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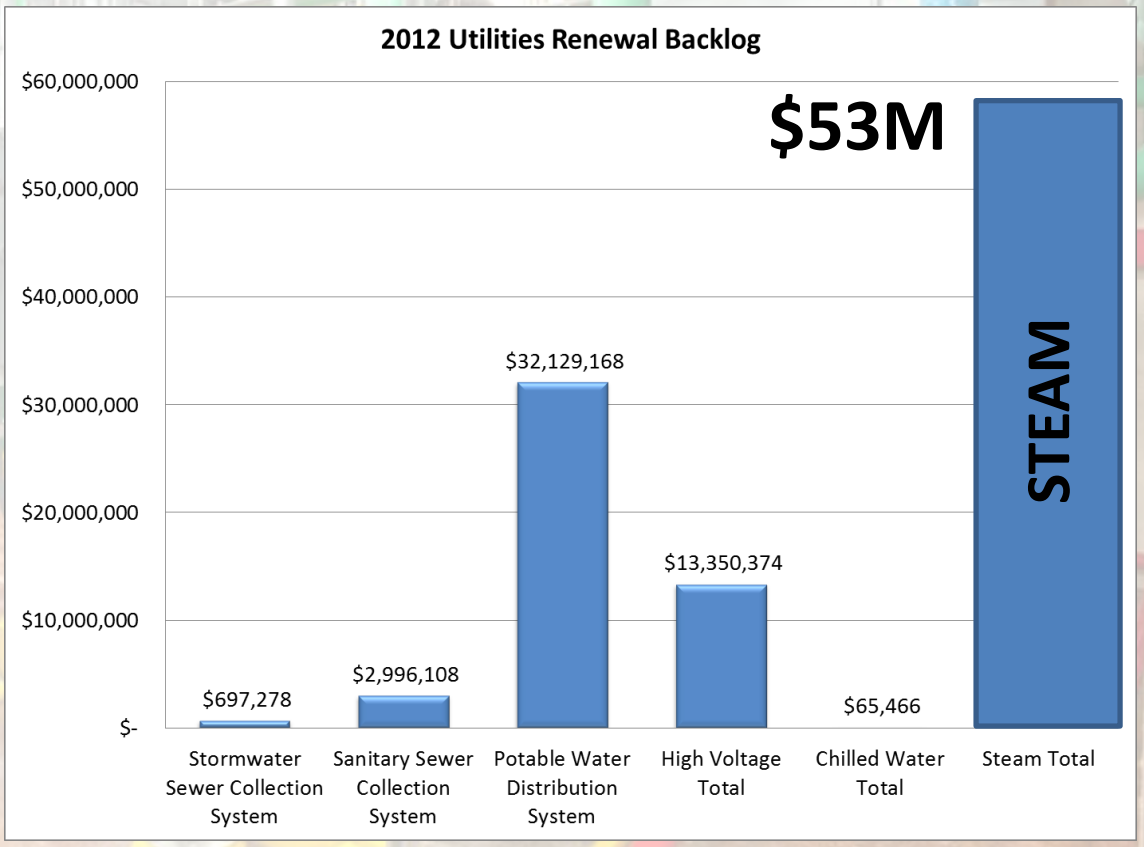
HEATING AT DUKE

- **Steam**
  - 540,000 PPH
  - 138 buildings
  - 19.5 miles piping

- **Regional Hot Water**
  - 40,000 MBH
  - 6 buildings
  - 2 miles piping

AGING STEAM DISTRIBUTION

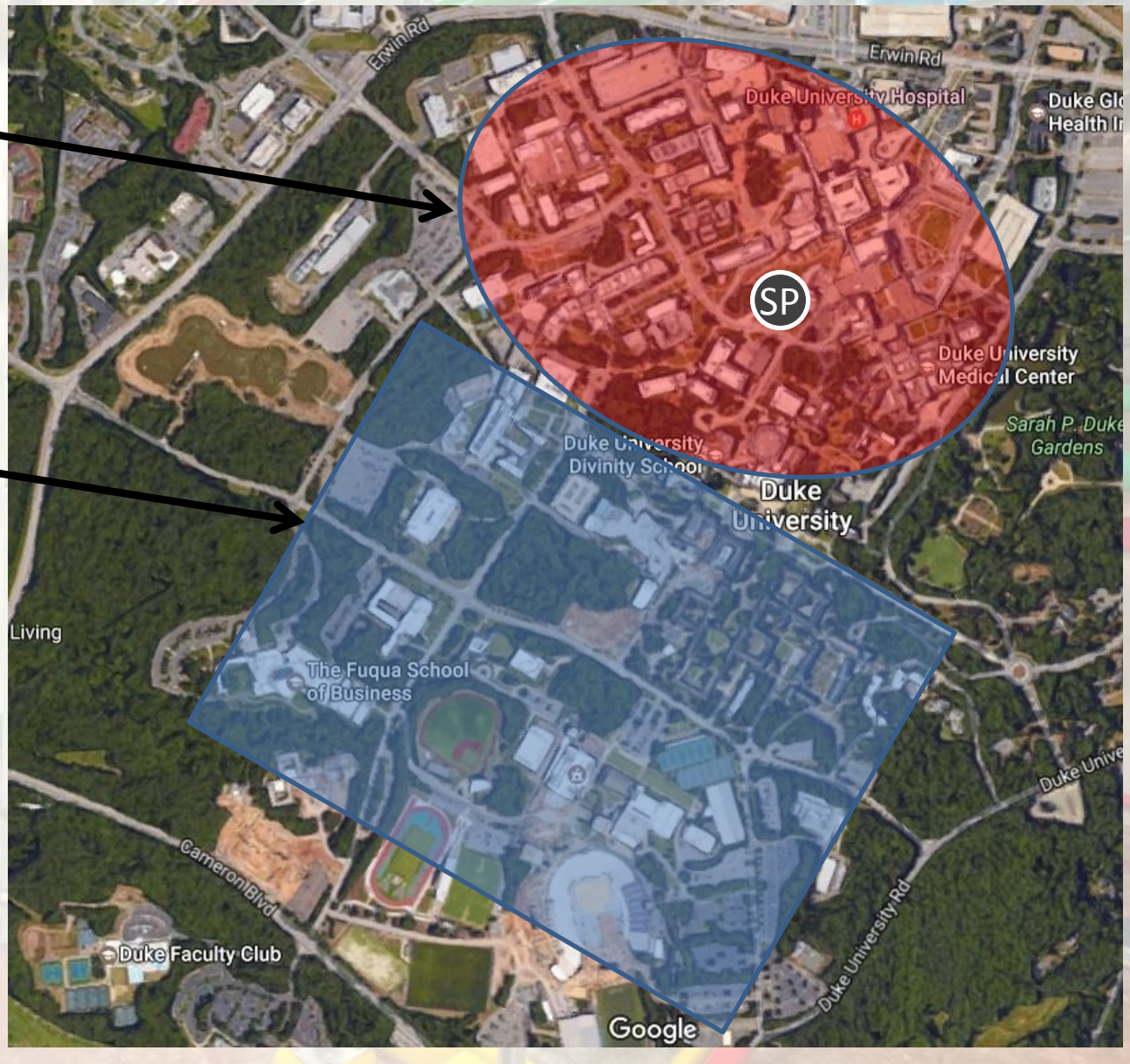
- Steam distribution dominates utility backlog
- Best path forward?



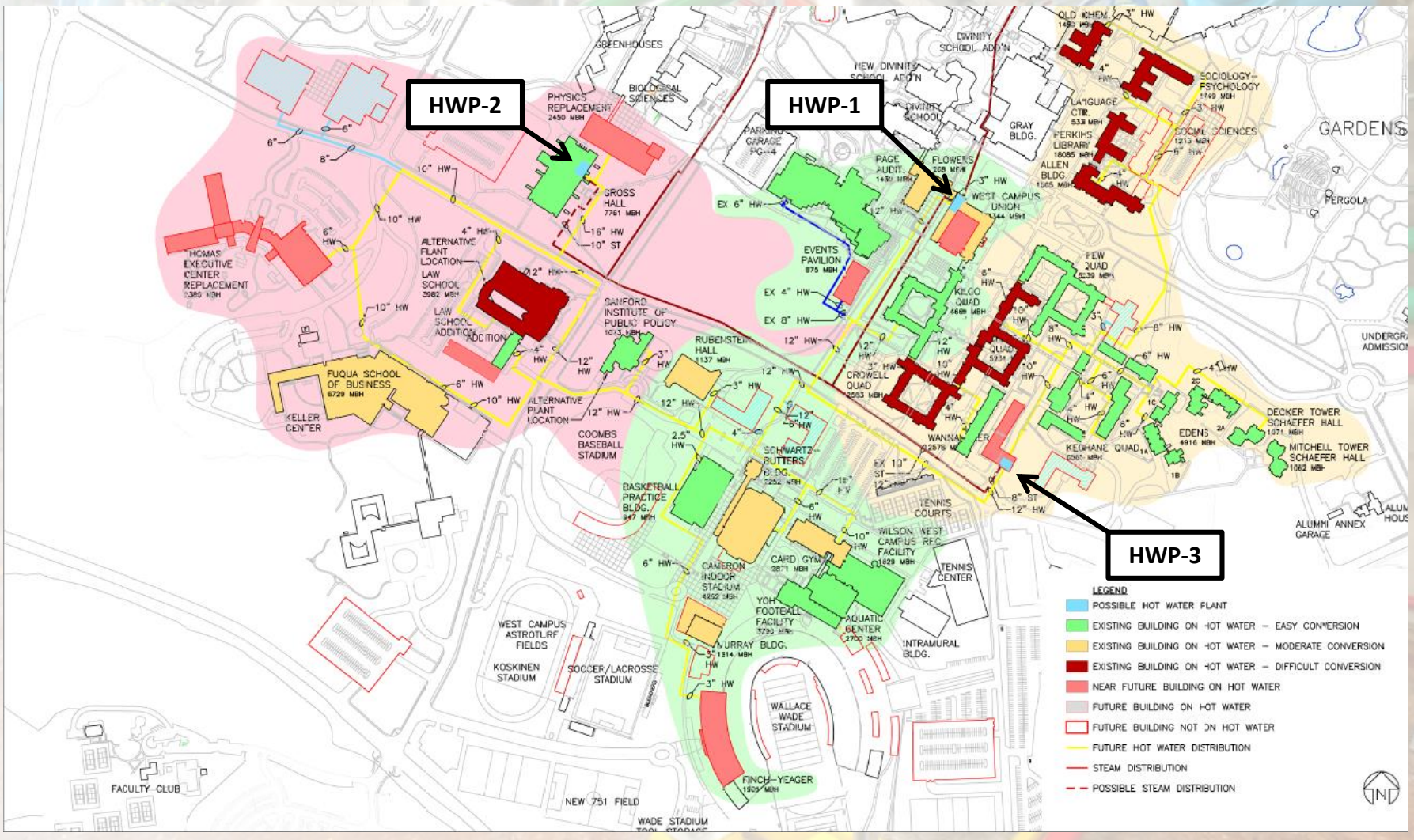
CAMPUS FACILITY GROWTH

Steam Core
Medical + Research

Regional Hot Water
Classroom + Residential



WHAT IS REGIONAL HOT WATER?



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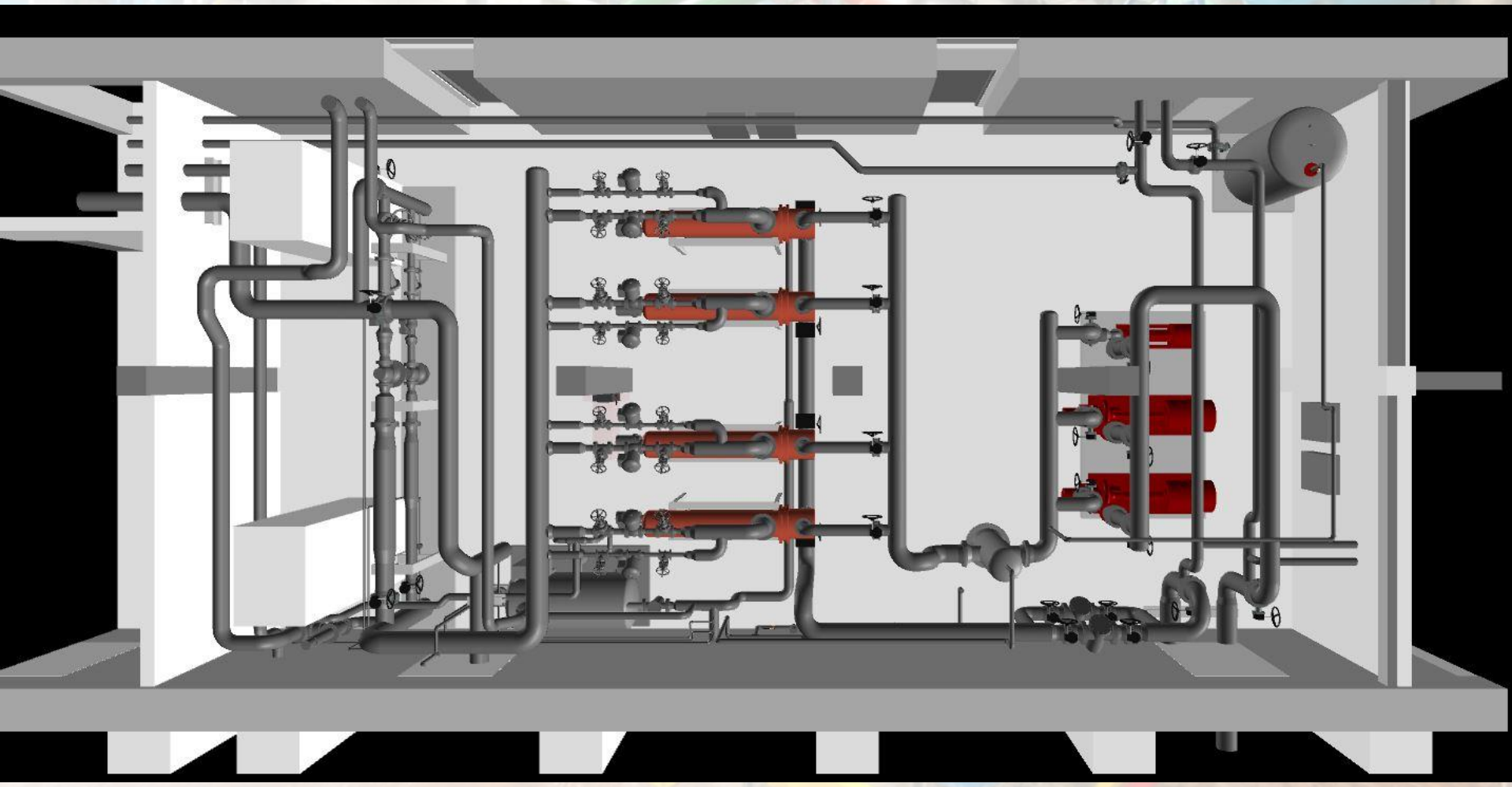
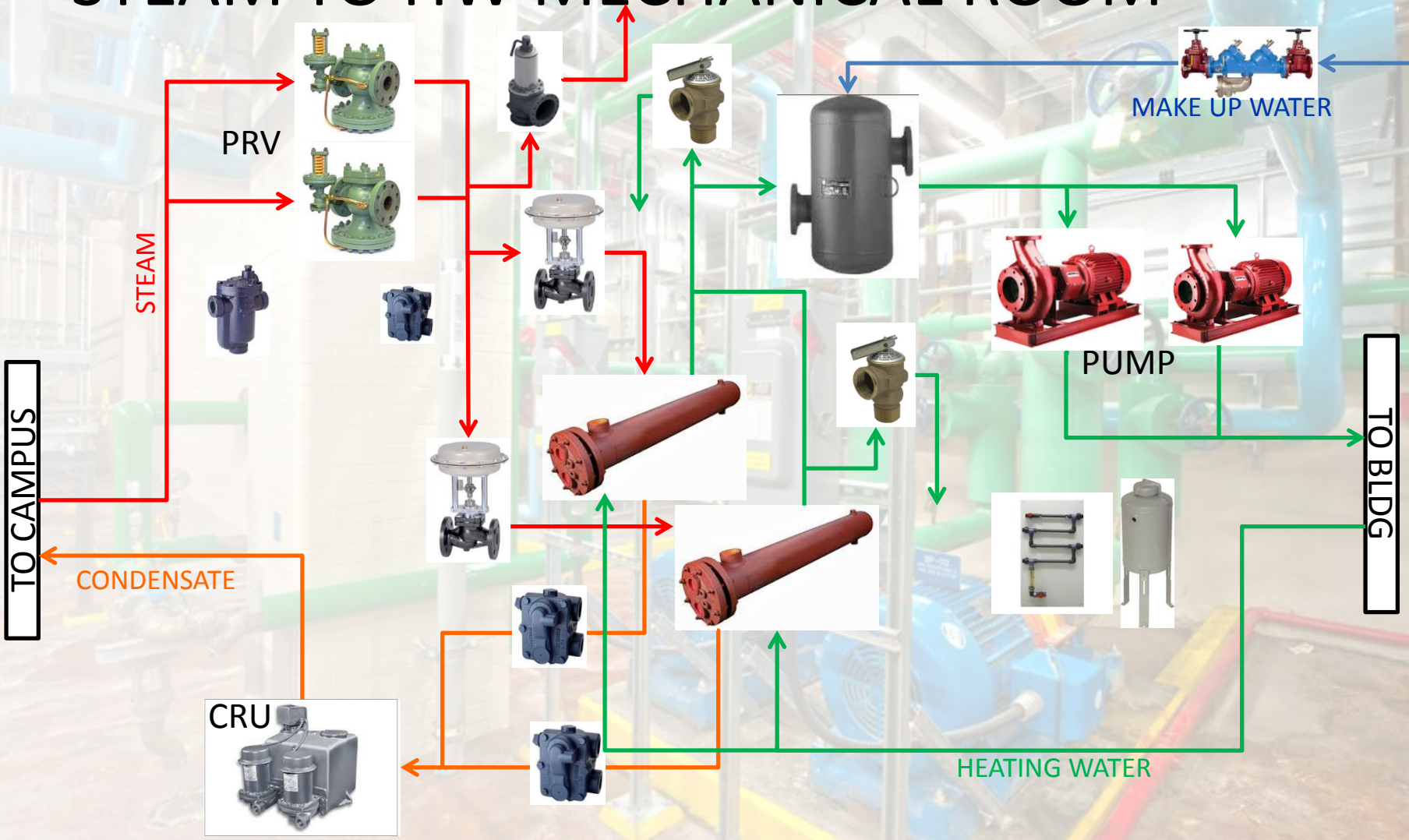
HOT WATER PLANT – 40,000 MBH



STEAM TO HW MECHANICAL ROOM



REGIONAL HW MECHANICAL ROOM

HEATING WATER SUPPLY

HEATING WATER RETURN

TO CAMPUS

TO BLDG

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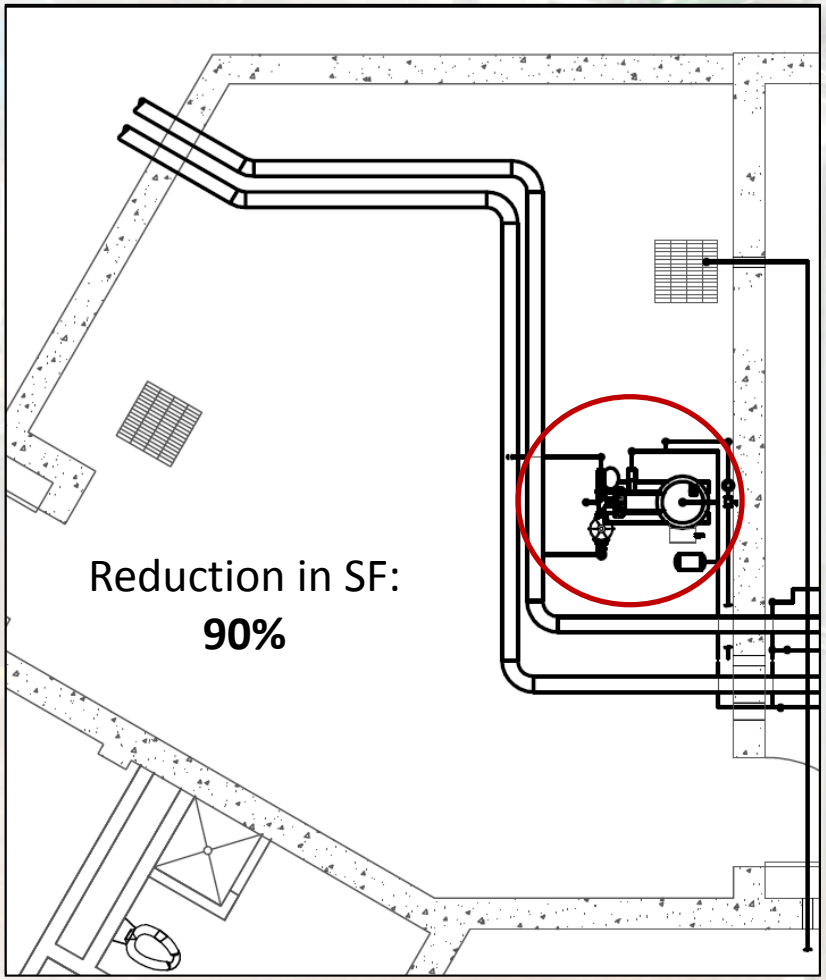
WHY REGIONAL HW?

MECH ROOM COST/SPACE REDUCTION

Hot Water Construction Cost: $250K



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BEFORE

AFTER

HW DISTRIBUTION = LOWER COST

Example: Assuming 40,000 MBH system.

Steam: $2,400/LF

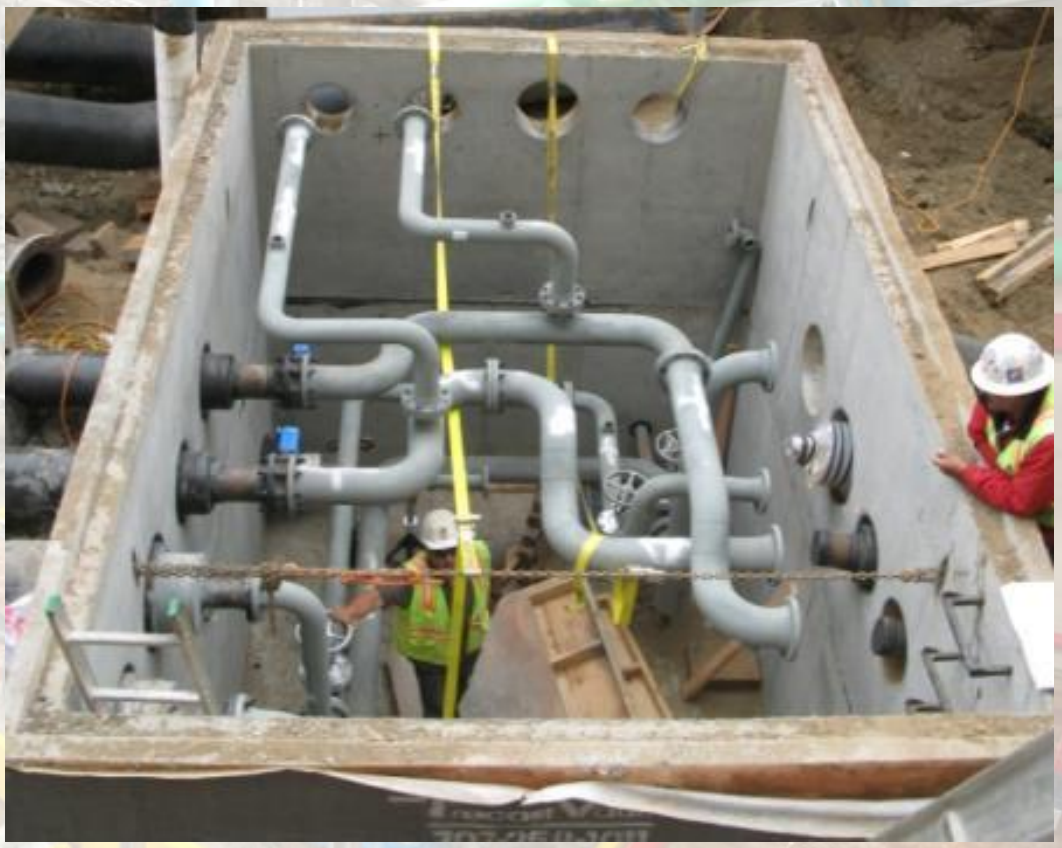
Hot Water: $1,100/LF

STEAM VAULTS = HIGH MAINTENANCE

- Accessibility
- Personnel Comfort
- Emergency access
- Flooding

HW DISTRIBUTION = NO VAULTS

- Direct buried valves
- No drip legs
- No sump pumps



SAFETY IMPACTS

- Reduced Vaults
  - » Fewer confined spaces
  - » Fewer ladders

- Reduced high pressure steam mechanical rooms

- Reduced Noise

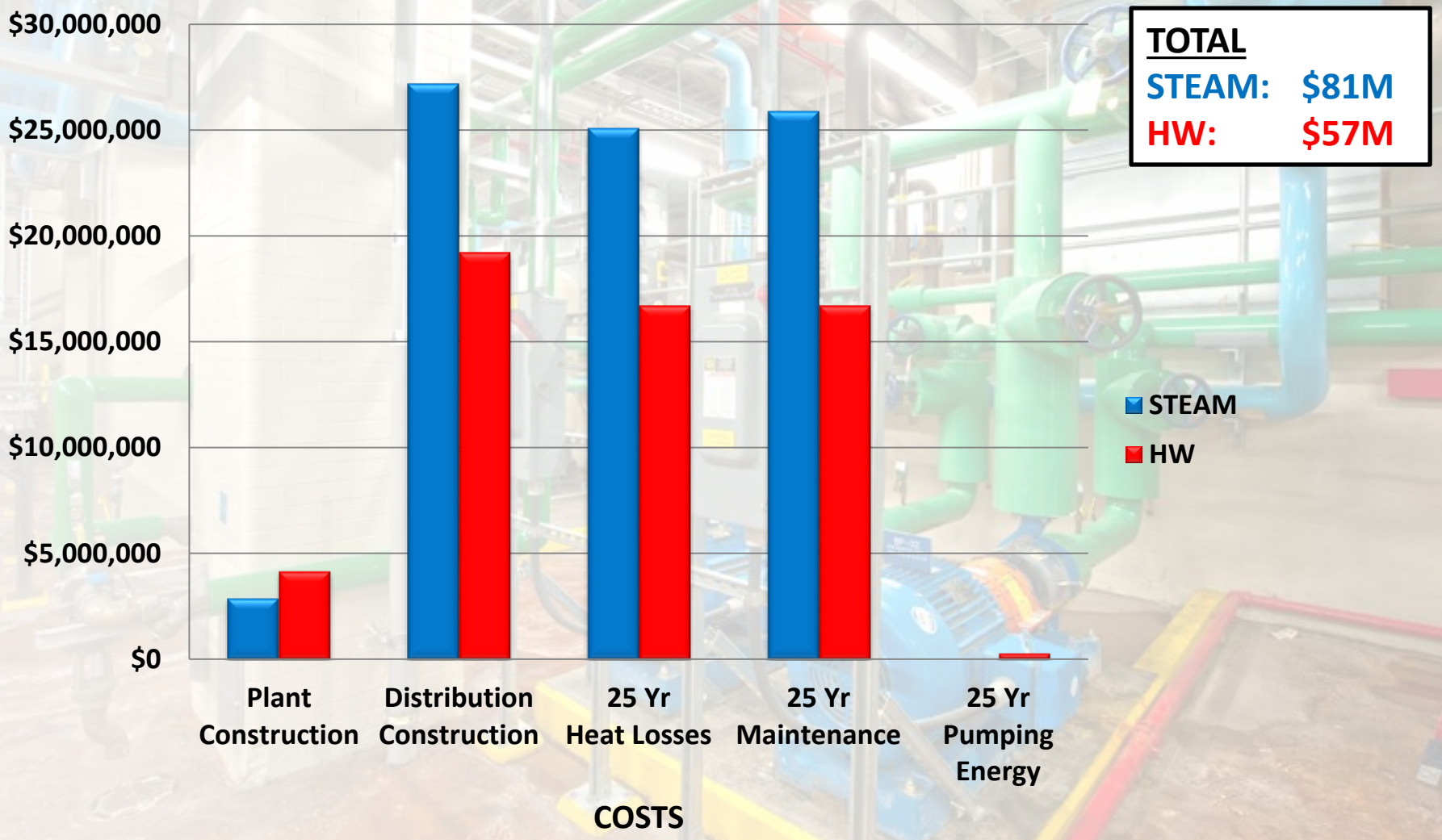
HOT WATER = LESS EQUIPMENT

	STEAM	HOT WATER	REDUCTION
PRV STATIONS	254	107	58%
STEAM VAULTS	104	64	38%
HW PUMPS	508	219	57%
STEAM TRAPS	1385	744	46%
COND. RETURN UNITS	254	51	80%

REGIONAL HW = LESS MAINTENANCE

- Improved accessibility
  - Consolidated equipment locations
  - Optimized plant design for HW components access
- Reduced HW components
- No condensate pipe
- Closed system
  - More control
  - Consolidate chemicals

HOT WATER ECONOMICS – 25 YEAR



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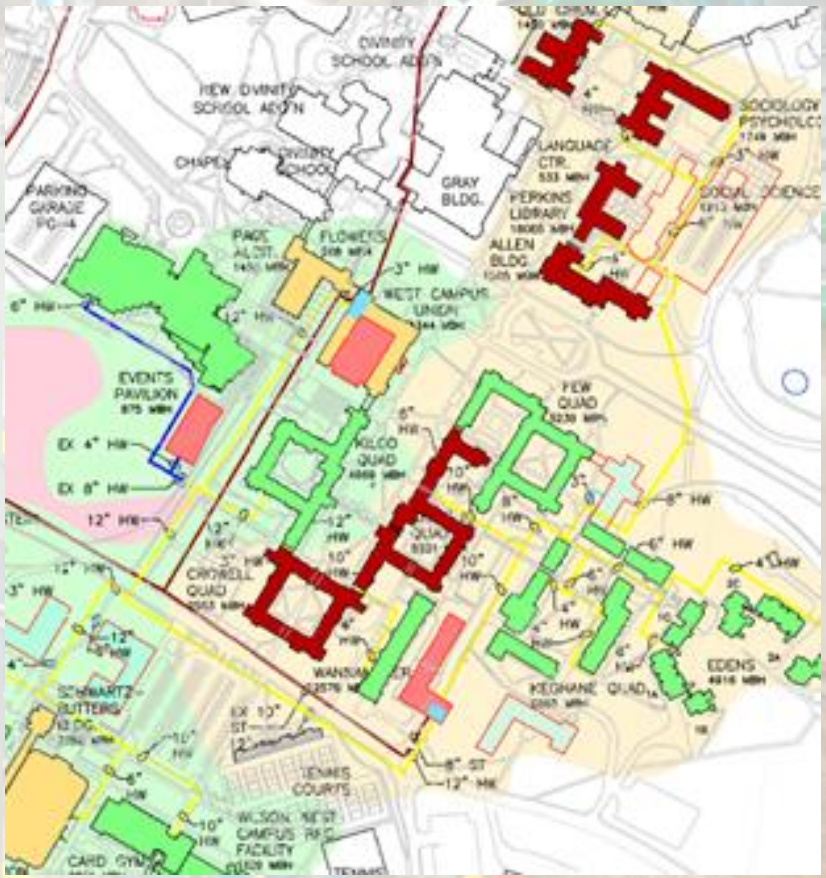
REGIONAL HOT WATER APPLICATION

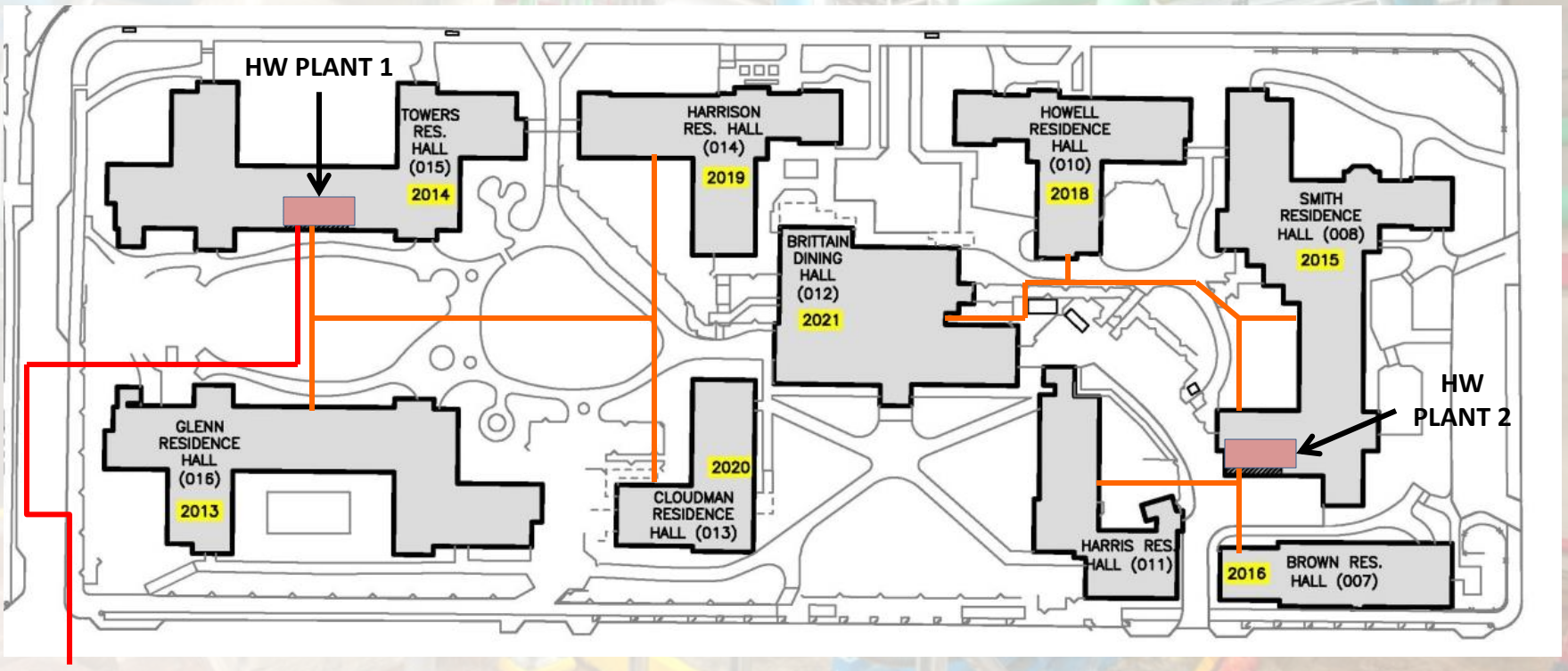
- Key challenges
- Ideal application
- Conclusions

REGIONAL HOT WATER APPLICATION

- Building Conversion
  - No more steam?
- Plant Location
  - Reliable steam
  - Physical space



IDEAL REGIONAL HW APPLICATION



REGIONAL HW RESULTS – GEORGIA TECH

	STEAM	HOT WATER	REDUCTION
PRV STATIONS	9	2	-7
STEAM VAULTS	8	2	-6
HW PUMPS	18	6	-12
STEAM TRAPS	44	10	-34
COND. RETURN UNITS	9	2	-7
TEMP CONTROL VALVES	36	4	-28

94 Fewer Hot Water Components

CONCLUSIONS

- Regional Hot Water Benefits
  - Less first cost
  - Less equipment
  - Less maintenance
  - Less complicated
  - Longer equipment life

- Best Applications
  - Remote building groups
  - Aged steam distribution
  - Building renovations