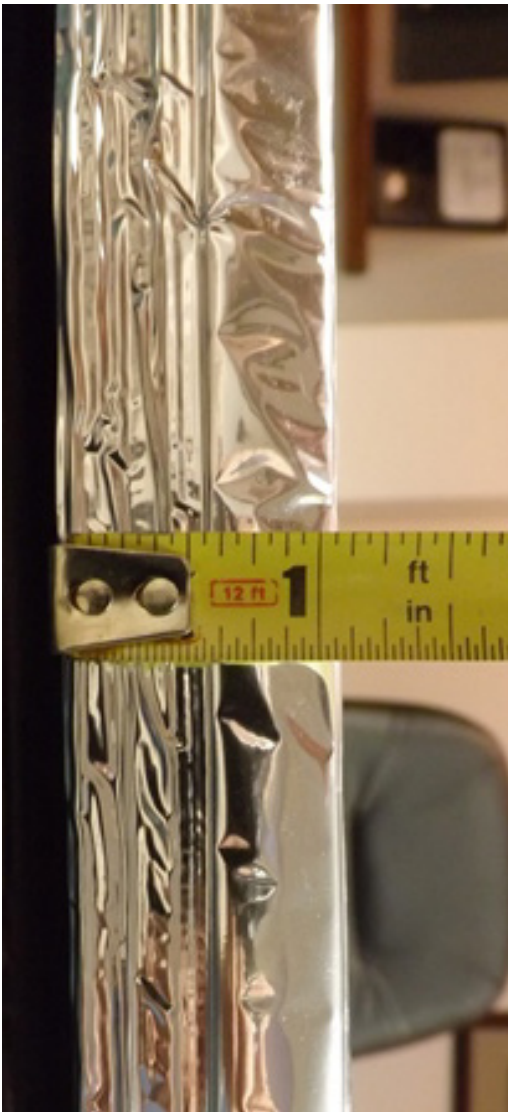


GPG-011 | MARCH 2014

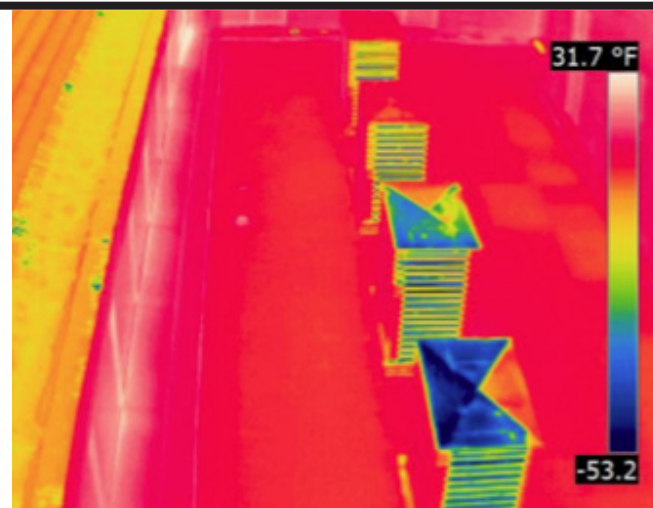
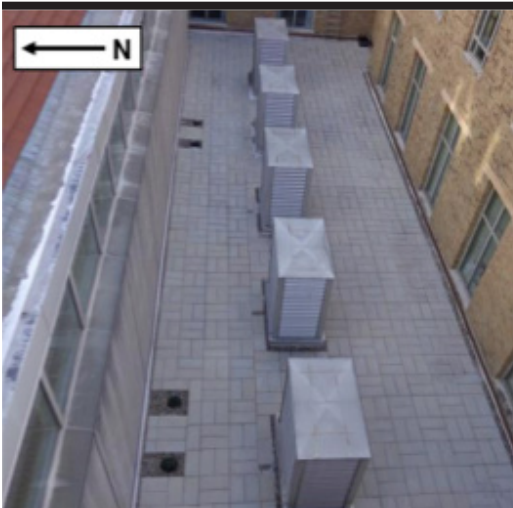
# VACUUM INSULATED PANELS FOR ROOFING



## VIPs Save Energy While Meeting the Demands of Real-World Construction

According to the U.S. Department of Energy, heating, ventilation, and air conditioning (HVAC) account for roughly 37%<sup>1</sup> of all the energy used in commercial buildings, a large percentage of which routinely escapes as heat through the building envelope. Vacuum Insulated Panels (VIP) are a promising technology that present new opportunities to mitigate those losses. Invented for use in major appliances, like refrigerators and stoves, VIPs use vacuum technology to achieve high R-values within a very slim profile. Until recently, the price and fragility of VIPs have undermined their investment value in building envelope applications, when compared with standard insulation panels. With more manufacturers entering the market, however, unit costs have declined, and it is now possible to consider VIPs for roofing applications, particularly for retrofits where space limitations prohibit additional roof height. GSA's GPG program recently assessed a VIP installation for material performance at the Post Office and Courthouse in Camden, New Jersey, and used digital modeling to estimate cost and energy savings across various building types and climate zones. Researchers found that VIPs were more durable than anticipated, and that R-50 insulation can offer favorable payback in one-story buildings in regions with extreme climates and high utility costs.

# INTRODUCTION



Northern half of the second floor roof at the U.S. Post Office and Courthouse, Camden, New Jersey. Consistent red color in infrared photograph shows no apparent damage to the VIPs during construction.

*“VIPs met the requirement of upgrading our roof to an R-50 value without adding thickness to the existing roof, and they proved to be cost-effective compared to traditional panels where additional thickness would have meant expensive remodeling.”*

—Tony Lopez  
Construction Control Representative  
Camden, New Jersey, GSA

## What We Did

### EVALUATED FOR RUGGEDNESS, EFFICACY AND ENERGY SAVINGS

In November 2011, GSA retrofitted a leaky section of the roof at the U.S. Post Office and Courthouse in Camden, New Jersey to improve its insulating performance. Due to limitations imposed by building design, the additional roof height required by standard insulating roof panels would have necessitated expensive modification of flashing, brickwork, and windowsills. GSA therefore elected to install VIPs to achieve an R-50 insulating value, avoiding any increase in the thickness of the existing roof structure.

Because they are vacuum-sealed, VIPs lose R-value and rigidity if cut or punctured; installation requires both careful site preparation and meticulous measurement. Researchers surveyed the construction team for lessons learned, with particular attention to how the fragile VIPs withstood the rigors of construction. Researchers also inspected the completed installation with an infrared camera in search of thermal leaks that would signal damage. Finally the team digitally modeled three types of buildings common to the GSA inventory: small (single-story), medium, and large office buildings. The modeling sought to determine the impact of R-50 roofing insulation on overall cost and energy consumption, and compared electric and gas savings by both building size and climate zone.

### PERFORMANCE SPECIFICATIONS

Insulation Thickness

#### CONVENTIONAL

R-50 **15”**

#### VIPS

R-50 **1”**

# FINDINGS



**ENERGY SAVINGS GREATEST IN SINGLE-STORY BUILDINGS** In energy simulations, R-50 insulation reduced consumption of electricity by up to 8% and natural gas by up to 10%, compared with code-compliant roofs of R-9 to R-16. The most pronounced savings are in single-story buildings with large, flat roofs.



**PAYBACK VARIES BY CLIMATE, UTILITY COST AND BUILDING PROFILE** In the test case, installing VIPs was 53% less expensive than modifying the building to accommodate a thicker roofing material. However, payback for a typical single-story office building without roof-height constraints is estimated at between 55 and 90 years. VIPs may have a favorable payback if physical barriers exist to installing a standard code-compliant roof, or if an extreme hot or cold climate combined with high utility costs make a small improvement in R-value worthwhile.



**PROPER PLANNING MAKES FOR A STURDY PRODUCT** Though indeed more fragile than standard roofing panels, VIPs were found to be harder than expected. Key factors in a successful installation include keeping the roof surface clean during installation, choosing a trusted vendor that can meet job requirements, and properly sizing the custom-made panels.



**RECOMMENDED IF R-50 IS REQUIRED AND INSTALLING CONVENTIONAL INSULATION NECESSITATES COSTLY ALTERATIONS** If extreme climate and energy costs alone recommend R-50, conventional insulation will be more cost-effective.

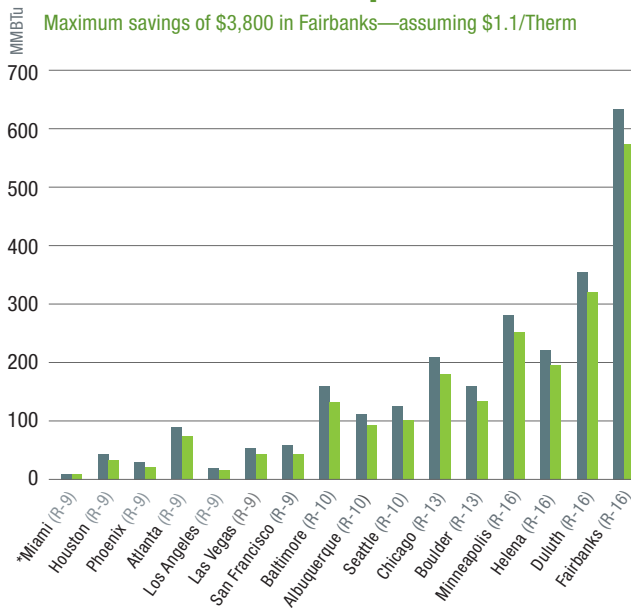
## Modeled Energy Use in a Single-Story Office Building

Largest savings in extreme climate zones, such as Fairbanks and Phoenix

### Annual Gas Consumption

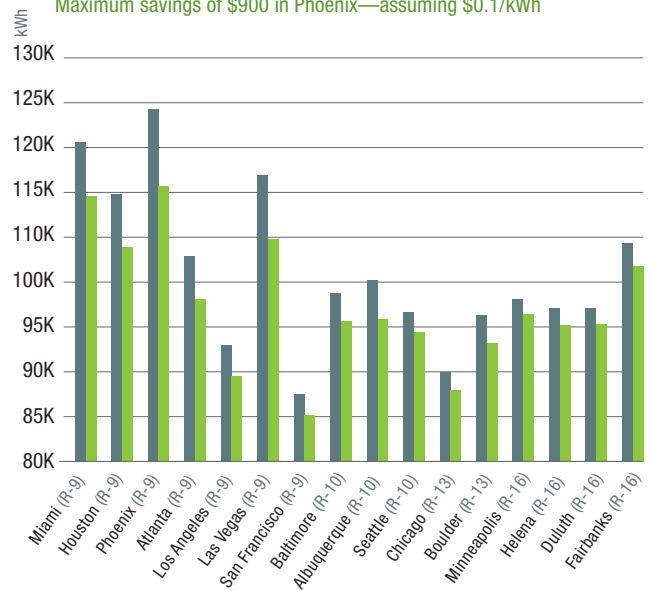
Maximum savings of \$3,800 in Fairbanks—assuming \$1.1/Therm

■ Baseline (R-9 to R-16)  
■ VIP (R-50)



### Annual Electricity Consumption

Maximum savings of \$900 in Phoenix—assuming \$0.1/kWh



\*Cities listed by climate zone from Hot-Humid (1A) to Subarctic (8A)<sup>1</sup>

# CONCLUSIONS

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These Findings are based on the report, “Vacuum Insulated Panels in a Roofing Application Camden U.S. Post Office and Courthouse Camden, New Jersey,” which is available from the GPG program website, [www.gsa.gov/gpg](http://www.gsa.gov/gpg)

For more information, contact GSA's GPG program [gpg@gsa.gov](mailto:gpg@gsa.gov)



## What We Concluded

### VIPS ARE A VIABLE CHOICE WHEN R-50 IS REQUIRED AND SPACE LIMITATIONS PROHIBIT CONVENTIONAL INSULATION

VIPs are a viable roofing choice in structures where building constraints make it expensive to accommodate the thickness associated with traditional insulation materials, and where an R-value of 50 is required either to meet code or to save on energy costs in extreme climates. In the case of Camden's post office and courthouse, VIPs were 53% less expensive than modifying the roof to accommodate thicker roofing materials. Simulations show that R-50 roofing panels can reduce a building's electricity bill by up to 8% and natural gas bill by up to 10%, with best performance in single-story buildings.

## Best Practices

### CAREFUL PLANNING LEADS TO OPTIMAL RESULTS

- Since perforation of any kind causes a loss in rigidity and R-value, using VIPs requires meticulous planning and rigorous onsite precautions.
- A clean roof surface that has been cleared of all remnants of the prior roof system is critical.
- Since VIPs cannot be modified once they are fabricated, the roof area must be precisely measured and panels sized to fit by the manufacturer.
- Choosing a trusted vendor who is capable of careful planning is key.
- Because insulation offers diminishing savings as R-value climbs, the cost benefit of increasing the R-value of insulation must be carefully considered.

## Footnotes

<sup>1</sup>Nicholas P. Avdelidis, Timo K. Kauppinen, 2008. "Thermography as a Tool for Building Applications and Diagnostics," in Proceedings of SPIE, v 6939, Thermosense XXX, March 18-20, 2008, Orlando, Florida.

Cover Photo Credit: Thermal Visions

*Technology for test-bed measurement and verification provided by Thermal Visions, Inc.*

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