Federal Facilities Council

National Gallery of Art

“Best Practices to Meet Mission and Energy Costs Targets”

David Samec, P.E., CFM
Chief of Facilities Management

June 12, 2013
The National Gallery of Art

- Andrew Mellon donated his art collection in 1936 to the U.S. for a new national art museum
- Designed by Russell Pope
- West Building built March 1937 – December 1940
- Mellon’s children funded a second building for modern art, designed by I.M. Pei
- East Building built 1971 – June 1978
- Sculpture Garden constructed and opened in May 1999
- Nearly 5,000,000 visitors annually
Facilities Management at the National Gallery of Art

- 1,374,000 square feet of facilities
- 10.2 acres of landscaped grounds
- 6.2 acre National Sculpture Garden
- 70,900 linear feet of glass windows
- 16,800 light fixtures
- 64 rest rooms
- 363 plumbing fixtures
- 34 conveyance systems
- 53 major air handling systems
  - most with air washers
- 1,500 major facility assets
- 10,000 point BAS
"To serve the United States of America in a national role by preserving, collecting, exhibiting, and fostering the understanding of works of art at the highest possible museum and scholarly standards."
Facilities Management
Mission

“...preserving...great works of art.”

Temperature = 70-degrees F +/- 5-degrees
Relative Humidity = 50% +/- 5%
Sustainability: “...meeting the needs of the present without compromising the ability of future generations to meet their own needs.”
Sustainability - Legislation

1965 Solid Waste Disposal Act
1970 Clean Air Act
1976 Resource and Recovery Act
1978 National Energy Act
1980 Energy Security Act
1998 EO 13101 – Greening the Government Through Waste Reduction, Recycling, and Federal Acquisition
2005 Energy Policy Act
2006 ISO 14064-1/2/3 “Greenhouse Gases”
2006 Guiding Principles for Federal Leadership in Sustainable Buildings
2007 Energy Independence and Security Act
2007 EO 13423 - Strengthening Federal Environmental, Energy, and Transportation Management
2009 The American Recovery and Reinvestment Act of 2009
2009 EO 13514 - Federal Leadership in Environmental, Energy, and Economic Performance
Balancing Sustainability with Budget

Art Preservation
Staff
Visitors
Daily Cleaning
Preventive Maintenance
Daily Operations
Routine Maintenance
Emergency Maintenance
Deferred Maintenance
Equipment
Utilities Bills
Exhibitions
Art Moves
Special Projects
Special Events
Project Backlogs
Safety
Security
Mobile Devices
IT

Sustainability Goals
Energy Consumption Reduction
Energy Conservation Measures
Greenhouse Gas Reductions
Green Cleaning
Social Programs
Combining Sustainability with Budget

Art Preservation
Daily Cleaning
Preventive Maintenance
Daily Operations
Routine Maintenance
Emergency Maintenance
Deferred Maintenance
Equipment
Utilities Bills
Staff
Visitors
Exhibitions
Art Moves
Special Projects
Special Events
Project Backlogs
Safety
Security
Mobile Devices
IT

Sustainability Goals
Energy Consumption Reduction
Energy Conservation Measures
Greenhouse Gas Reductions
Green Cleaning
Social Programs
Reach for All Hanging Fruit

High Hanging Fruit

Medium Hanging Fruit

Low Hanging Fruit

Vincent van Gogh, The Olive Orchard, 1889
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Alignment of Vision, Mission, and Goals

Leaders empowered to improve services, to include sustainable practices
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Establish a Sustainability Office
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Good Communications Between Gallery Staffs

- Curators
- Exhibitions
- Design and Construction
- Registrar
- Conservators
- Safety - Risk Management
- Fire Marshal
- Security
- Facilities Management
- Legal – Loan Agreements
Best Practices to Meet Mission and Energy Costs Targets
Best Practices to Meet Mission and Energy Costs Targets
Best Practices to Meet Mission and Energy Costs Targets
Best Practices to Meet Mission and Energy Costs Targets
Best Practices to Meet Mission and Energy Costs Targets
Best Practices to Meet Mission and Energy Costs Targets
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Good Communications Between Gallery Staffs
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Know Where You Are Spending in Your Facilities

% of Utilities
So Let’s Look at Our Building

SOURCES OF HEAT AND MOISTURE TRANSMISSION

THERMAL TRANSMISSION

INTERNAL SENSIBLE HEAT

INTERNAL SENSIBLE & LATENT HEAT

MOISTURE TRANSMISSION
Facilities Management Mission

Temperature = 70-degrees F +/- 5-degrees
Relative Humidity = 50% +/- 5%

“…preserving…great works of art.”

A – Humidification Only (Up)
B – Heating and Humidifying
C – Sensible Heating Only (Right)
D – Desiccant Dehumidifying
E – Dehumidification Only (Down)
F – Cooling & Dehumidifying
G – Sensible Cooling Only
H – Evaporative Cooling Only
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Conduct Regular Energy Audits to Check the Condition and Efficiency of Your Equipment

<table>
<thead>
<tr>
<th>Component</th>
<th>MMBH</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Fan</td>
<td>356</td>
<td>5.3%</td>
</tr>
<tr>
<td>Return Fan</td>
<td>209</td>
<td>3.1%</td>
</tr>
<tr>
<td>Spray Pump</td>
<td>334</td>
<td>4.9%</td>
</tr>
<tr>
<td>Reheat</td>
<td>2,689</td>
<td>39.9%</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>3,157</td>
<td>46.8%</td>
</tr>
</tbody>
</table>

**TOTAL ENERGY CONSUMPTION**

6,745 MMBH

* MMBH = 1 MILLION BTU/HR
### Best Practices to Meet Mission and Energy Costs Targets

#### WAC NO. 16 OCCUPIED SPACE COOLING LOAD SUMMARY

<table>
<thead>
<tr>
<th>SPACE NO.</th>
<th>FLOOR AREA (SF)</th>
<th>CEILING (BTU/HR)</th>
<th>WALL (BTU/HR)</th>
<th>LAYLIGHT SOLAR (BTU/HR)</th>
<th>LIGHTS (BTU/HR)</th>
<th>PEOPLE SH (BTU/HR)</th>
<th>ROOM SH (BTU/HR)</th>
<th>PEOPLE LH (BTU/HR)</th>
<th>ROOM TH (BTU/HR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-46</td>
<td>848</td>
<td>14,378</td>
<td>---</td>
<td>6,020</td>
<td>6,649</td>
<td>4,240</td>
<td>31,287</td>
<td>4,240</td>
<td>35,527</td>
</tr>
<tr>
<td>M-47</td>
<td>1,283</td>
<td>21,495</td>
<td>5,090</td>
<td>11,200</td>
<td>10,946</td>
<td>6,416</td>
<td>55,147</td>
<td>6,416</td>
<td>61,563</td>
</tr>
<tr>
<td>M-48</td>
<td>1,166</td>
<td>19,648</td>
<td>---</td>
<td>9,100</td>
<td>7,331</td>
<td>5,830</td>
<td>41,909</td>
<td>5,830</td>
<td>47,739</td>
</tr>
<tr>
<td>M-49</td>
<td>959</td>
<td>16,129</td>
<td>3,959</td>
<td>8,064</td>
<td>7,945</td>
<td>4,794</td>
<td>40,891</td>
<td>4,794</td>
<td>45,685</td>
</tr>
<tr>
<td>M-50</td>
<td>944</td>
<td>15,903</td>
<td>3,733</td>
<td>8,064</td>
<td>6,308</td>
<td>4,720</td>
<td>38,728</td>
<td>4,720</td>
<td>43,448</td>
</tr>
<tr>
<td>M-50A</td>
<td>203</td>
<td>---</td>
<td>1,697</td>
<td>---</td>
<td>4,297</td>
<td>1,015</td>
<td>7,009</td>
<td>1,015</td>
<td>8,024</td>
</tr>
<tr>
<td>M-50B</td>
<td>378</td>
<td>1,316</td>
<td>---</td>
<td>---</td>
<td>6,343</td>
<td>1,890</td>
<td>9,549</td>
<td>1,890</td>
<td>11,439</td>
</tr>
<tr>
<td>M-50C</td>
<td>210</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>4,910</td>
<td>1,051</td>
<td>5,961</td>
<td>1,051</td>
<td>7,012</td>
</tr>
<tr>
<td>M-51</td>
<td>848</td>
<td>14,378</td>
<td>---</td>
<td>6,048</td>
<td>7,297</td>
<td>4,240</td>
<td>31,963</td>
<td>4,240</td>
<td>36,203</td>
</tr>
<tr>
<td>TOTAL</td>
<td>6,839</td>
<td>103,247</td>
<td>14,479</td>
<td>48,496</td>
<td>62,026</td>
<td>34,196</td>
<td>262,444</td>
<td>34,196</td>
<td>296,640</td>
</tr>
</tbody>
</table>

**NOTES:**
1. PERIMETER ZONE (RHC 16-1) PEAK COOLING - SEPTEMBER 6:00 PM, 80°F DB.
2. INTERIOR ZONE (RHC 16-2) PEAK COOLING - JULY 2:00 PM, 92°F DB.
3. OCCUPANCY - 50 SF/PERSON, 250 BTU/HR SH, 250 BTU/HR LH.

- 178,914 BTU/HR
- 60% OF TOTAL LOAD
Best Practices to Meet Mission and Energy Costs Targets

NEW INSTRUMENTATION

- SUPPLY FAN AIR FLOW STATION
- RETURN FAN AIR FLOW STATION
- SPRAY PUMP VARIABLE FREQUENCY DRIVE
- SPRAY HEADER PRESSURE CONTROL

NEW PUMP VARIABLE FREQUENCY DRIVE

NEW AIR FLOW STATIONS

NEW CONTROL SEQUENCE MODIFICATION

- SUPPLY FAN AIR FLOW SET TO MAINTAIN 14,000 CFM
- RETURN FAN AIR FLOW SET TO MAINTAIN 11,900 CFM
- SPRAY PUMP VARIABLE FREQUENCY DRIVE CONTROLLED FROM HEADER PRESSURE SENSOR
- SPRAY HEADER PRESSURE CONTROL MAINTAINS A HEADER PRESSURE EQUIVILENT TO 151 GPM
- RE-IMPLEMENT DISCHARGE AIR RESET FOR HUMIDITY CONTROL

Best Practices to Meet Mission and Energy Costs Targets
Best Practices to Meet Mission and Energy Costs Targets

- **REDUCE AIR VOLUME FROM 18,700 CFM TO 14,000 CFM**

- **REDUCE SPRAY PUMP FLOW RATE FROM 290 GPM TO 151 GPM**

- **REDUCE OUTSIDE AIR VOLUME FROM 2,805 CFM TO 2,100 CFM**

- **ADJUST INDIVIDUAL GALLERY OUTLETS BASED ON LOAD CALCULATIONS FOR INDIVIDUAL GALLERIES**
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Align HVAC Use With Occupancy

WEST AC#16
MODEL AFTER THE RE-INSTRUMENTATION AND AIR & WATER BALANCE AND IMPLEMENTATION OF UNOCCUPIED BYPASS

BYPASS SAVINGS
$23,223

TOTAL OPERATING COST
$92,985

SUPPLY FAN
$4,117

RETURN FAN
$2,059

CHILLED WATER
$26,352

REHEAT
$54,884

SPRAY PUMP
$5,511

TAB SAVINGS
$65,622

UNOCC SAVINGS
$20,263

$2,059

$54,884

$5,511

$4,117
Best Practices to Meet Mission and Energy Costs Targets

TOTAL ESTIMATED WEST BUILDING SAVINGS

WEST BLDG TAB SAVINGS
$524,073

WEST BLDG UNOCCUPIED SAVINGS
$506,613

WEST BLDG BYPASS SAVINGS
$578,841

ESTIMATED WEST BUILDING SAVINGS
$1,609,527
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Be Creative with HVAC Schedules

Rolling Outages"...The following units will turn off for 60 mins and come back on to help conserve energy.

These units will shut down for 60mins in a 24 hour period:

West Building Units

<table>
<thead>
<tr>
<th>Unit</th>
<th>Off</th>
<th>On</th>
<th>Off</th>
<th>On</th>
<th>Off</th>
<th>On</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAC1</td>
<td></td>
<td>12M</td>
<td>2AM</td>
<td>9PM</td>
<td>11PM</td>
<td></td>
</tr>
<tr>
<td>WAC2</td>
<td>2AM</td>
<td>4AM</td>
<td>7PM</td>
<td>9PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC3</td>
<td>7AM</td>
<td>8AM</td>
<td>10PM</td>
<td>11PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC4</td>
<td>3AM</td>
<td>4AM</td>
<td>6PM</td>
<td>7PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC6</td>
<td></td>
<td>945AM</td>
<td>5PM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC12</td>
<td>4AM</td>
<td>5AM</td>
<td>8AM</td>
<td>9AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC13</td>
<td>1AM</td>
<td>3AM</td>
<td>9AM</td>
<td>10AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC14</td>
<td>5AM</td>
<td>6AM</td>
<td>8PM</td>
<td>9PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC15</td>
<td>7AM</td>
<td>8AM</td>
<td>10PM</td>
<td>11PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC18</td>
<td>2AM</td>
<td>4AM</td>
<td>6PM</td>
<td>8PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC19</td>
<td>5AM</td>
<td>6AM</td>
<td>8PM</td>
<td>10PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC16</td>
<td>8AM</td>
<td>9AM</td>
<td>11PM</td>
<td>12M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC21</td>
<td>1AM</td>
<td>3AM</td>
<td>9AM</td>
<td>10AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC“X&quot;</td>
<td>3AM</td>
<td>4AM</td>
<td>6PM</td>
<td>7PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

East Building Units

<table>
<thead>
<tr>
<th>Unit</th>
<th>Off</th>
<th>On</th>
<th>Off</th>
<th>On</th>
<th>Off</th>
<th>On</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAC1</td>
<td>12M</td>
<td>2AM</td>
<td>8AM</td>
<td>9AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC2</td>
<td>3AM</td>
<td>4AM</td>
<td>7PM</td>
<td>8PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC4</td>
<td>4AM</td>
<td>5AM</td>
<td>7PM</td>
<td>9PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC5</td>
<td>1AM</td>
<td>2AM</td>
<td>9AM</td>
<td>10AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC6</td>
<td>6AM</td>
<td>5PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC7</td>
<td>2AM</td>
<td>3AM</td>
<td>5PM</td>
<td>6PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC10</td>
<td>8AM</td>
<td>9AM</td>
<td>11PM</td>
<td>12AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC12</td>
<td>12M</td>
<td>1AM</td>
<td>9AM</td>
<td>10AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC9</td>
<td>5AM</td>
<td>6AM</td>
<td>10PM</td>
<td>11PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC13</td>
<td>12AM</td>
<td>6AM</td>
<td>7AM</td>
<td>8AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC14</td>
<td>7AM</td>
<td>8AM</td>
<td>11PM</td>
<td>12M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC21</td>
<td>7AM</td>
<td>8AM</td>
<td>11PM</td>
<td>12M</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

East Building Con’t

<table>
<thead>
<tr>
<th>Unit</th>
<th>Off</th>
<th>On</th>
<th>Off</th>
<th>On</th>
<th>Off</th>
<th>On</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAC22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC23</td>
<td>5AM</td>
<td>6AM</td>
<td>9PM</td>
<td>10PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC31</td>
<td>4AM</td>
<td>5AM</td>
<td>7PM</td>
<td>8PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC11</td>
<td>7AM</td>
<td>8AM</td>
<td>10PM</td>
<td>11PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC27</td>
<td>3AM</td>
<td>4AM</td>
<td>7PM</td>
<td>9PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC24</td>
<td>4AM</td>
<td>5AM</td>
<td>8PM</td>
<td>10PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC25</td>
<td>1AM</td>
<td>3AM</td>
<td>5PM</td>
<td>6PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC26</td>
<td>6AM</td>
<td>7AM</td>
<td>10PM</td>
<td>11PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC28</td>
<td>2AM</td>
<td>4AM</td>
<td>7PM</td>
<td>9PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC32</td>
<td>12AM</td>
<td>6AM</td>
<td>7AM</td>
<td>9PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC33</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC34</td>
<td>6AM</td>
<td>6PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC35</td>
<td>5AM</td>
<td>6AM</td>
<td>8PM</td>
<td>9PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC36</td>
<td>12M</td>
<td>1AM</td>
<td>6PM</td>
<td>7PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC30</td>
<td>3AM</td>
<td>4AM</td>
<td>6PM</td>
<td>7PM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Best Practices to Meet Mission and Energy Costs Targets
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Use Daylighting Where Possible
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Convert Lights to Lower Energy Use Lights

Incandescent → Fluorescent → LEDs
Improvements with Fluorescents

Replaced 93 T-8’s with 45 new T5’s

Put lights on BAS schedule & added motion sensors
Use Available Technology

COTS → High Tech Light
- Full light spectrum
- No LED “droop”
- Minimal heat
- UL listed
- 1/4 wattage of LED

New Gallery Lights
- 90W → 19.5W
- No visible light differences
- 41-year life
- Temperature drop ~3-degrees
- ~4-year payback (getting better)
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Add Metering and Sub-Metering

BAS Sensors (T/RH/Pressure)

Electricity Meters & Sub-Meters

Chilled Water Sub-Meter

Air Flow Meter

Water Meter & Sub-Meters
Building Automation System

- Proprietary system since 1990’s
- 2006 migration to “open system”
- Going wireless
- 51 major AHUs
- 116 digital controllers
- 10,000 total points
- 800 T/RH sensors
- Lighting controls
- Chiller plant control
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Buy Energy Efficient Equipment
Learn from Others Within Your Industry

Fruit: Benchmark Against Other Like Facilities

International Association Of Museum Facilities Administrators (IAMFA)

International Facility Management Association (IFMA)

American Association Of Museums (AAM)
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Schedule Work During Regular Shift Hours
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Use New Sustainable Technology in Daily Business

- Low & No VOC Paints
- Re-Using What We Have
- Timers on Irrigation systems
- Green seal certified
- Motion Sensors
- Green cleaning
- EPA Design for Environment
Best Practices to Meet Mission and Energy Costs Targets

Different Cleaning Systems = Different Carpet “Life”

- New Carpet Fiber
- New Carpet Fiber After Wet Extraction Cleaning
- New Carpet Fiber After Spin Bonnet Cleaning
- New Carpet Fiber After Sustainable Carpet Cleaning
- New Carpet Fiber Crystalline Cleaning
Best Practices to Meet Mission and Energy Costs Targets

Proper Maintenance Extends the Life of Carpet

Reduces Landfill Waste AND saves money!!!!
Keep up with Training and Technology

Fruit: Look for Free or Inexpensive Training

Webinars

Local Training & Conferences
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Network with Others in Profession
Meeting Federal Mandates

**EO 13423**
- 30% reduction in energy consumption by 2015

**EO 13514**
- 28% reduction in GHG building emissions by 2020
Develop a Plan of Action

Fruit: Use Subject Matter Experts

“20/20 by 2020”

20% reduction in energy consumption

20% reduction in GHG emissions
Work Within Budget
System & Constraints
Understand the Big Picture
Develop and Design Energy Conservation Measures

Figure 7.4: Pain - Gain Index
Design and Develop Energy Conservation Measures

1. Sculpture Garden Pavilion
2. Gallery Lighting Retrofit
3. Continuous Commissioning (CCX)
4. Cascades Café – EAC 33 and EAC 34 Renovations
5. Air Filtration Retrofit
6. Steam Metering
7. Power Shaver
Don’t Be Afraid to Reach for the High Fruit

Adding a 4\textsuperscript{th} Heat Exchanger and De-Rating a 3\textsuperscript{rd}

SEQUENCE
10,500 gpm
9,500 gpm
8,000 gpm
7,000 gpm
6,000 gpm
4,500 gpm
3,500 gpm
2,500 gpm
1,000 gpm

SEQUENCE
10,500 gpm
7,000 gpm
3,500 gpm
Know When to Stop Reaching

Law of Diminishing Returns

INVESTMENT: TIME, ENERGY, MONEY ETC.
# Measure and Trend Results

## Chilled Water Consumption and Cost by FY

<table>
<thead>
<tr>
<th>FY</th>
<th>Tons CHW</th>
<th>Cost CHW</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY2008</td>
<td>10,692,830</td>
<td>$2,107,625</td>
</tr>
<tr>
<td>FY2009</td>
<td>10,838,756</td>
<td>$2,123,615</td>
</tr>
<tr>
<td>FY2010</td>
<td>10,400,684</td>
<td>$2,229,533</td>
</tr>
<tr>
<td>FY2011</td>
<td>9,026,934</td>
<td>$1,815,850</td>
</tr>
<tr>
<td>FY2012 Final</td>
<td>8,290,280</td>
<td>$1,588,850</td>
</tr>
</tbody>
</table>

Chilled Water Costs: cooling in ton-hours
Measure and Trend Results

Steam Use and Cost by FY

<table>
<thead>
<tr>
<th></th>
<th>FY2008</th>
<th>FY2009</th>
<th>FY2010</th>
<th>FY2011</th>
<th>FY2012 Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kibs Steam Use</td>
<td>75,876</td>
<td>86,402</td>
<td>81,410</td>
<td>72,703</td>
<td>57,992</td>
</tr>
<tr>
<td>Cost Steam</td>
<td>$2,959,620</td>
<td>$3,456,407</td>
<td>$3,327,332</td>
<td>$2,828,239</td>
<td>$2,256,008</td>
</tr>
</tbody>
</table>
Measure and Trend Results

Electricity Use and Cost by FY

<table>
<thead>
<tr>
<th>FY</th>
<th>Electricity (kWh)</th>
<th>Electricity Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY2008</td>
<td>23,664,152</td>
<td>$2,936,542</td>
</tr>
<tr>
<td>FY2009</td>
<td>23,459,148</td>
<td>$2,880,233</td>
</tr>
<tr>
<td>FY2010</td>
<td>22,860,895</td>
<td>$2,746,185</td>
</tr>
<tr>
<td>FY2011</td>
<td>22,551,223</td>
<td>$2,610,012</td>
</tr>
<tr>
<td>FY2012</td>
<td>22,114,392</td>
<td>$2,281,940</td>
</tr>
</tbody>
</table>

NATIONAL GALLERY OF ART
## NGA Energy Use by Fiscal Year in MMBtus

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Chilled Water</th>
<th>Steam</th>
<th>Electricity</th>
<th>MMBtu Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY2008</td>
<td>128,314</td>
<td>90,596</td>
<td>80,766</td>
<td>240,000</td>
</tr>
<tr>
<td>FY2009</td>
<td>130,065</td>
<td>103,164</td>
<td>80,066</td>
<td>240,000</td>
</tr>
<tr>
<td>FY2010</td>
<td>124,808</td>
<td>97,203</td>
<td>78,024</td>
<td>240,000</td>
</tr>
<tr>
<td>FY2011</td>
<td>108,323</td>
<td>86,807</td>
<td>76,967</td>
<td>240,000</td>
</tr>
<tr>
<td>FY2012 Final</td>
<td>99,483</td>
<td>69,242</td>
<td>75,476</td>
<td>240,000</td>
</tr>
</tbody>
</table>

### Energy Goal in MMBtus

<table>
<thead>
<tr>
<th>Year</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>240,000</td>
</tr>
<tr>
<td>2009</td>
<td>240,000</td>
</tr>
<tr>
<td>2010</td>
<td>240,000</td>
</tr>
<tr>
<td>2011</td>
<td>240,000</td>
</tr>
<tr>
<td>2012 Final</td>
<td>240,000</td>
</tr>
</tbody>
</table>
Determine if Reaching Energy Costs Targets

Fruit: Track Success with KPI’s

NGA Greenhouse Gas Emissions in Metric Tons Carbon Dioxide equivalents (MT CO₂e): Goal - 20% Reduction by 2020

<table>
<thead>
<tr>
<th>Year</th>
<th>GHG-CHW</th>
<th>GHG-Steam</th>
<th>GHG Electricity</th>
<th>GHG Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY2008</td>
<td>5,294</td>
<td>8,905</td>
<td>12,296</td>
<td>22,000</td>
</tr>
<tr>
<td>FY2009</td>
<td>5,401</td>
<td>10,140</td>
<td>12,189</td>
<td>22,000</td>
</tr>
<tr>
<td>FY2010</td>
<td>5,217</td>
<td>9,554</td>
<td>11,878</td>
<td>22,000</td>
</tr>
<tr>
<td>FY2011</td>
<td>4,557</td>
<td>8,533</td>
<td>11,717</td>
<td>22,000</td>
</tr>
<tr>
<td>FY2012 Final</td>
<td>4,212</td>
<td>6,806</td>
<td>11,490</td>
<td>22,000</td>
</tr>
</tbody>
</table>

MT CO₂e

Determine if Reaching Energy Costs Targets
Measure Against Similar Agencies
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Spread the Good News

Reduce, Reuse & Recycle

Recycling opportunities (see reverse for more details):

- Batteries – alkaline, nickel cadmium, and more
- Building materials – doors, sinks, toilets, etc.
- Cardboard, including corrugated
- Construction materials – construction, demolition, renovation
- Containers – aluminum cans, glass and plastic bottles, food containers
- Cooking oil
- Electronics
- Fluorescent lamps – CFL, tubes
- Metal – scrap
- Paper – glossy, brochures, newsprint, copper paper – all paper
- Plastics – acrylic sheeting, ABS, nylon, polyethylene sheeting
- Toner cartridges
- Wood – scrap, pallets

- The Gallery currently recycles batteries, cardboard, containers (plastic and glass), fluorescent lamps and paper:
  
  Note: All types of paper are recyclable; this includes brochures, maps, color and white.

- Food Service contractors recycle cardboard, containers and cooking oil.
- Reuse building materials as appropriate.
- Recycling of construction materials is stipulated and included in AAE and AFM contracts.
- The Gallery will occasionally recycle Metal and Wood based on volume.
Best Practices to Meet Mission and Energy Costs Targets

Fruit: Track Success With KPI’s
Fruit: Add Metering and Sub-Metering
Fruit: Look for Free or Inexpensive Training
Fruit: Convert Lights to Lower Energy Use Lights
Fruit: Use Subject Matter Experts

Fruit: Alignment of Vision, Mission, and Goals
Fruit: Use Daylighting Where Possible

Fruit: Establish a Sustainability Office
Fruit: Use New Sustainable Technology in Daily Business

Fruit: Align HVAC Use With Occupancy
Fruit: Conduct Regular Energy Audits to Check the Condition and Efficiency of Your Equipment

Fruit: Schedule Work During Regular Shift Hours
Fruit: Know Where You Are Spending in Your Facilities

Fruit: Be Creative with HVAC Schedules
Fruit: Benchmark Against Other Like Facilities

Fruit: Good Communications Between Gallery Staffs
Fruit: Schedule Work During Regular Shift Hours

Fruit: Buy Energy Efficient Equipment
Fruit: Network with Others in Profession

Fruit: Spread the Good News
Fruit: Use Subject Matter Experts

Fruit: Track Success With KPI’s
Fruit: Align HVAC Use With Occupancy
Fruit: Align HVAC Use With Occupancy
Thank you!

“Best Practices to Meet Mission and Energy Costs Targets”

David Samec, P.E., CFM
Chief of Facilities Management

June 12, 2013