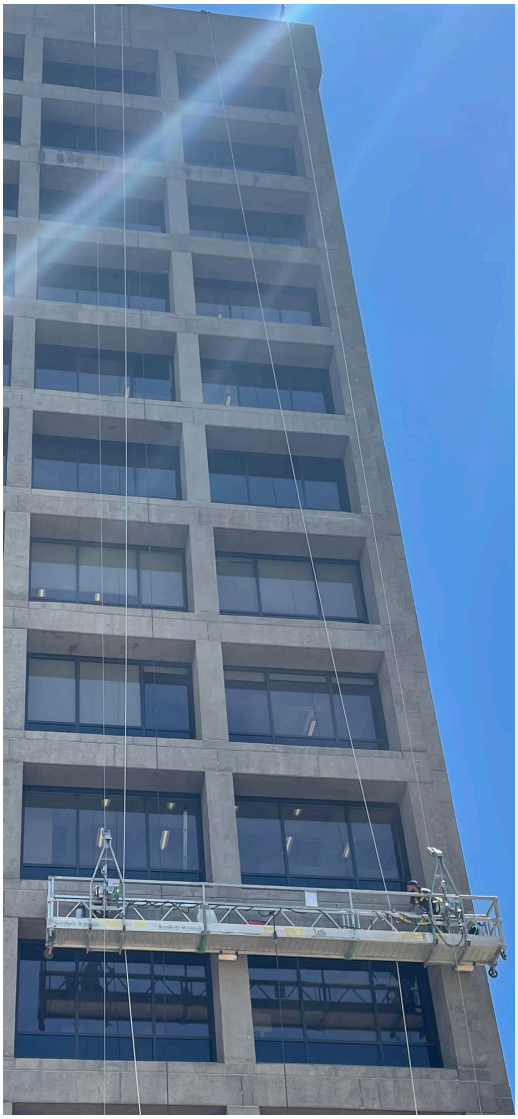
U.S. General Services Administration

063 | MAY 2026

# NON-METALIZED EXTERIOR SOLAR CONTROL FILMS



## Durable Exterior Film, Effective for Tinted Double-Pane Windows

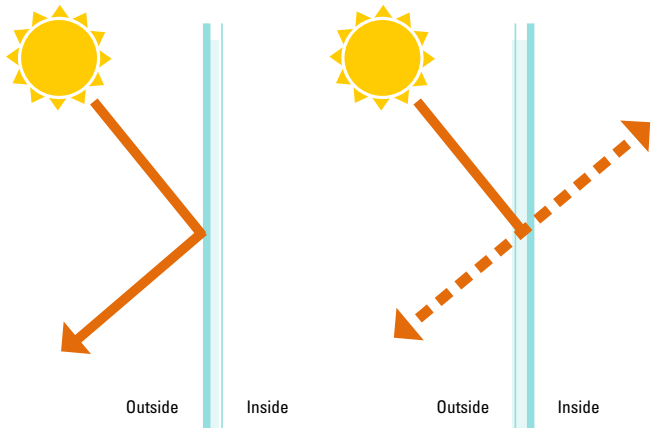
Window films effectively reduce energy use and costs for single-pane windows, but savings have been more limited for double-pane, especially for tinted double-pane windows. Exterior films better prevent solar heat gain than interior, but concerns about durability have been a deterrent. Non-metalized window films are designed without the layer of metal common in exterior films, which increases lifespan and extends the savings potential of window films to double-pane windows.

In collaboration with Lawrence Berkeley National Laboratory (LBNL), CEBT evaluated the performance of a non-metalized exterior solar control film at the Denver Federal Center. Researchers compared exterior and interior applications in a building with a history of temperature control issues and occupant comfort complaints.

Initially intended as a single-floor study, non-metalized exterior film was installed on all remaining floors following positive occupant feedback and improved comfort. Exterior application had a substantially better ROI than interior film with the most significant savings found in warm climates. The film is most cost-effective when applied to tinted double-pane windows without a low-emissivity (low-e) coating.

# INTRODUCTION

**Prevent solar heat from re-radiating into interior. Better heat rejection with enhanced durability, comfort, and non-disruptive installation.**




*"Building 67 had a history of comfort complaints and hot calls. The film was installed on the whole building based on the improvements we saw on the 12th floor."*

–Tyler Cooper
Mechanical Engineer
Office of Facilities Management
U.S. General Services Administration

## What Is This Technology

### SPECTRAL SELECTION WITH LESS RISK OF DETERIORATION

Non-metalized exterior solar control films are spectrally selective with the durability required for exterior applications. Spectrally-selective films block harmful ultraviolet (UV) rays and solar heat in the form of infrared radiation, while optimizing natural light.[1] Spectral selection can be achieved with a thin layer of metal inside the film, which is prone to corrosion. Non-metalized films are spectrally selective without the metal component. By preventing heat absorption and re-radiation into interior spaces, exterior films more effectively control solar heat gain than interior films and are particularly effective for tinted double-pane windows. Exterior installation may require additional planning and equipment, but disruption to occupants and operations is minimized. The technology for this evaluation was provided by 3M with field verification and execution by NGS.

## What We Did

### COMPARED PERFORMANCE TO INTERIOR FILMS

The evaluation was conducted at the Denver Federal Center's Building 67 in Lakewood, CO. The 372,000-square-foot building has 56,909 SF of window surface area, with greater distribution on the east and west elevations. The existing windows are tinted double-pane with hard coat low-e. Frequent comfort complaints during the cooling season contributed to site selection. Non-metalized films were installed on the exteriors of the 12th floor, except the north side. Based on initial findings of improved comfort, the film was installed on the remaining floors and the evaluation was extended to the whole building. Transmitted vertical irradiance was measured on site, while the film's optical properties were analyzed at LBNL's Window Optics Lab. Researchers modeled energy use to evaluate annual and peak energy savings across climates. Baseline windows for modeling were double-pane bronze. Researchers also compared the performance of the same film installed on the interior and assessed the level of difficulty of exterior installation.

# FINDINGS

**REDUCED SOLAR HEAT GAIN AND UV TRANSMITTANCE** Vertical irradiance was reduced by 43-90%, with an average reduction of 74%, indicating solar heat gain reduction. The film blocked more than 99% of UV rays.

**WARM CLIMATES PERFORM BEST** Climate zones 1A, 2B, 3A, 3B, and 3C had significant energy savings with estimated payback between six and 13 years. Colder climates can expect longer paybacks, potentially between 20–40 years, due to the film increasing heating demand.

**76% PREFER FILM OVER BASELINE WINDOWS** Survey respondents (n=33) generally felt cooler during warm weather. Light levels were more comfortable with reduced glare. Most respondents did not notice the film, but a small minority reported visual artifacts attributed to the film.

**SUPERIOR PERFORMANCE OVER INTERIOR INSTALLATION** Interior installation costs were $1.05/SF-window lower than exterior, but with fewer energy savings. The estimated payback for interior film at the testbed was 138 years, considerably longer than the 19-year payback for exterior.

**BETTER ROI WITH DEMAND CHARGES** Peak electricity demand lowered by 6-9% and peak demand for gas ranged from 4% savings to a 29% increase. By factoring in typical demand charges in Denver, payback lowered to just over 10 years and saved almost $4,000 more annually.

**QUICKER THAN ANTICIPATED INSTALLATION** The film was installed on 13 floors in 12 working days by two installers, less than half the time planned for (48 calendar days). The initial, single-floor installation was completed in less than three days.

**CONSIDER FOR TINTED DOUBLE-PANE WINDOWS IN WARM CLIMATES** ROI improves in cooler climates if there are significant cooling demand charges.

## Exterior Film Delivers Stronger Performance*

Greater savings in warm climates. Demand savings will increase ROI.

| | Non-Metalized Interior | Non-Metalized Exterior |
|---|---|---|
| Installed Technology Cost ($/SF) | $11.85 | $12.90 |
| Testbed Electricity Savings (kWh/yr) | 7,644 | 51,600 |
| Testbed Gas Savings (kWh/yr) | -9,121 | -37,560 |
| Testbed Electricity Savings (blended $0.11/kW/yr) | $841 | $5,676 |
| Testbed Gas Savings (blended $7.68/MMBTU/yr) | $-239 | $-985 |
| **Testbed / GSA Avg Simple Payback** (yrs)** | **138 / 33–89** | **19 / 6–13** |
| **Testbed / GSA Avg Savings-to-Investment Ratio ***** | **0.11 / 0.17–0.45** | **0.78 / 1.17–2.18** |

*Based on whole-building simulation for Boulder, Colorado, using a DOE medium office model with baseline tinted windows without low-e coating

**GSA payback applies only in select climate zones (1A, 2B, 3A, 3B, 3C): Assumes electricity $0.09–$0.27/kWh and natural gas $4.80–$20/MMBtu blended rates; accounting for demand charges is expected to significantly decrease payback.

***Technology lifespan = 15 years, SIR > 1 indicates a positive Return on Investment

# CONCLUSIONS

These Findings are based on the report, "Non-Metalized Exterior Solar Control Film," which is available from the CEBT program website, www.gsa.gov/cebt

For more information, contact GSA's CEBT program cebt@gsa.gov



## What We Concluded

### BEST ROI IN WARM CLIMATES, PERFORMS BETTER THAN INTERIOR

Non-metalized exterior solar control films saved energy and improved comfort with a significantly shorter payback than interior film, but ROI is best in warm climates. Cooling energy savings were evident across climates, but cost savings are dependent on the extent of heating energy increases and utility rate structures. Coastal California, the southwest, and south Florida can expect ROI in less than 10 years, while payback for the majority of northern states is likely to be 25 years or more. Better ROIs are expected if demand charges are a significant component of cooling energy costs. Although not a quantifiable metric to factor into cost savings, significant occupant comfort improvements may prove valuable to building management and operations.

## Lessons Learned and Best Practices

### INSTALLATION AND MAINTENANCE

- Follow all safety regulations. Work may be required at significant heights.
- Perform a walkthrough with the contractor to coordinate swing stage access, reduce installation time, and ensure safety.
- Installation should be rescheduled if rain, wind, or temperatures outside of 45-95˚F are forecasted. Do not install film if temperatures are expected to be below freezing for the next three days.
- Minimize complications by working with an experienced film installer.
- No special maintenance required. Clean with soapy water and do not use ammonia-based products or sharp, abrasive tools.

### DEPLOYMENT

- Most recommended for tinted double-pane windows without low-e coating.
- Warm climates with high energy costs have the best ROI (climate zones 1A, 2B, 3A, 3B, and 3C).
- Expect a better ROI in buildings with significant demand charges.
- Compatibility with existing windows varies depending on the windows' specific characteristics, including orientation, tint, and the type and position of low-e coatings.
- Consult with the manufacturer and installer for site-appropriate recommendations.
- Appropriate in cooler climates if heating penalties are not a major concern. Uncommon examples include inexpensive heat sources and district heating that utilizes waste heat.
- Buildings with high window-to-wall ratios and narrow floorplates gain the most from any window improvement, including non-metalized films.

## Footnotes

[1] Spectrally Selective Glazings, https://windows.lbl.gov/publications/spectrally-selective-glazings

*Technology for testbed measurement and verification provided by 3M with field verification and execution by NGS.*

*Reference above to any specific commercial product, process, or service does not constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof.*