Case studies – BioPCM® in Practice
Case 1: Two Shelters with no HVAC

LOCATION: Asheboro, NC

- Two identical metal buildings tested in Asheboro-NC
- One with BioPCM®, the other used as control
- Both buildings had standard fiberglass insulation
Controlling Temperature with No HVAC

Ambient - 37°F Swing
49°F to 86°F

Timeline:
- 12 AM
- 4 AM
- 8 AM
- 12 PM
- 4 PM
- 8 PM
- 12 AM
Temp Swing inside Control Shelter

Controlling Temperature with No HVAC

Ambient—37°F Swing
49°F to 86°F

Control—26°F Swing
57°F to 83°F
Temp Swing inside Test Shelter

Controlling Temperature with No HVAC

Ambient: 37°F Swing
49°F to 86°F

Control: 26°F Swing
57°F to 83°F

Phase Change: 4°F Swing
69°F to 73°F

Temperature F

Temperature C

Timeline

12 AM  4 AM  8 AM  12 PM  4 PM  8 PM  12 AM
Why BioPCM® saves HVAC costs
Two identical wooden buildings tested at the STAR test facility for 12 months
- One had BioPCM® and the other was used as a control
- The buildings were heated and air conditioned and their energy usage was recorded

LOCATION: Phoenix, AZ
## STAR Test Facility - Results

### Test HVAC Run Times

|  | Ctrl HVAC Run Times | PCM HVAC Run Times |
|---------------------------------|-------------------|
| Test building (green) vs. control (red) | Ctrl HVAC Run Times | PCM HVAC Run Times |
|  |  |  |

### Annual Energy Savings

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Average Annual Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without BioPCM® (kWh)</td>
<td>157</td>
<td>114</td>
<td>92</td>
<td>96</td>
<td>126</td>
<td>273</td>
<td>319</td>
<td>293</td>
<td>189</td>
<td>94</td>
<td>60</td>
<td>153</td>
<td>1,966 kWh</td>
</tr>
<tr>
<td>With BioPCM® (kWh)</td>
<td>112</td>
<td>91</td>
<td>84</td>
<td>82</td>
<td>109</td>
<td>240</td>
<td>268</td>
<td>234</td>
<td>140</td>
<td>71</td>
<td>43</td>
<td>116</td>
<td>1,590 kWh</td>
</tr>
<tr>
<td>Savings (%)</td>
<td>29%</td>
<td>20%</td>
<td>9%</td>
<td>15%</td>
<td>14%</td>
<td>12%</td>
<td>16%</td>
<td>20%</td>
<td>26%</td>
<td>24%</td>
<td>29%</td>
<td>24%</td>
<td>20%</td>
</tr>
</tbody>
</table>
Arizona Public Service Conclusions

- “The investigation showed significant energy and cost savings with BioPCM® as well as peak load time shift and a reduction in energy usage during on-peak hours during the summer months.”
- “BioPCM® is a proven technology for prospective energy conservation in buildings.”
BioPCM® was installed in a telecom shelter in a 12 month study to explore the potential to reduce HVAC costs.

The installation of BioPCM® resulted in a 20+% reduction in HVAC energy consumption.

This study demonstrates a 1.5 Year ROI (based on electric cost of 15¢ per kWh)!
BioPCM® was installed by attaching it to the interior walls of the shelter and around electronics racks.

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
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<th>Mar</th>
<th>Apr</th>
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<th>Jul</th>
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<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Average Annual Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Without BioPCM® (kWh)</strong></td>
<td>2,703</td>
<td>2,765</td>
<td>2,808</td>
<td>2,927</td>
<td>3,088</td>
<td>3,429</td>
<td>3,411</td>
<td>3,576</td>
<td>3,208</td>
<td>2,905</td>
<td>2,813</td>
<td>2,689</td>
<td>36,322 kWh</td>
</tr>
<tr>
<td><strong>With BioPCM® (kWh)</strong></td>
<td>1,965</td>
<td>2,013</td>
<td>2,184</td>
<td>2,317</td>
<td>2,597</td>
<td>2,985</td>
<td>2,833</td>
<td>2,994</td>
<td>2,699</td>
<td>2,191</td>
<td>2,075</td>
<td>1,984</td>
<td>28,837 kWh</td>
</tr>
<tr>
<td><strong>Savings (%)</strong></td>
<td>27%</td>
<td>27%</td>
<td>22%</td>
<td>21%</td>
<td>16%</td>
<td>13%</td>
<td>17%</td>
<td>16%</td>
<td>16%</td>
<td>25%</td>
<td>26%</td>
<td>26%</td>
<td>21%</td>
</tr>
</tbody>
</table>
## Telecom Shelter – ROI Analysis

<table>
<thead>
<tr>
<th></th>
<th>Jordan Actual Case</th>
<th>Assuming the same Annual kWh Reduction at different representative rates in the US</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual kWh Reduction</strong></td>
<td>7,485</td>
<td>7,485 7,485 7,485 7,485 7,485 7,485</td>
</tr>
<tr>
<td><strong>kWh Cost ($)</strong></td>
<td>$0.24</td>
<td>0.18 0.15 0.12 0.10 0.08</td>
</tr>
<tr>
<td><strong>Annual Savings</strong></td>
<td>$1,796</td>
<td>1,347 1,123 898 749 599</td>
</tr>
<tr>
<td><strong>Cost Including Installation (314 s.f. of BioPCM®)</strong></td>
<td>$1,590</td>
<td>1,590 1,590 1,590 1,590 1,590</td>
</tr>
<tr>
<td><strong>ROI (years)</strong></td>
<td>0.885</td>
<td>1.180 1.416 1.770 2.124 2.655</td>
</tr>
</tbody>
</table>
Case 4: JP Morgan Chase

LOCATION: Elmhurst, NY

- 2000 Sq. Ft. of BioPCM® installed
- Covering 70% of the surface area above the ceiling tiles
- No disruption to normal operations
Retrofit Installation

Installation above drop ceiling
Financial Summary - First Year Results

Daily kWh Reduction: 109* kWh
kWh Cost: $0.1847
Daily Savings: $20.13
Annual Savings: $7,347

Cost of BioPCM® @ $4.69 Sq. Ft.**: $9,380
Payback BioPCM®: 1.28 Yr.

* As Tracked via Noveada Technologies Energy Dashboard
** Cost of 2000 sq. ft. Open Plenum product plus installation and shipping.
Case 5: University of Washington

LOCATION: Seattle, WA

- Designed by Zimmer Gunsul Frasca Architects
- Construction completed in 2012. 2nd building under construction.
- Building uses BioPCM® for passive cooling (no HVAC cooling used)
- Energy Design by Affiliated Engineers, Seattle, Washington
“During a 2 week period where the outside temperature exceeded 90F, the interior never exceeded 75F. Many people commented on our great AC system and were shocked when I told them that the building had none.”  

Christopher Adams, Building Coordinator
Case 6: Easton Archery Center

LOCATION: Chula Vista, CA

- Expected ROI <12 months (cost avoidance plus energy usage reductions)
- 43,800 sq. ft. BioPCM® installation
- Bob Easton Architect, Kiewit Corporation