ACCOMPLISHMENTS IN ENERGY REDUCTION EFFORTS AT THE ARCHITECT OF THE CAPITOL

IDEA CAMPUS ENERGY CONFERENCE
MARCH 8, 2018
PRESENTATION TOPICS:

• OVERVIEW OF THE AOC
• DRIVERS FOR ENERGY CONSERVATION
• AOC ACCOMPLISHMENTS IN ENERGY REDUCTION EFFORTS
• BRIEF HISTORY OF THE CPP
• CONDITIONS AT THE START OF THE EFFORT
• CPP ENERGY CONSERVATION EFFORTS
THE ARCHITECT OF THE CAPITOL

CARE FOR: 17.4 MILLION+ SQUARE FEET OF FACILITIES; 580+ ACRES OF GROUNDS AND THOUSANDS OF WORKS OF ART

OVERSEE ANNUAL BUDGET OF APPROXIMATELY $600 MILLION PER YEAR AND MANAGE $1 BILLION+ IN ACTIVE CONSTRUCTION PROJECTS

HOST 3 MILLION+ VISITORS ANNUALLY WHILE SERVING 30,000 DAILY OCCUPANTS AROUND THE CLOCK TO MAINTAIN THE CAPITOL CAMPUS

SERVE

PRESERVE

INSPIRE
**Energy Policy Act of 2005**

- Established a 20% energy intensity reduction goal by 2015
- Used 2003 energy intensity as a baseline
KEY DRIVERS FOR FEDERAL ENERGY CONSERVATION EFFORTS
KEY DRIVERS FOR FEDERAL ENERGY CONSERVATION EFFORTS

ENERGY INDEPENDENCE AND SECURITY ACT 2007:

• ESTABLISHED A MORE AGGRESSIVE GOAL OF A 30% REDUCTION IN ENERGY INTENSITY BY 2015

• STILL USED THE 2003 ENERGY INTENSITY AS THE BASELINE
ARCHITECT OF THE CAPITOL
ENERGY CONSERVATION EFFORTS SUCCESS STORY

AOC ENERGY CONSERVATION: A STORY OF SUCCESS!

ANNUAL VALUE OF ENERGY REDUCTIONS

<table>
<thead>
<tr>
<th>Year</th>
<th>Value (Millions)</th>
<th>Reduction Progress</th>
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</thead>
<tbody>
<tr>
<td>FY 2006</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>FY 2007</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>FY 2008</td>
<td>11</td>
<td>5</td>
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<tr>
<td>FY 2009</td>
<td>15</td>
<td>8</td>
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<tr>
<td>FY 2010</td>
<td>17</td>
<td>9</td>
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<tr>
<td>FY 2011</td>
<td>19</td>
<td>10</td>
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<tr>
<td>FY 2012</td>
<td>22</td>
<td>13</td>
</tr>
<tr>
<td>FY 2013</td>
<td>25</td>
<td>14</td>
</tr>
<tr>
<td>FY 2014</td>
<td>25</td>
<td>14</td>
</tr>
<tr>
<td>FY 2015</td>
<td>31</td>
<td>17</td>
</tr>
</tbody>
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MAJOR SOURCES OF COST SAVINGS

- 12% BUILDING ELECTRIC SAVINGS
- 4% FREE COOLING
- 34% THERMAL ENERGY SAVINGS, BUILDINGS AND POWER PLANT
- 50% ENERGY SAVINGS PERFORMANCE CONTRACTS – $90 MILLION IN UPGRADES

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OVERVIEW OF THE CAPITOL POWER PLANT

1910 Initial Construction
OVERVIEW OF THE CAPITOL POWER PLANT

1930’S REFRIGERATION PLANT
OVERVIEW OF THE CAPITOL POWER PLANT

1950’S AND 1960’S RENOVATIONS
OVERVIEW OF THE CAPITOL POWER PLANT

1970’S WEST REFRIGERATION PLANT CONSTRUCTION
OVERVIEW OF THE CAPITOL POWER PLANT

2000’S EXPANSION OF THE WEST REFRIGERATION PLANT
OVERVIEW OF THE CAPITOL POWER PLANT

CAPITOL POWER PLANT TODAY
OVERVIEW OF THE CAPITOL POWER PLANT
THE CAPITOL POWER PLANT (IN 2007)

SYSTEM SNAPSHOT

• 1970’s REFRIGERATION PLANT EXPANSION COMPLETED IN 2007
• CONNECTED LOAD FOR ~17.5 MILLION SQ. FT.
• 7 BOILERS (620,000 / 460,000 PPH)
• 7 ELECTRIC-DRIVEN CHILLERS (40,200 TONS)
• 4 FREE-COOLING HEAT EXCHANGERS
• PRIMARY-SECONDARY PUMPING (125 - 150 PSIG)
• SUPPLY TEMPERATURE (41°F – 43°F)
• OPERATOR TRAINING PROGRAM
THE CAPITOL POWER PLANT (IN 2007)
CPP Chilled Water System Conservation Efforts

Annual Chilled Water Production Efficiency (KW/Ton)

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CPP CHILLED WATER SYSTEM CONSERVATION EFFORTS

ANNUAL CHILLED WATER PRODUCTION EFFICIENCY (KW/Ton)

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CPP CHILLED WATER SYSTEM CONSERVATION EFFORTS

ANNUAL CHILLED WATER PRODUCTION EFFICIENCY (KW/Ton)
CPP CHILLED WATER SYSTEM CONSERVATION EFFORTS

Note the total plant KW/Ton are approx.:  
- 0.45 when free cooling is in service  
- 0.70 when cooling is in service  
- 0.90 when using mechanical cooling
CPP Chilled Water System Conservation Efforts

Percent Free Cooling System Use (Oct. – Mar.)

- Chiller Only
- Co-Cooling
- Free Cooling

2012
2013
2014
CPP CHILLED WATER SYSTEM CONSERVATION EFFORTS

Maximum Flow Comparison

- **Single Chiller**
- **Two Chillers**
- **Three Chillers**
- **Four Chillers**

Flow (GPM) vs. Delta Temperature (degree F)

- 6,000 Tons
- 12,000 Tons
- 18,000 Tons
- 24,000 Tons
CPP CHILLED WATER SYSTEM CONSERVATION EFFORTS

MAXIMUM FLOW COMPARISON

FLOW (GPM)
0.00 5.00 10.00 15.00 20.00 25.00 30.00 35.00 40.00 45.00 50.00

DELTA TEMPERATURE (DEGREE F)

FOUR CHILLERS
THREE CHILLERS
TWO CHILLERS
SINGLE CHILLER

6,000 TONS
12,000 TONS
18,000 TONS
24,000 TONS
CPP CHILLED WATER SYSTEM CONSERVATION EFFORTS

MAXIMUM FLOW COMPARISON

- SINGLE Chiller
- TWO Chillers
- THREE Chillers
- FOUR Chillers

FLOW (GPM)

DELTA TEMPERATURE (DEGREE F)

- 6,000 TONS
- 12,000 TONS
- 18,000 TONS
- 24,000 TONS
CPP CHILLED WATER SYSTEM CONSERVATION EFFORTS

ANNUAL CHILLED WATER PRODUCTION EFFICIENCY (KW/Ton)
ANNNUAL CHILLED WATER PRODUCTION EFFICIENCY (KW/Ton)
CPP Steam System Conservation Efforts

Annual Steam Plant Energy Input (MMBTU)
CPP Steam System Conservation Efforts
CPP Steam System Conservation Efforts

CPP Boiler Combustion Efficiency

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CPP BOILER COMBUSTION EFFICIENCY
CPP STEAM SYSTEM CONSERVATION EFFORTS

CPP BOILER COMBUSTION EFFICIENCY

CONDENSING ECONOMIZERS
Biomass
Biodiesel
Steam Trap Replacement

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CPP STEAM SYSTEM CONSERVATION EFFORTS

CPP BOILER COMBUSTION EFFICIENCY

CONDENSING ECONOMIZERS
- Biomass
- Biodiesel
- Steam Trap Replacement
CPP Steam System Conservation Efforts

CPP Boiler Combustion Efficiency

Condensing Economizers

Biomass

Biodiesel

Steam Trap Replacement

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CPP STEAM SYSTEM CONSERVATION EFFORTS

CPP BOILER COMBUSTION EFFICIENCY

CONDENSING ECONOMIZERS
BIOMASS
BIODIESEL
STEAM TRAP REPLACEMENT
CPP STEAM SYSTEM CONSERVATION EFFORTS

CPP BOILER COMBUSTION EFFICIENCY

CONDENSING ECONOMIZERS
BIOMASS
Biodiesel
STEAM TRAP REPLACEMENT
CPP Energy Conservation Efforts

AOC’s Energy Reduction Progress

-34%


Energy Intensity Reduction Percentage

Architect of the Capitol
AOC FY 2016 - FY 2025 50% Energy Reduction Goal
AOC’s 10-Year Energy Reduction Priorities

- Cogeneration
  - Capitol Power Plant

- ESPC
  - Library Buildings and Grounds

- DDC Upgrades
  - Library of Congress Madison Building

- Other Efficiency Improvements
  - Capitol Campus

- Renewal
  - Cannon House Office Building

- Refrigeration Revitalization
  - Capitol Power Plant

Projected Energy Use Reduction

FY 2016

FY 2025 50% Goal
CPP ENERGY CONSERVATION EFFORTS

OPERATIONAL ENERGY CONSERVATION EFFORT STRATEGIES

• WEEKLY OPERATIONS STAFF MEETINGS

• CREATING METRICS AND TARGETS

• IMPROVING VISIBILITY OF METRICS AND TARGETS

• PROVIDING EMPLOYEES FLEXIBILITY TO EXPERIMENT

• COMMUNICATE WITH FACILITY MANAGERS

• CONDUCT ANNUAL BOILER TUNING

• EXPLORE DEMAND RESPONSE OPPORTUNITIES
CPP ENERGY CONSERVATION EFFORTS

CAPITAL PLANNING/IMPROVEMENT STRATEGIES

• IMPLEMENT FREE COOLING
• IMPROVING SYSTEM METERING
• REPLACED STEAM TRAPS
• DON’T OVERLOOK METER DATA MANAGEMENT
• INTEGRATING EFFICIENCY TARGETS INTO CAPITAL IMPROVEMENT PROJECTS
• EXPLORE MULTIPLE AVENUES FOR ENERGY CONSERVATION EFFORTS
• INTEGRATE PERFORMANCE TARGETS INTO UTILITY MASTER PLANS
CONTACT INFORMATION

THANK YOU

• BRIAN KLEIN
  ASSISTANT DIRECTOR OF OPERATIONS
  CAPITOL POWER PLANT
  bklein@aoc.gov
QUESTIONS?