Electrification and Decarbonization

Ronald Reagan Building and International Trade Center

The power behind **your mission**

Johnson Controls

Modernizing Historical Federal Facilities

A GSA National Deep Energy Retrofit (NDER) Project

The GSA is taking aggressive steps to address climate change and decarbonization by implementing cost-effective retrofits that will modernize seven iconic and historical buildings within and around the White House complex, funded by an Energy Savings Performance Contract (ESPC).

Improvements include replacing chillers with the latest magnetic bearing technology, upgrading lighting fixtures to LED technology, replacing transformers and replacing plumbing fixtures with high-efficiency equipment, and using groundwater as cooling tower makeup water to save 26 million gallons of potable water annually. Antiquated controls will be replaced by a modern controls system that enables advanced energy management, gives operators better insight into HVAC system performance, and provides early detection of facility related operational issues. Central Utility Plant optimize software adapts to time-of-use utility pricing, peak demand charges or demand response signals, and uses dynamic equipment performance algorithms, weather forecasting and load allocations to minimize utility costs.

Key Outcomes

- **Energy Savings**
  This Energy Savings Performance Contract (ESPC) will produce $6.2M in guaranteed annual savings
- **Reduced Consumption**
  Energy usage will be reduced by 42%, water by 50%
- **Reduced Greenhouse Gases**
  GHG will be reduced by more than 20,000 tons annually – the equivalent of removing 4,500 cars from the road each year

Project Detail

Deep Energy Retrofit Leads to Electrification

ECM	Scope of Work	
	NEOB	RRBITC
2.1 Chiller Replacement & Optimization	Replace three Trane chillers with three York YMC^2 chillers; replace cooling towers, pumps	Replace three Trane chillers with three York YZ chillers; install Johnson Controls OpenBlue Chiller Plant Optimization
3.1 Energy Management Control System	Upgrade Schneider BAS to Schneider EcoStruxture (5000 points @NEOB)	Replace obsolete BAS with Metasys-based DDC (12K points) with OpenBlue technology and enable data analytics; replace 3000+ VAVs
4.1 HVAC Conversion to VAV	Replace 132 constant volume boxes with newer variable control VAV boxes	
5.1 Lighting Upgrades	LED upgrades (12,000 luminaires)	LED upgrades (57,000 luminaires)
6.1 Building Envelope Improvements	Install 560 Thermolite window inserts, door weatherstripping, wall insulation	
7.1 Steam Trap Replacement	Replace 34 steam traps and 12 HVAC coil air vents	Replace 92 steam traps
7.2 Steam Condensate Heat Recovery	Install HX to recover discharged condensate heat	
12.1 High Efficiency Transformers	Replace 47 transformers with high efficiency models	Replace 519 transformers with high efficiency models
13.1 Water Conservation	Replace 310 fixtures; install condenser water treatment tower blowdown submeter	Replace 1910 fixtures; install condenser water treatment; replace city water for towers with treated groundwater

GSA IT Network Infrastructure

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Ethernet

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FX80 – Supervisory Controller
(Niagara 4.x)

FX Server
(Niagara 4.x)

SkySpark Analytics Software

FAC – Advanced Application Field Equipment Controller
(Central Plant, Complex AHUs, etc.)

CGM – General Purpose Application Controller
(Moderate AHUs, Complex FCUs, etc.)

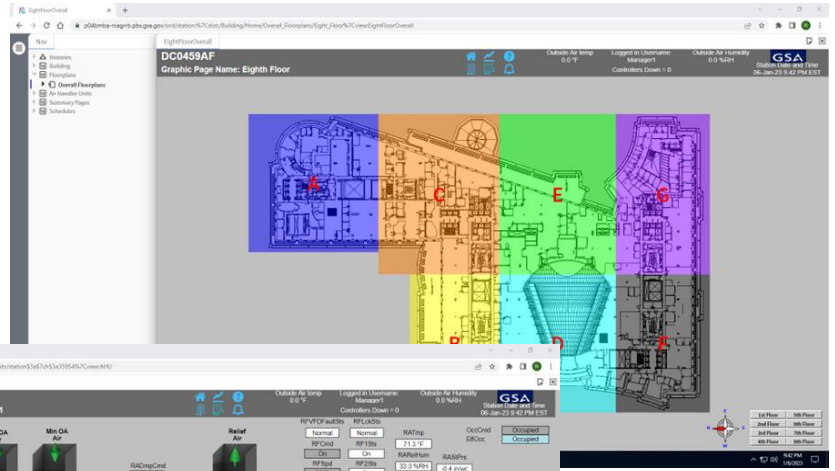
FEC – Field Equipment Controller
(Moderate AHUs, Complex FCUs, etc.)

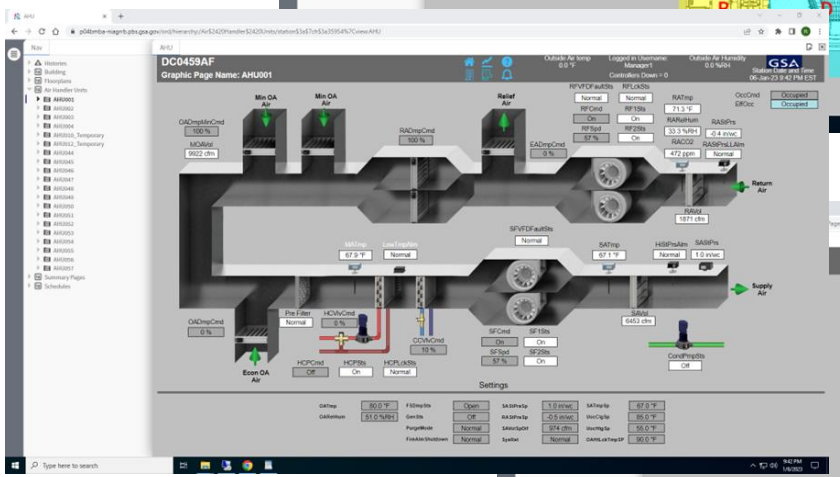
IOM – Input/Output Module
(I/O Point Expansion)

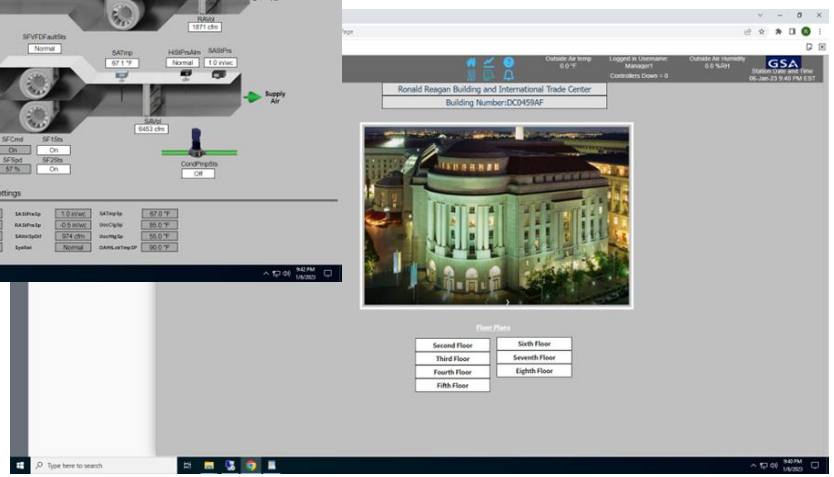
CVM – VAV Box Controller
(Cooling Only and Reheat VAV Boxes)

BACnet MS/TP
Field Bus

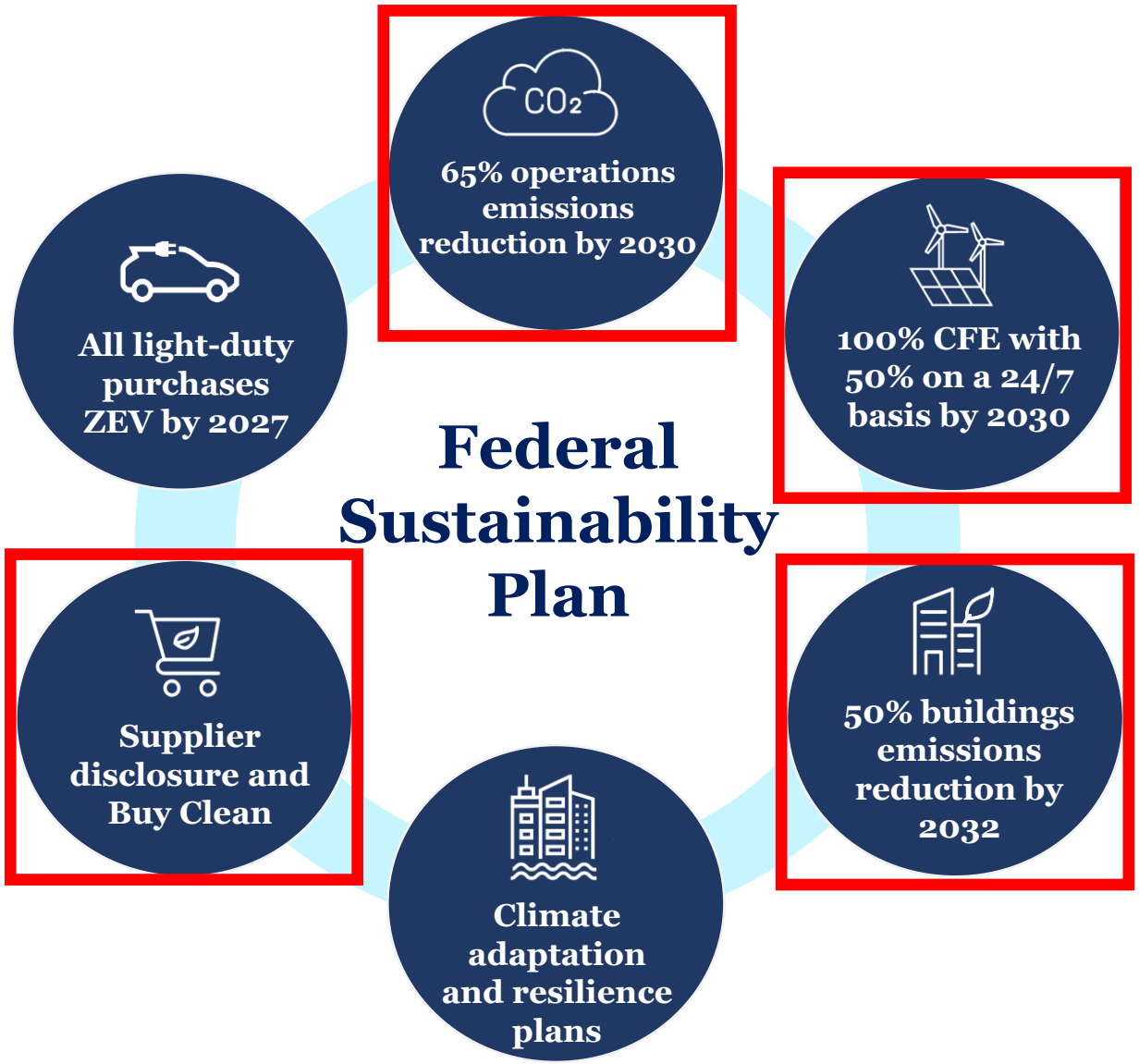
TEC – Terminal Equipment Controller
(Simple FCUs, Unit Heaters, Rooftop AHUs, etc.)







A Decade of Action That Starts Now



Electrifying RRBITC

- Prepares building for using 100% CFE
- Net reduction of Scope 2 GHG emissions
- Achieves building emission reduction goals

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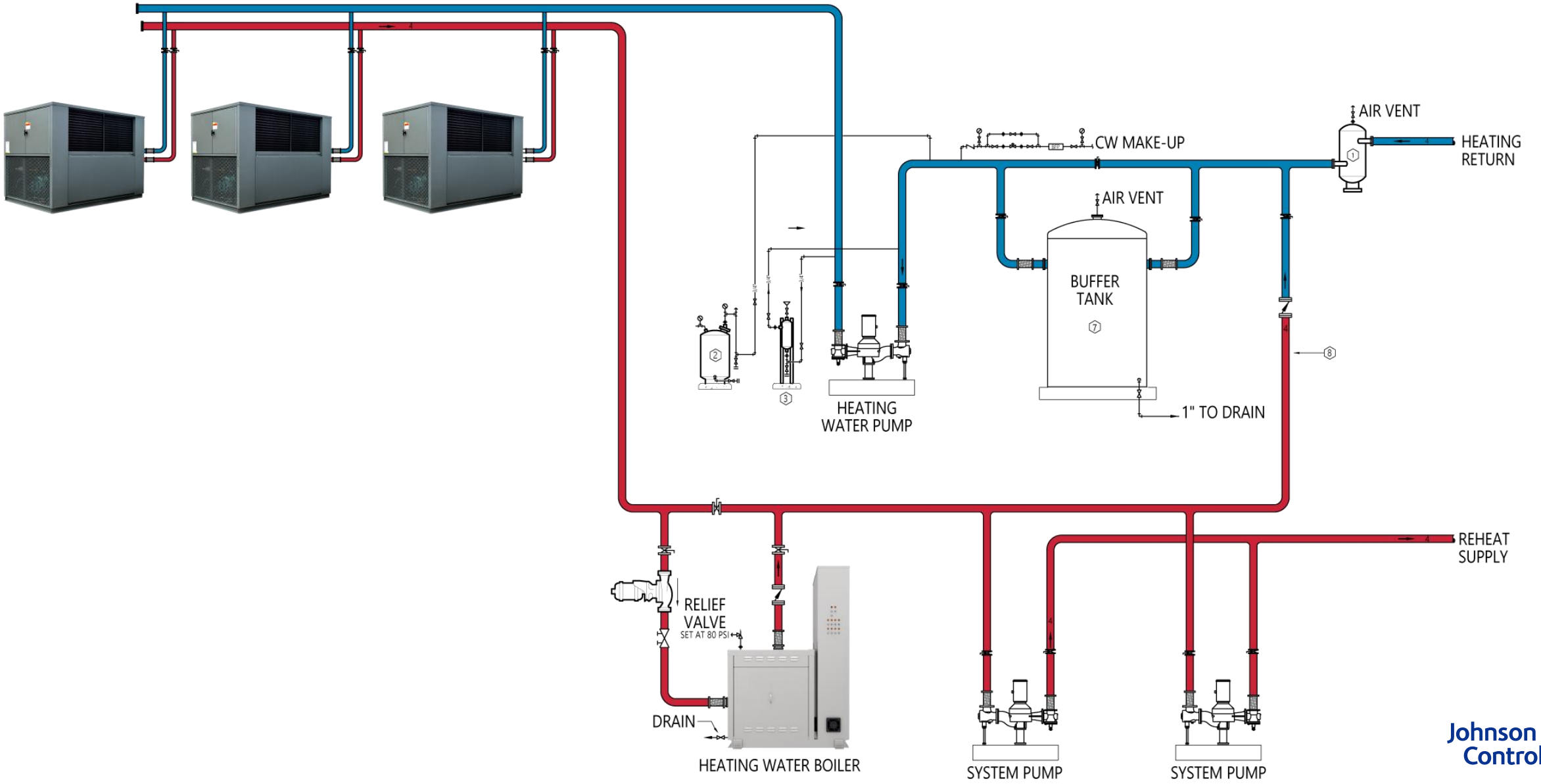
Electrification and Decarbonization of the RRBITC

Electrification Strategy

- Replace district steam with electricity as the energy source for HVAC heating water and domestic hot water
- Use heat pumps as the primary heating source
  - More efficient than boilers as they “move heat” yielding an energy output greater than the input
  - Limitation – difficult to provide high water temperature needed for HVAC application in winter
- Supplement heat pumps with electric boilers to boost water temperature as needed
- Use tanks to thermally store hot water produced during non-peak times
- Use a heat pump chiller that produces hot water as a byproduct of producing chilled water for building cooling needs

Typical System Layout



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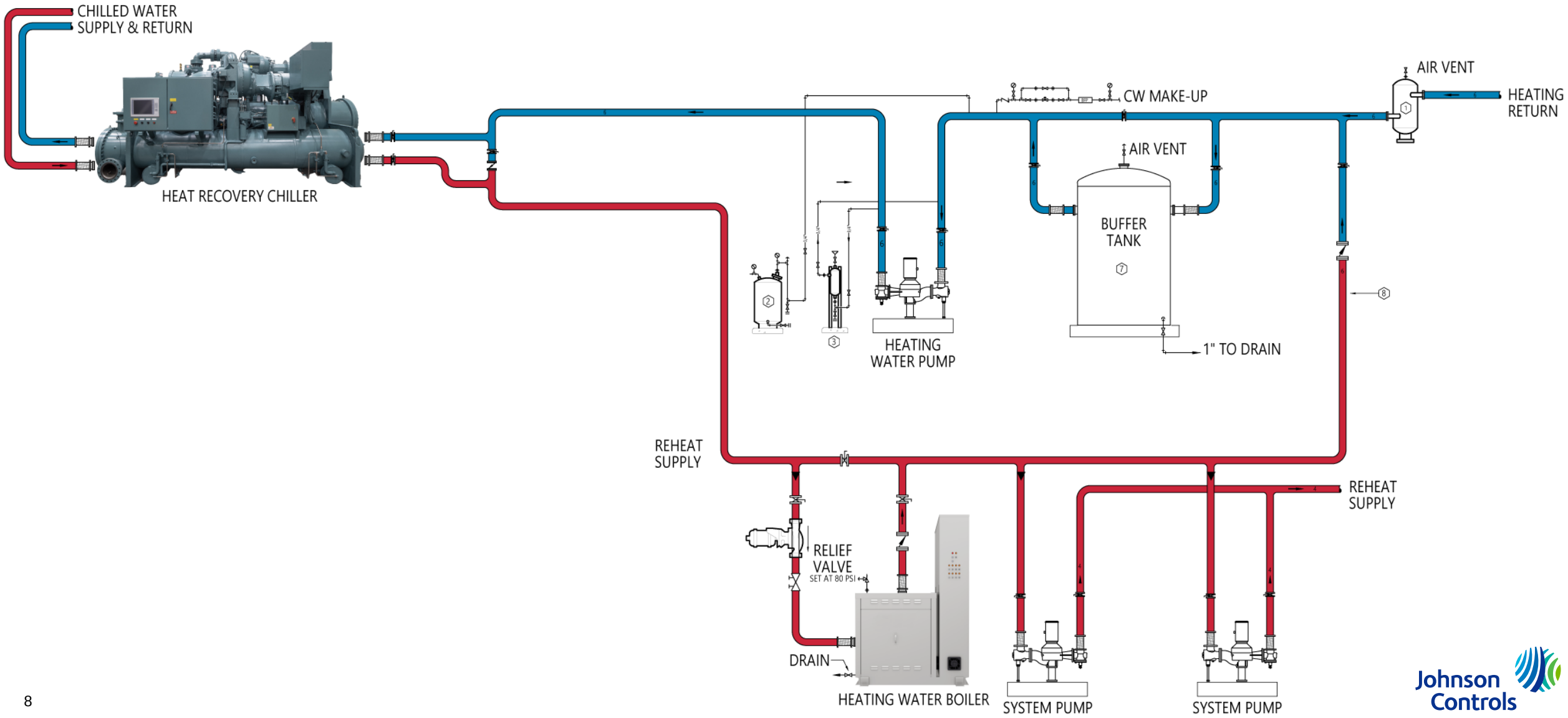
Typical System Layout



Electrification and Decarbonization of the RRBITC

Anticipated ESPC and Electrification Results

Ronald Reagan Building (RRB)	Total Energy (MMBtu/yr)	GHG (Metric Tons CO_2e)	Electric Consumption (kWh/yr)	Electric Demand (kW/yr)	Steam (MMBtu/yr)
Usage for entire site (FY19)	239,551	21,645	48,652,800	93,057	73,499
Total proposed RRB savings	93,731	8,554	17,056,010	33,679	35,519
Usage after ESPC	145,820	13,101	31,596,790	59,378	37,980
Percent reduction after DER ESPC	39.1%	39.5%	35.1%	36.2%	48.3%
Total proposed electrification savings	20,873	2,234	(5,013,915)	(11,439)	37,980
Usage after electrification	**124,947**	**10,867**	**36,610,705**	**70,817**	**-**
Cumulative percent reduction after electrification	**47.8%**	**49.8%**	**24.8%**	**23.9%**	**100.0%**

Project square footage (SF): 2,568,966

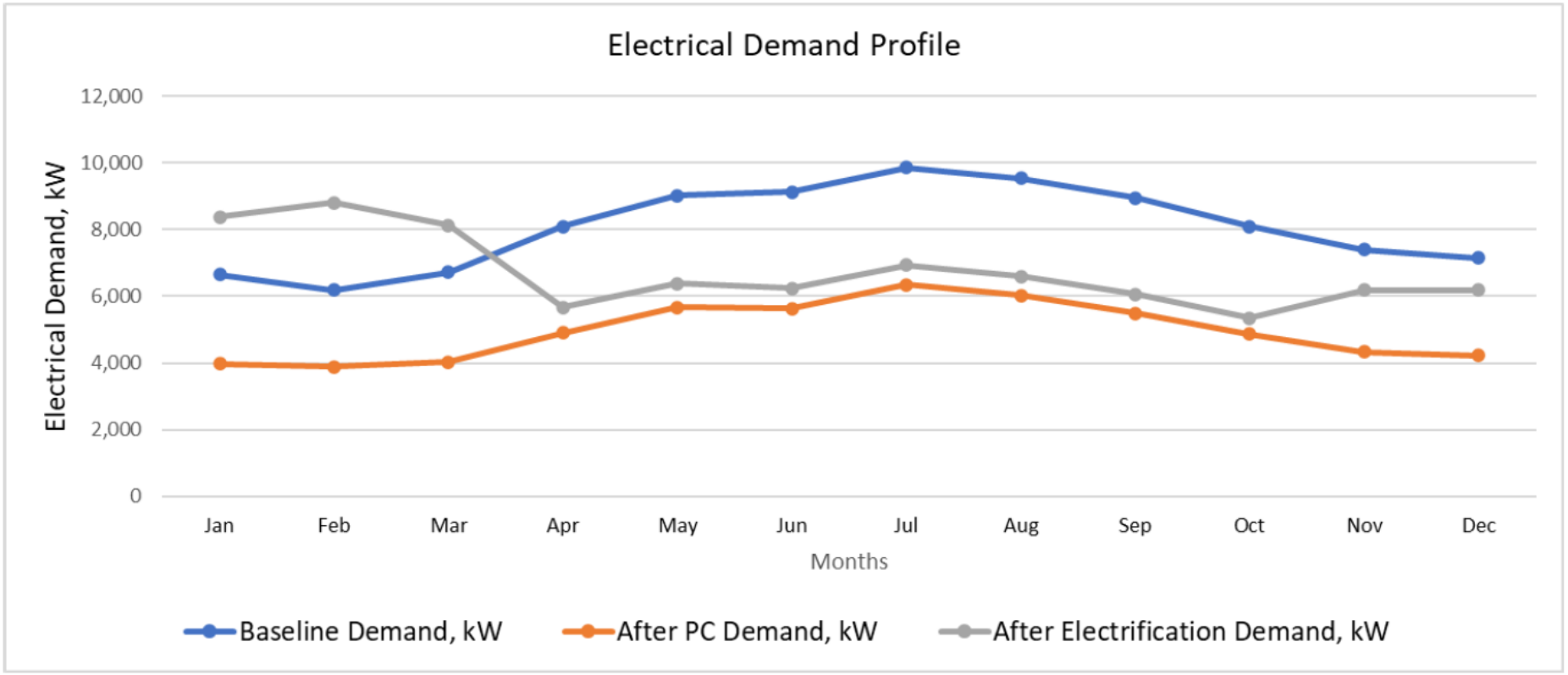
EUI before project: 93.2

EUI after project: 48.6

- As CFE deploys, RRBITC Scope 2 emissions will continue to improve
- Contributes to HOTD Scope 1 emissions reduction plan
- Reduces demand-side (building) energy use allowing optimization of CFE development (Value of Deep Energy Retrofit)

Electrification and Decarbonization of the RRBITC

Electrical Demand Impact



- Maximum electrification monthly demand less than FY19 baseline
- GSA has provided this preliminary information to PEPCO (utility)
- Building overall capacity adequate
- No major electrical equipment needed to accommodate heat pumps and boilers