

ENRG BLANKET™ CALIFORNIA BANK M&V STUDY (41 Branches - Document 18A-314)

**ENRG Blanket Installation Results in Up To:
15% kWh savings and 64% Total HVAC Savings
Average HVAC Savings of 24% Achieved Across All
Sites**



PCES – Engineering Team

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ABSTRACT

Phase Change Materials (PCMs) are engineered around a fundamental property of nature—the natural tendency of materials to absorb heat when they melt (phase change transition from solid to liquid) and to release heat when they solidify (transition from liquid to solid). All materials exhibit this behavior; however, there are some that release or absorb unusually large amounts of heat in the process at a designed transition temperature which are known as phase change materials.

Phase Change Solutions (PCS) uses bio-based materials in a proprietary formulation that go through this phase change at or near room temperature marketed as ENRG Blanket™ powered by BioPCM®. When ENRG Blanket is installed into the building envelope (roof, walls, attic or above drop ceilings) it absorbs heat during the day and releases this latent heat at night. This increases the thermal mass of the envelope and makes the building more efficient as less energy (BTU or kWh) is used to heat and cool the building while the ENRG Blanket passively manages to capture and release wasted energy.

ENRG Blanket was developed to:

- Lower HVAC energy and maintenance expenses
- Shift peak electricity demand to off-peak hours
- Balance indoor temperatures and room variances
- Provide reasonable upfront cost and rapid ROI
- Become a sustainable, bio-based solution to manage energy costs
- Perform without degradation or maintenance for decades

INTRODUCTION

ENRG Blanket is installed in a variety of commercial, residential and governmental in retrofit and new construction

applications. A particularly easy method of installing ENRG Blanket above the drop ceilings allows the material to manage both interior heat loads (people, computers, and equipment) and exterior gains from the roof and walls and windows (solar gain). An emerging application in the retail market is the installation of the material above the drop ceiling in branch banks. An ongoing utility audit with M&V analysis is in progress. At present time, this includes a variety of branches, HVAC types/tonnage and various control strategies in climates located across the United States. The scale of this M&V program will be expanded as the installation schedule progresses.

At present, PCS has analyzed 41 sites out of 217 California branches where ENRG Blanket was installed in 2017. International Performance Measurement & Verification Protocol (IPMVP Option C) Whole Building analysis was performed on these sites using 15-minute interval data as supplied by the utility companies. This study was to determine the performance of ENRG Blanket (as installed) to support claims reducing HVAC energy consumption by 25-35%.

ANALYSIS METHODOLOGY

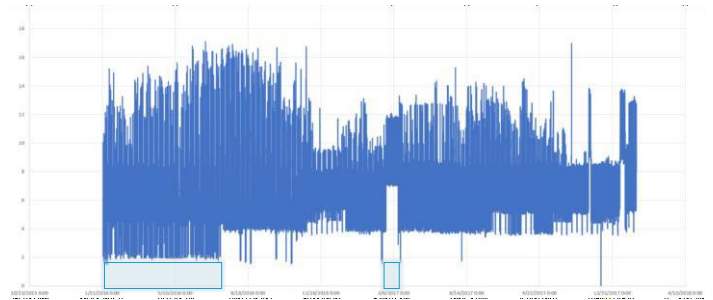
Utility data was provided by the client and analyzed by PCS engineers and validated by 3rd party energy management group, Overlay Consulting. Whole-building electricity and gas was normalized for weather differences using TMY3 (30-year) weather data for all locations. A baseline was established for sites that in were not impacted by other energy control measures (ECM's) and had at least 220 days of pre-install baseline data to analyze. Sampling periods included both a heating and cooling portion of the year and had data regression correlations exceeding 0.90. This report summarizes the findings:

SUMMARY FINDINGS

- **Total building electricity savings of 7.3%** as of March 2018 on average for all 41 sites.
- **HVAC energy reduction of 31%** (in-line with 25-35% HVAC savings as advertised)
- **California locations** averaged 4,635 square feet in size with an average reduction of electricity of 8,385 kWh per site with ENRG Blanket installed.
- **Average Calculated Savings** per site was \$1,453 in electricity and approximately \$134 in gas (where gas was the primary heating method)
- **Energy Cost vs. HVAC%** seems to follow free market economics where the higher cost of energy (\$0.15-\$0.18/kWh) is offset by lower HVAC % (averaging 24% in California) of Total Building Energy.

Data analysis showed operational changes in the baseline for a few sites across the portfolio. Where appropriate, the baseline was adjusted, and the 220-day rule was applied. If the site did not meet these criteria, then the site was eliminated from further examination. Unfortunately, this narrowed the site samples significantly but provided a much stronger data set for analysis.

This is an example of the operational baseline change where the areas highlighted below with a grey box were removed from the baseline analysis as this didn't align with known operational changes or installation dates of the ENRG Blanket.



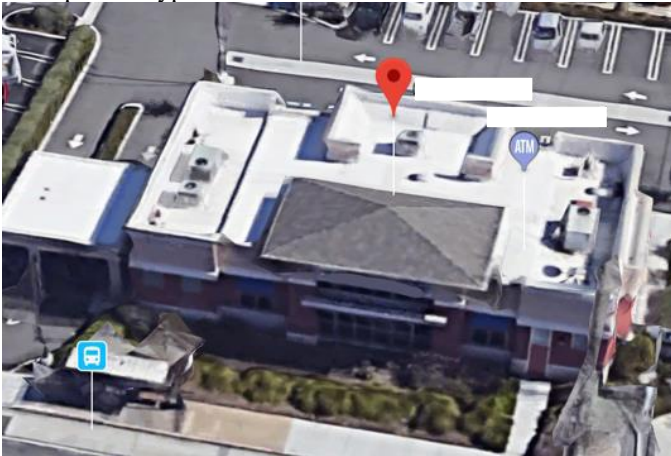
Multi-variable regression analysis was performed against TMY3 (30-year weather data) for each remaining site and was correlated against electricity use (kWh), humidity, temperature and hours of operation.

An example site below shows the performance improvement with savings calculations performed for cooling and heating offset, total HVAC savings and total building savings for an entire year.

M&V STUDY

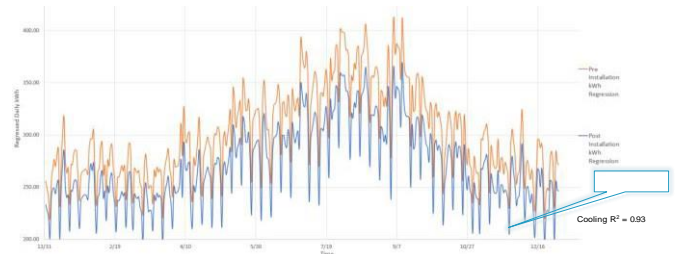
The branch locations for the California Bank Branch Study were selected mainly through the identification of sites without ECM impact and full pre/post install 15-minute interval data sets that comprised season to season analysis and also 220 days or more of pre-install data.

Example of a typical California branch site:



Key building data such as building location, climate, energy rates, HVAC type, age and building type were taken into account for pilot consideration. The locations varied in size from 3,000 to 5,000 square feet and had a variety of HVAC systems (heat pumps & gas packs systems) and differed in the number of units per location.

Example Site:



Total Building Savings % (Interval)	HVAC % Savings	Utility Interval Data Cooling Savings%	HVAC Cooling kWh Offset	Utility Interval Data Heating Savings %	HVAC Heating kWh Offset	Total Building Use kWh
10.3%	41.95%	5.22%	5738	4.85%	5332	109,937

Orange = Pre Install Blue = Post Install (Yearly TMY3)

Data for the California sites:

Site Count	41
Average Building ft ²	4,635
Total Offset (kWh)	8,385
% HVAC Savings (kWh only)	31%
% Total Building Savings	7.3%
Annual Electricity Savings	\$1,453
Annual Gas Savings	\$134

Substantial energy savings was observed in all the 41 California sites. Total Building energy savings (kWh only) ranged from 3.0% to 15.3% and percent of HVAC savings ranged from 13% to 64%. (HVAC % of Total Building averaged about 24% across all sites in California)

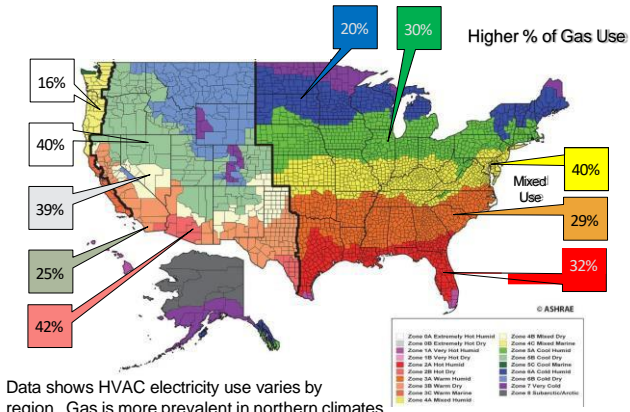
Savings were then aggregated from the 41 sites and applied to the entire California portfolio.

Installed Site Count	217
Total Annual Cost Savings	\$344,379
Total Project Cost	\$2,082,115
Simple Payback	6.05 years
IRR*	19.3%
NPV*	\$2,153,240
ENRG Blanket Life	85+ Years

* Based on 10% hurdle rate, 3% utility cost escalation and 30-year life.

One interesting note was that the HVAC % of Total Building that was calculated for California was one of the lowest in the nation at 24%. If the ENRG Blanket HVAC savings of 31% is applied to the 24% HVAC figure above, the anticipated savings for the market is 7.44%. The 41 sites showed 7.3% savings which is in-line with expectations.

Calculated HVAC % of Total Building (kWh) PHASECHANGE ENERGY SOLUTIONS



As the HVAC % of Total Building is increased, ENRG Blanket has more impact on the Total Building Energy.

Illinois Example:	Chicago Site
Building ft ²	4,106
Total Offset (kWh)	12,252
% HVAC Savings (kWh only)	36%
% Total Building Savings	9.4%
Annual Electricity Savings	\$1,593
Annual Gas Savings	\$217

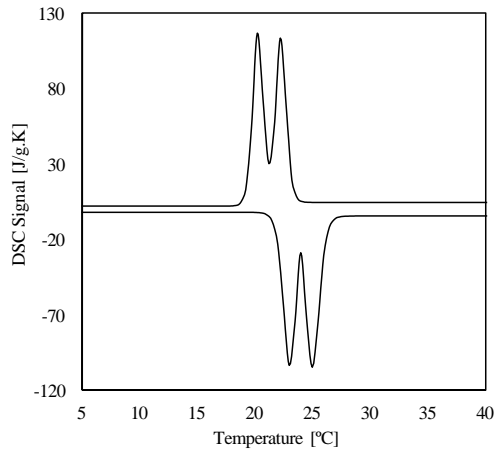
Three things to note from the Chicago site:

1. HVAC % of Total Building moved up to 30% (from 25% in California)
2. Energy Cost went down to \$0.13 per kWh (from \$0.17 in California)

Gas savings went up as observed in northern climates (typically \$200-\$500 per avg. branch). ENRG Blanket typically improves HVAC energy by 25-35%. When applied in Illinois where the HVAC % averages 30%, then the material should reduce energy consumption by 7.5% to 10.5%. The observed 9.4% falls directly in-line with these estimates.

HVAC energy use is directly contingent on the proper maintenance, operation and control methods of the equipment. Industry studies have shown that improper maintenance of HVAC equipment can increase HVAC energy consumption by 20%. If a building is being maintained for comfort, ENRG Blanket is designed to work efficiently with a customer's particular temperature control strategy for various locations.

Note--PCES is exploring the use of a "dual-temp" BioPCM where part of the material is utilized for hot conditions and the other for colder conditions as seen in the figure below.



This dual-temp material will do two things in the building:

- 1) In high temp climates (AZ, TX, FL), the ENRG Blanket will react to the more common thermostat setting, but on days where soaring temperatures overwhelm the building, the higher secondary transitional point of the BioPCM will activate and condition at higher temperatures.
- 2) For federally mandated temperature settings (78°F Cooling/65°F Heating), the BioPCM can be 'tuned' to hit the extremes in both the cooling and heating seasons with one material.

CONCLUSIONS

This study shows how energy savings can be translated to the meter through the use of ENRG Blanket powered by BioPCM in the California market.

The material effectively reduces the energy consumed by the HVAC systems and can generally be used to support a 25-35% reduction in HVAC energy by a given retail bank building. The varying percentage of HVAC energy varies across the country and should be applied accordingly when considering ENRG Blanket for specific markets and climates.

Further studies are ongoing to determine the best fit for the material. Climate, HVAC equipment condition/maintenance and operational controls of the building play important roles in the effectiveness of ENRG Blanket as a passive ECM solution.

Given the performance longevity of the material without significant performance degradation, ENRG Blanket™ powered by BioPCM® will play an important role in reducing energy consumption by buildings in the future.

Facility Managers can now consider the material for localized comfort issues or total building energy solutions--with quick payback and effective mitigation to excess heat related issues