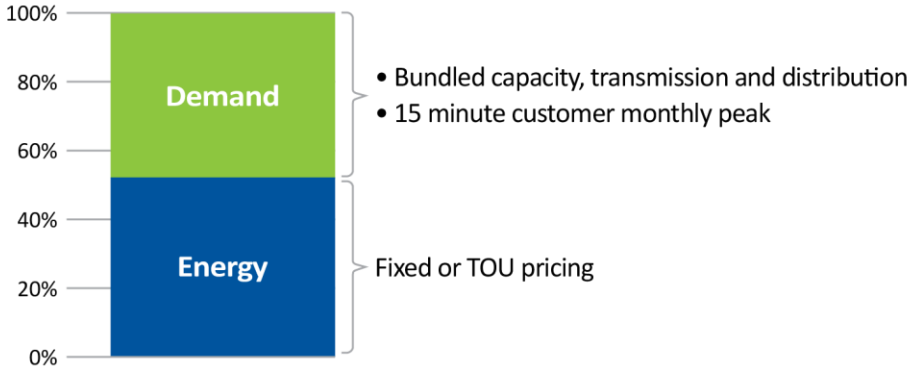
Minimize utility costs based on time-of-use rates and demand charges, not just kWh

Electricity Price Component Examples

Retail Choice (Chicago, avg. price = $0.09/kWh)



Fully Regulated (Southern California, avg. price = $0.17/kWh)



Solution

3. Flexible, outcome-based commercial models

- Newest plant designed, built, operated and maintained 2011-2014 under “cooling as a service” (utility services agreement) model
- Converted to O&M contract with guaranteed plant availability and energy performance January 2015
- 2018-2019 upgrade project added to savings guarantee

Solution

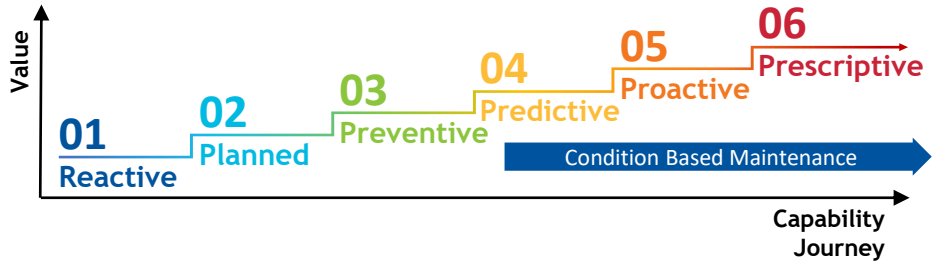
4. O&M Contracting

- Johnson Controls operates the CUP and holds the risk for all building systems, including the HVAC system, electrical switchgear, roof, driveways, and even the interior paint.
- Performance guarantees are reviewed annually.
- The use of on-site personnel, preventive maintenance, and advanced monitoring technology enables the hospital to run the plant with only a single full-time manager.

Solution

5. Expand digital tools to grow savings

- OpenBlue Enterprise Manager
  - Continuously analyzes building system data across campus both plant *and* airside systems, and critical environments (ORs)
  - Visualizes performance on dashboards
  - Fault detection and diagnostics (FDD) with prioritization supports predictive condition-based maintenance



Results

- New CEP plant construction 2009-2012 completed **ahead of schedule** and **under budget** under DBOM model
- Digital twin simulation enabled $1.4M in chiller water distribution piping **capex avoidance** in 2018-2019 system-wide optimization project
- Additional lifecycle savings from removal of steam system
- **15.1% IRR,** $6.1M net present value (NPV) over 20-year term

2020 Performance Year Savings Achieved

- **Electricity** = 363,130 kWh/year (2% vs. baseline)
- **Natural gas** = 76,710 MMBtu/year (78% vs. baseline)
- **GHG emissions** = 9,320,000 lbs CO2e/year (34% vs. baseline)*
- **Utility cost** = $679,425/year (32% vs. $2.1M baseline)
- **O&M cost savings** = $87,445/year

Lessons Learned

- Break journey into **phases** to increase optimization readiness
- **Digital twin** simulation tools to compare ROI for design options
- Business case should include **non-energy benefits**
- **Robust testing** of native field-controller sequence programs prior to running supervisory control software
- Address low Delta T challenges in both plant *and* field
- Plant optimization should **address demand** and **time of use utility rates** rather than minimizing electricity use alone.

Questions?

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