P&G's Central Plant Optimization Program

REBUILD Conference – Oct 7, 2021

Moderator

SIEMENS

Chris Depenhart

Sales Executive, Siemens Smart Infrastructure

Mr. Depenhart manages key account relationships for Siemens Smart Infrastructure in the Life Sciences and Higher Education markets, including Procter & Gamble/Jones Long Lasalle account for North America

Panel Members

Steve Winbigler

Global Technical Leader – Utilities Systems
P&G Corporate Offices & Innovation Centers

Responsible for providing Global Technical Oversight for Facility Systems in Procter & Gamble's GBS Workplace Services. Focus area include Asset Life Cycle Management, Energy Optimization, Organization Technical Skill Education, and Focused Improvement Opportunities.

Steve Weyler

JLL Engineering Director
JLL, a P&G GBS Business Partner

Responsible for providing technical support and guidance to JLL facility and project delivery teams servicing Procter &Gamble's global portfolio. Define process and technology solutions to ensure safe, efficient and effective operations focusing on system reliability and total cost of ownership. Additional responsibilities include energy, sustainability and HS&E.

Panel Members

Jerome (Jerry) W. Doerger

P.E. LEED AP, SPM
Executive Vice President & Workplace Market Leader
PEDCO E&A Services Inc.

Jerry is a Mechanical Engineer who has spent the past 32 years PEDCO. Responsibilities include client manager for PEDCO on the P&G account, overseeing PEDCO's MEP designs for P&G. Throughout my career my technical responsibilities ranged from small engineering studies to commissioning of all the MEP systems at the Mason Business Center to the design of complex research laboratories, office buildings and central utility plants; totaling more than 3.5 million square feet.

David Eslinger, CEM

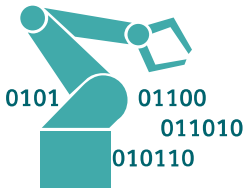
Senior Energy Engineer, Atlantic Zone
Siemens Smart Infrastructure

Responsible for optimizing chilled water and air-handling systems at Siemens building automation system customer sites.

Discussion Outline

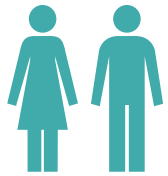
1. P&G Net Zero Ambitions and facility operations
2. Why chilled water optimization?
3. Project approach and results
4. Operating and design philosophy in new work reality

These five megatrends are impacting us all



55 billion

The number of devices that will be linked online by 2020



9.7 billion

The earth's population in 2050, with an average life expectancy of 83 years

800,000 years ago

The last time the Earth's atmosphere had a higher CO_2 concentration

70%

The percentage of the population that will live in cities by 2050

200%

The growth rate of global trade between 2000 and 2014

Sources: IDC, United Nations, UNCTAD Statistics, Scripps Institute Of Oceanography, "The Keeling Curve," November 11, 2015

P&G'S AMBITION TO NET ZERO

Including 2030 science-based targets for Scope 1, 2, and 3 emissions to accelerate progress.

P&G IT'S OUR HOME | NET ZERO 2040

Path to Net Zero by 2040

2010

ACHIEVING INITIAL GOALS

- Reduced operations emissions 52%*
- Reduced truck miles 25% per unit of production
- Avoided 200,000+ tons of plastic through package redesign
- Doubled use of recycled plastic resin
- 100% certified wood pulp in P&G brands
- 100% certified palm ingredients in P&G brands
- 15 million tons of CO_2 reduced through consumer cold water washing

2021

30

OPERATIONS

- Reduced operations emissions 52%*

Reduce absolute emissions as much as possible via energy efficiency and renewable energy

Purchase **100% renewable electricity** by 2030, already at 97%

Pilot and scale renewable **thermal energy solutions**

Advance **natural climate solutions** to balance any emissions we cannot eliminate this decade

LING SOLUTIONS

- ale renewable thermal energy novation
- ale renewable carbon, recycled bon, and captured carbon chnologies
- ow rail and shipping while creasing renewable fuels and ergy sources for transportation

Aligned with 1.5°C ambition

2040

OUR AMBITION

NET ZERO

ACROSS OPERATIONS AND SUPPLY CHAIN EMISSIONS — FROM RAW MATERIAL TO RETAILER

- Cut most of our emissions
- Balance any remaining emissions that cannot be eliminated with natural or technical solutions that remove and store carbon

ADDITIONAL PROGRESS VIA OUR CLIMATE TRANSITION ACTION PLAN

Reducing … Product Innov…

Avoid 30 million tons o… water washing by 2030

Reducing Product End of Life

100% recycled or reusable packaging by 2030

Enable more recycling in homes and communities

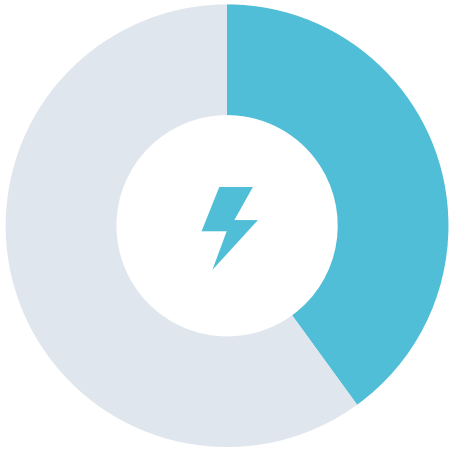
Pilot and scale materials from recycled carbon

*Against a 2010 baseline.

†Against a 2020 baseline.

††Inclusive of priority categories that account for over 90% of P&G's supply chain emissions.

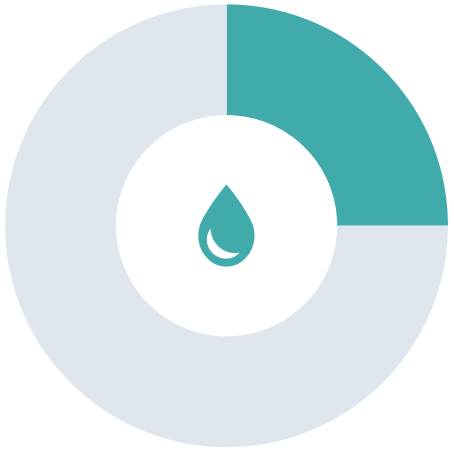
Why Focus on Building Energy Consumption?



They consume

40%

of all energy



They use

25%

of all water

They emit

33%

of all green-house gases

Sources: CommScope/IDC Energy Insights, Business Strategy: Global Smart Building Technology Spending 2015 – 2019 Forecast Intel, Smarter Building & Homes with the Internet of Things

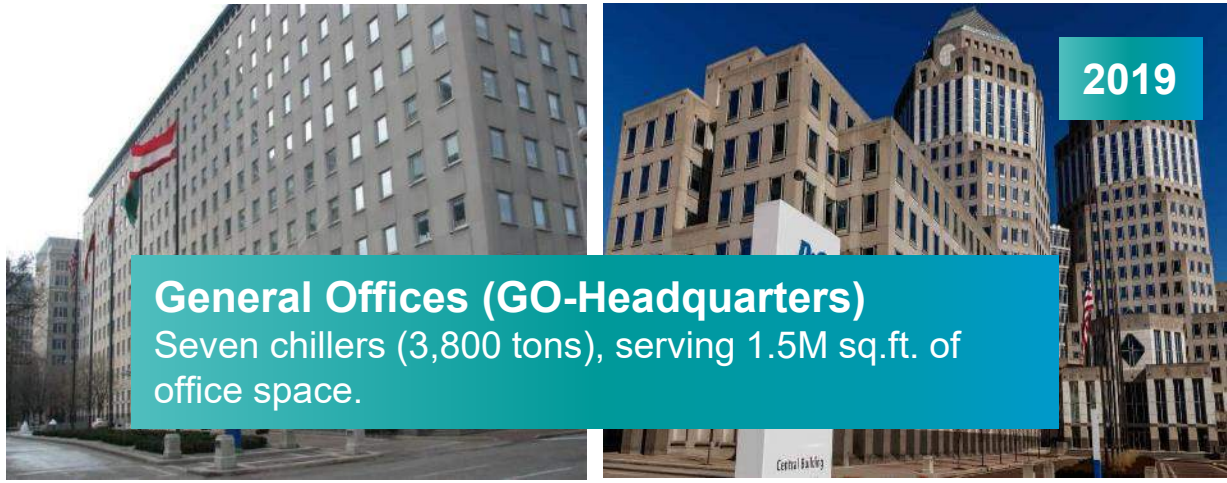
Chilled Water Optimization Projects at Three P&G Facilities

Winton Hills Business Center (WHBC)
Four chillers (6,500 tons) serving 1.4M sq.ft.* of office, laboratory and production space
*WHBC since reduced to 1.1M sq.ft.

Mason Business Center (MBC)
Seven chillers (14,300 tons) serving 2.2M sq.ft. of office, laboratory and production space

Central Building

Tower Buildings



General Offices (GO-Headquarters)
Seven chillers (3,800 tons), serving 1.5M sq.ft. of office space.

General Offices

- Headquarters showcase for P&G
- Member of Cincinnati 2030 District
- Two buildings, two plants and seven chillers
- Chilled water plant in good condition

Chilled Water Optimization Project – Scope at GO

Challenge #1: Complexity

- Two plants interconnected by cross-over piping
- Central Bldg plant (Four 650-ton centrifugal chillers)
- Tower Bldg plant (Two 500-ton centrifugal chillers, plus one 225-ton heat recovery chiller)
- Chilled water needed 365 days/year with nighttime and seasonal variability
- Primary chilled water pumping configuration limits flexibility

Challenge #2: "Always been done that way"

- Chiller sequencing handled manually, varied depending on operator on-duty
- No measurement of which chillers or plant was more efficient

Project Scope

- Added VFDs to 125-hp condenser water pumps in Central Bldg Plant
- Upgraded select temperature and pressure sensors to better measure flow and load at each chiller
- Automated isolation valves on older cooling tower
- Added VFDs to smaller booster pumps for CHW/HW 2-pipe loop

Chilled Water Optimization Strategy

Typical Characteristics	Inherent Shortcomings
Chillers not operating at design temperature splits	"Low Delta-T Syndrome“ hurts efficiency
Constant volume pumping of condenser water	Excessive pump energy, pump wear and chiller efficiency
Over pumping of chilled water loops	Excessive pump energy, pump wear and chiller efficiency Opens chilled water bypass valve (wasted pumping and low delta-T”
Comfort sacrificed to obtain efficiency	Transfers energy use from chilled water pumping to AHU fan motors Uncomfortable occupants = reduced productivity
Total plant energy performance not fully measured	Difficult to manage (increased risk)

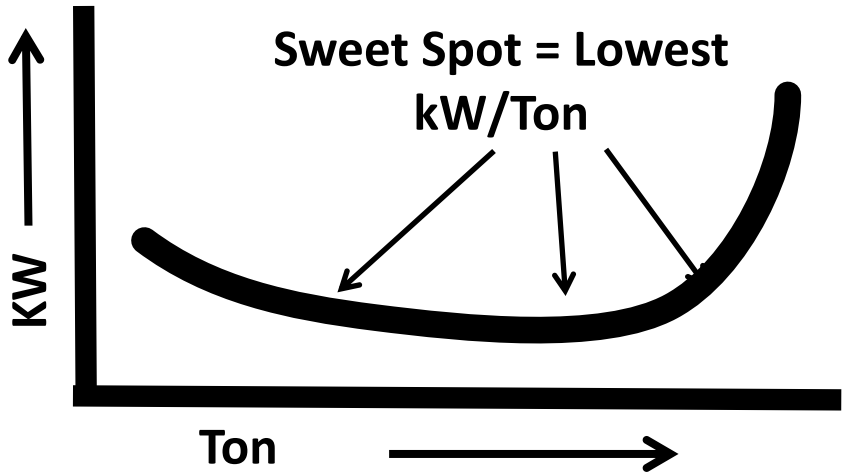
Chilled Water Optimization Strategy

Conventional methods of optimization

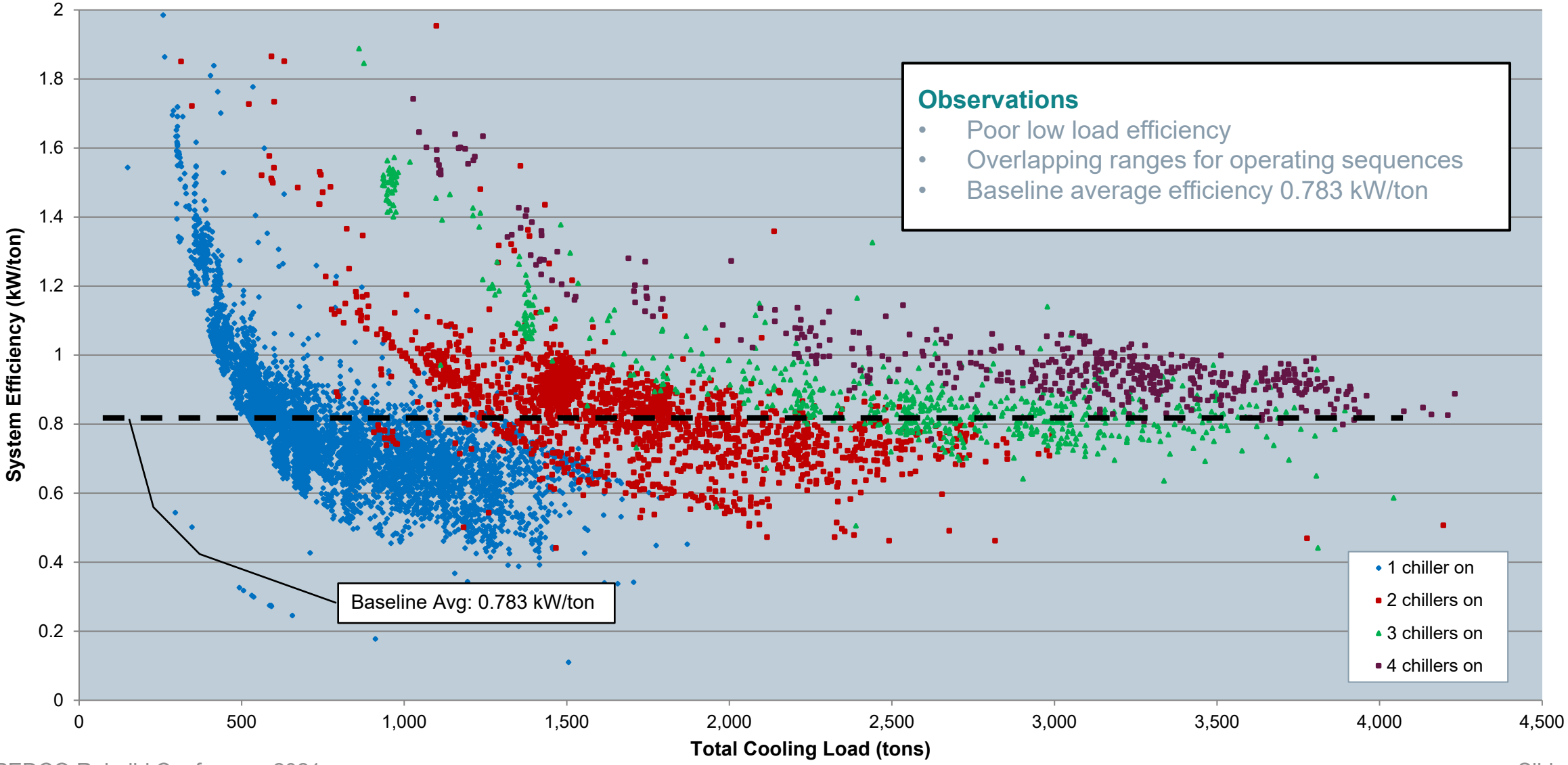
- Reset chilled water temperature up
- Chillers sequenced via a database of load profiles
- They all try to find a “sweet spot”

Comprehensive optimization

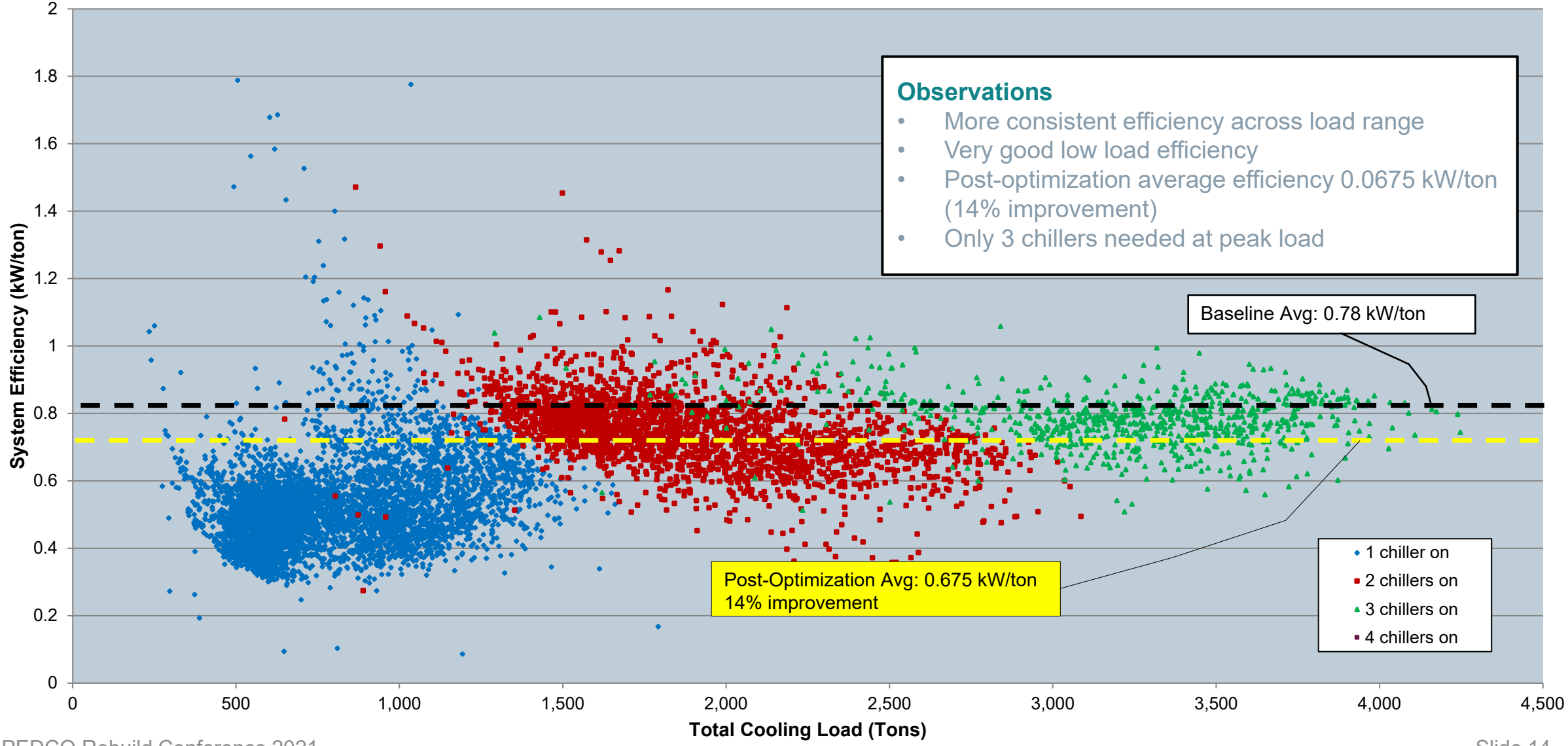
- Varying chilled and condenser water flows widens “sweet spot”
- Wider “sweet spot” = increased efficiency through the entire tonnage range
  - Varying condenser water and chilled water through chiller
  - Keeps chiller in design range (dT = 10F)
- Can increase tonnage delivered



P&G WHBC Chilled Water Optimization - Baseline



P&G WHBC Chilled Water Optimization – Post Optimization



Chilled Water Optimization Projects at Three P&G Facilities

Winton Hills Business Center (WHBC)

	Baseline (adj)	Actual	Savings
Building Load (Ton-hrs)		11,438,549	
Energy Use (kWh)	8,954,135	7,720,714	1,233,421
Efficiency (kW/ton)	0.783	0.675	14%

General Offices (GO-Headquarters)

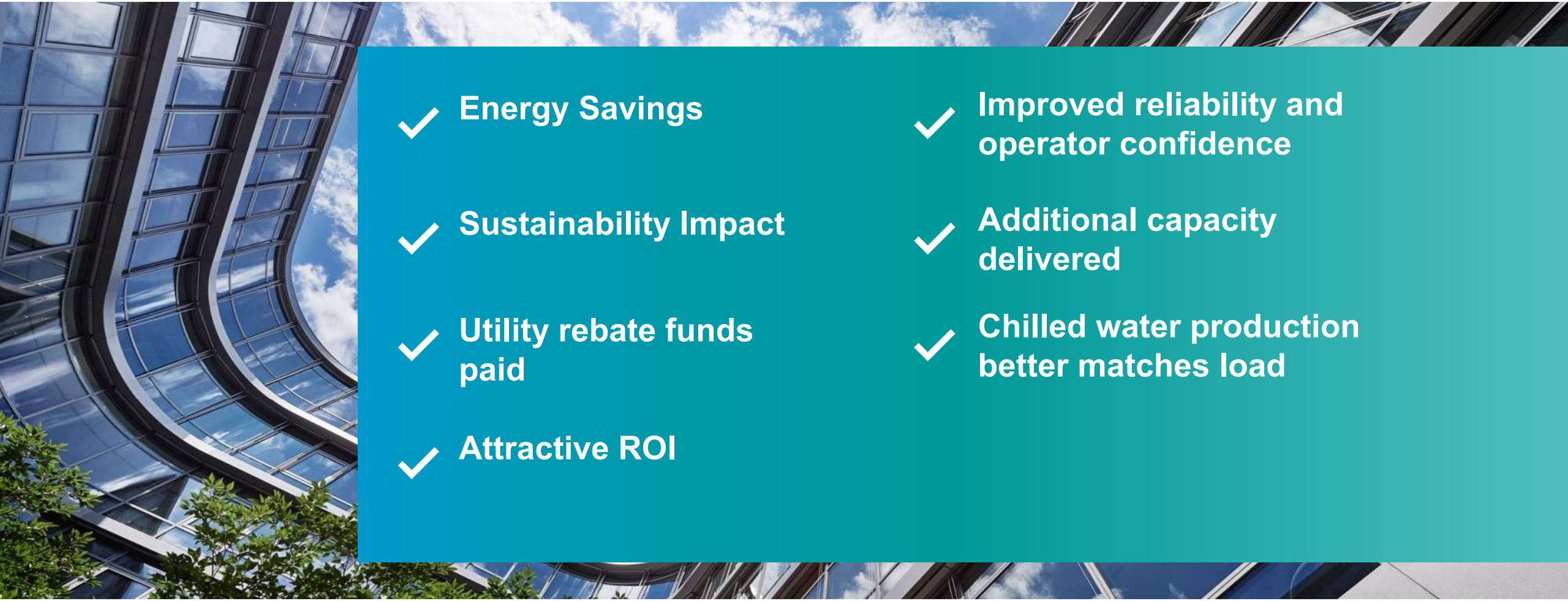
	Baseline (adj)	Actual	Savings
Annual ton-hrs		4,953,942	
Baseline Plant (kWh)	4,458,137	3,718,349	739,788
Efficiency (kW/ton)	0.900	0.751	17%

Mason Business Center (MBC)

	Baseline (adj)	Actual	Savings
Annual ton-hrs		20,297,801	
Baseline Plant (kWh)	21,863,781	13,886,598	7,977,183
Efficiency (kW/ton)	1.077	0.684	36%

- **Total Annual Savings**
  - ~9,950,000 kWh per year = 7,050 metric tons of CO2
  - Equivalent to
    - Removing 1,530 vehicles from the road
    - Supplying electricity to 1,280 homes
- **Utility Rebate Funds Received**
- **Attractive ROI**

Chilled Water Plant Optimization Achievements



- Energy Savings
- Sustainability Impact
- Utility rebate funds paid
- Attractive ROI
- Improved reliability and operator confidence
- Additional capacity delivered
- Chilled water production better matches load

Operating Facilities to Demand instead of Schedule

Lighting Controls

Daylight harvesting, network of occupancy sensors to not only control lighting but provide building usage feedback.

Green Labs

Reducing energy and improving safety by giving lab owners control of occupancy. Provides visual alarms when air flow deviates from safe conditions.

On-Demand Ventilation

Using building occupancy information to adjust air handler operating schedules and fresh air setpoints.

Incorporating Ideas into Best Design Practices

SIEMENS
Ingenuity for life

Facilities that limit success

- Uncomfortable work environment
- Poor lighting and air quality
- Dissatisfied occupants
- Space is utilized poorly
- No funds for work-place upgrades
- Lack of flexibility

Facilities that contribute to success

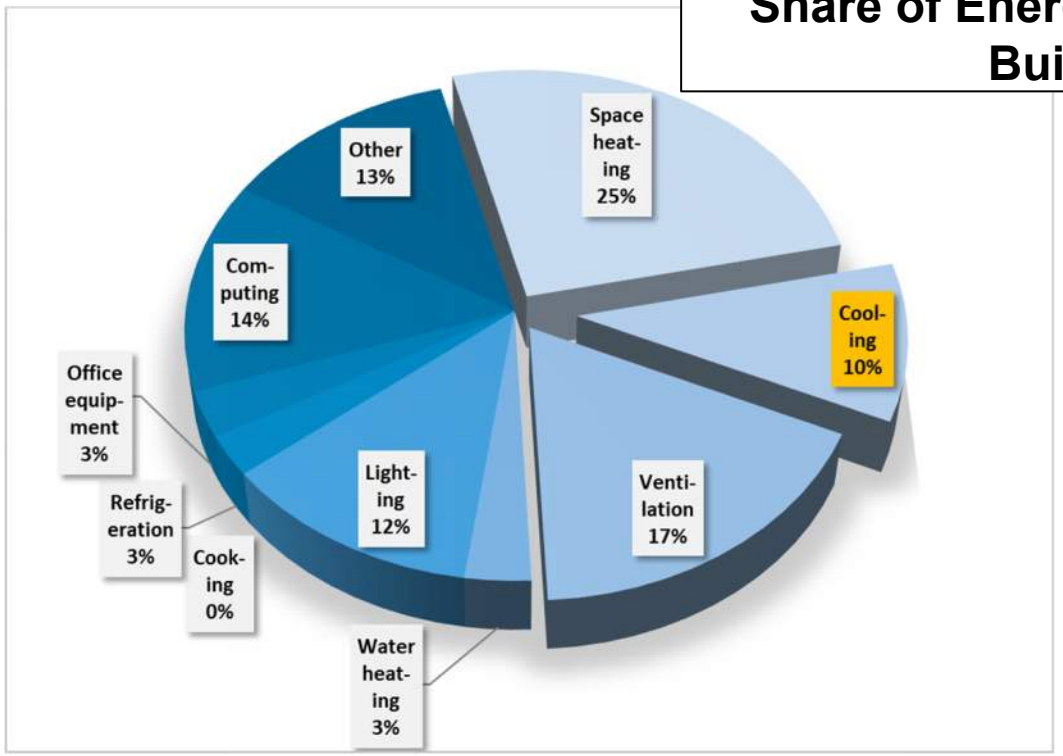
- ✓ Safe and comfortable employees
- ✓ Ideal working conditions
- ✓ Happier, confident employees
- ✓ The building suits its purpose
- ✓ Savings are reinvested
- ✓ Occupants engaged with the building

Q&A

Supplemental Slides

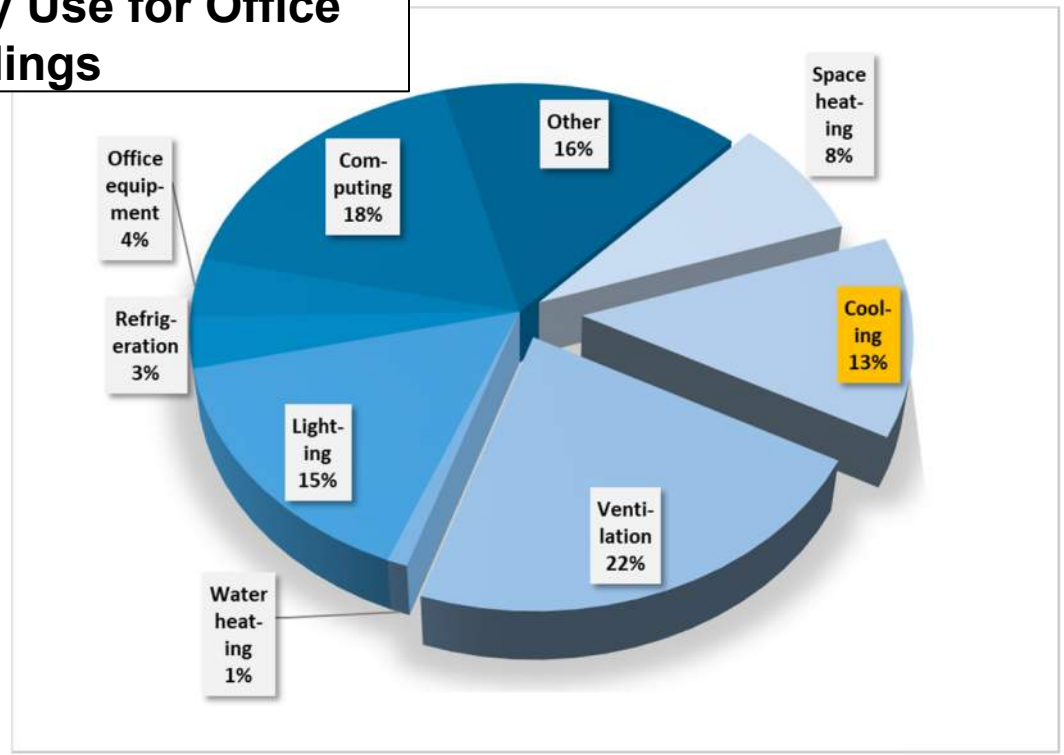
Why Focus on Cooling Systems?

Share of Energy Use for Office Buildings



10%

by BTU consumption



13%

by expenditure and GHG impact

Sources: US EIA, CBECS study 2012 Table E2 for Office Buildings. (2018 data not yet available, but cooling share expected to increase).