Advanced Window Film Technology Assessment – Phase I Report

ET Project Number: ET 11PGE1041

Photo: DOE's Window Retrofit Option Surface-Applied Window Films (Solutia Performance Films)

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ABBREVIATIONS AND ACRONYMS

PG&E	Pacific Gas & Electric Company
HMG	Heschong Mahone Group, Inc.
kBtu/sf	Kilo Btu per square foot of building area; Annual Electricity Savings
W/sf	Watts per square foot of building area; Demand Savings
NFRC	National Fenestration Rating Council
PNNL	Pacific Northwest National Laboratory
UV	Ultra-violet
SHGC	Solar Heat Gain Co-efficient
VT	Visible Transmittance
NIF	Near infrared
FIR	Far infrared energy
ASHRAE	Association of Space Heating, Refrigeration, and Air-Conditioning Engineers
WWR	Window to wall ratio
IWFA	International Window Film Association
NFRC	National Fenestration Rating Council
CPD	Certified Products Directory

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EXECUTIVE SUMMARY

PROJECT GOAL

The primary objective of this project was to provide unbiased, technically sound information that will allow customers, trade professionals, manufacturers, energy efficiency program administrators, and other stakeholders to make informed decisions about window films such that both long-term energy savings and owner/occupant satisfaction can be optimized. The results of this project will be applied to improve the scope and reach of the current PG&E rebate program for window film.

PROJECT DESCRIPTION

This report is of the first phase of a technical analysis that evaluates the savings potential and market viability of 'advanced window film' products that may offer improved characteristics relative to traditional tinted films. The advanced window films, defined for this project as 'spectrally selective' and 'low-e' window films, are an evolution of the older tinted film technology. Typical colored or dyed tinted films work primarily through increased absorption. The color absorbs the solar energy at the glass, thus reducing the direct transmission into the room. However, this is not very effective as it ends up heating the glazing surface and a portion of that energy gets transferred back into the building. The advanced films have enhanced spectral and heat rejection properties that are expected to produce better thermal and visual performance. Both 'spectrally selective' and 'low-e' technologies work by rejecting different wavelengths of solar energy. Spectrally selective films allow most of the visible light spectrum to go through, while reflecting mostly short-wave and some long-wave infrared radiation. Low-e films reflect mostly long-wave infrared radiation, which is typically emitted by a heated surface.

Phase 1 of this project consisted of multiple data collection activities: 1) Literature Review, 2) Review of NFRC product database, 3) Market actor surveys, 4) Evaluation of sites with existing window films, and 5) Simulation modeling and analysis.

Phase 2 of this project, which will be completed by end of 2013, will include field installation of advanced films and on-site monitoring of energy use, and incentives recommendation.

PROJECT FINDINGS/RESULTS

Window films have been used for decades for aesthetics, glare control, and their ability to reduce energy costs in commercial buildings and homes. A method of rating window films performance has been developed by the National Fenestration Rating Council (NFRC), and the Certified Products Directory (CPD) provides NFRC rated performance specifications for a total of 286 different window films. 3% of these products are low-e window films, while 8% are spectrally selective window films, the two categories considered as 'advanced window films' for this study. The remaining 89% of films represent non-advanced or traditional tinted films.

A survey of market actors found the cost of advanced window films ranged from $5-$10/sf, and the incremental cost over traditional tinted film was a range from $1-$4.5/sf. The survey also indicated that additional cost was the key market barrier for advanced window films.

Our evaluation of sites with window film installations indicated that occupants are most satisfied with window films when they are the least noticeable. Occupants in installations with high visible transmittance window films commented that they hardly noticed the films and were happy with the appearance.

Whole building energy simulations conducted using EnergyPlus for a medium office building in PG&E's inland, cooling dominated climate zone (CZ 13) showed that annual energy savings from window films on single pane clear window could be as high as 18.7% of whole building energy use, 30.4% of HVAC energy use savings, and 21.5% of peak demand reduction, with advanced window films. The same window with tinted film had annual energy savings of 9.4%, 15.3% of HVAC energy use savings, and peak demand reduction of 14.3%. However, these savings for both advanced and traditional tinted films decrease, when operable window shades are factored into the simulations. Simulation results for double pane windows showed lower savings than single pane, and tinted windows had lower savings than clear windows. With double pane windows, consistent savings across all cases only occur with the advanced window films. Only the highest performing advanced window films produced marginal savings in double pane low-e windows.

Energy savings from window films in coastal, mild/heating dominated climates (CZs 1, 2 and 3) were found to be only slightly lower than those in inland, mixed/cooling dominated climate zones (CZs 11, 12 and 13). For example the average HVAC energy savings for inland climate zones for advanced films on single pane glass was 14.4%, while that in coastal climate zones was 12.8%. On the other hand the average HVAC energy savings in inland climate zones for the tinted film was 5.3%, while in coastal climate zones was 4.2%.

Overall the results showed that advanced window films have the potential to produce greater energy and demand savings compared to traditional tinted films. Moreover, with these new advanced technologies, window films can produce savings beyond single pane clear glass windows. The simulations showed window films can provide savings for single pane tinted glass, as well as double pane clear and tinted glass windows.

PROJECT RECOMMENDATIONS

PG&E currently runs a deemed rebate program for window films, which is limited to films applied on a single pane clear windows. The current program also does not currently distinguish between high performing 'advanced' window films and typical tinted films. One of the objectives of this project is to provide recommendations on how PG&E should continue product development for this technology through revision of existing incentives, development of new incentives and potentially expanding the scope of the program.

These recommendations will be provided after analysis of results from Phase 2 of this project, which will be completed by end of 2013.

INTRODUCTION

The Customer Energy Solutions (CES) organization of Pacific Gas and Electric Company (PG&E) provides incentives, services, and information to help customers reduce electric and natural gas energy and peak demand use. PG&E's Emerging Technologies (ET) Program evaluates new and under-utilized energy efficient technologies as one channel to achieve long-term reduction goals and help its customers make informed decisions when selecting products. This report provides the first phase of a technical analysis that evaluates the technical and market viability of 'advanced window film' retrofit products that may offer improved characteristics relative to traditional tinted films. A second phase report will be completed by end of 2013 which will include findings from field installations, on-site energy monitoring of spaces with advanced window films, analysis and recommendations.

PG&E currently offers a deemed rebate for commercial window film projects and since 2006 has paid approximately $2 million in rebates for 1400 applications totaling 1.6 million square feet of film, resulting in claimed savings of 14 GWh, 3.6 MW, and -40,000 therms. Although this represents a very small portion of PG&E's portfolio of demand side management goals, this product is important due to the cross-section of customers it touches, highly engaged trade professionals, interactive impacts on other building systems, and the identification of fenestration improvements in general as one of the biggest opportunities for untapped energy efficiency savings

Window films can be applied to existing windows to alter their physical properties for various purposes, such as aesthetics, glare controls and energy savings. In general, the energy savings from solar control film comes from reducing the building's cooling load; however, this may be at the expense of reducing daylight levels and increasing seasonal heating loads. 'Advanced films' have been developed that offer solutions promising to mitigate the negative aspects of traditional tinted films. Two types of advanced window films have been identified for this evaluation:

- "Low-emissivity" (low-e) films claim to improve thermal performance, resulting in energy savings from reduced heating and cooling loads
- "Spectrally selective" films offer higher visible light transmittance, which may offset the negative impact of film on daylighting potential and related occupant health and satisfaction

BACKGROUND

Window films have been used for decades for many reasons, but one primary benefit of architectural films are their ability to reduce energy costs in commercial buildings and homes. Advances in the manufacturing of architectural window films have evolved to using all-metal films with no dyes, and carbon extraction processes to change color. Innovative adhesive systems have been developed that securely adhere films to glass and claim to provide a longer lifespan. Furthermore, better scratch-resistant coating than traditional films are expected to help in durability and easy cleaning and maintenance. Many applications around the globe have been in service for more than 20 years.

Most window films typically consist of a thin polyester film substrate that has a micro-thin, transparent metal coating applied to one side that reflects and/or absorbs the sun's energy before it can be transmitted into a building space. By reducing the solar heat gain through

windows and reducing the building cooling load, window films reduce the amount of time that a building's cooling equipment must run to maintain comfortable conditions, most often resulting in electricity savings. Savings in total building electricity costs, kilowatt-hour consumption, and kilowatt peak demand can often be achieved, with the savings amount dependent upon several factors, such as: glass type, window to wall ratio, presence of overhangs, climate, performance level of film used, and the efficiency of the building's cooling equipment.

The advanced window films (spectrally selective and low-e) are an evolution of the older dyed films and metal coated reflective films. These films have enhanced spectral and heat rejection properties that give them superior thermal and visual performance. Typical colored or dyed tinted films work primarily through increased absorption. The color absorbs the solar energy at the glass, thus reducing the direct transmission into the building. However, this is not very effective as it ends up heating the glazing surface and a portion of that energy gets transferred back into the building. The advanced films have enhanced spectral and heat rejection properties that give them superior thermal and visual performance. Both 'spectrally selective' and 'low-e' technologies work by rejecting different wavelengths of solar energy. Spectrally selective films allow most of the visible light spectrum to go through, while reflecting mostly short-wave and some long-wave infrared radiation. Low-e films reflect mostly long-wave infrared radiation, which is typically emitted by a heated surface.

EMERGING TECHNOLOGY/PRODUCT

This section describes the window film product and the physics behind how advanced window films deliver energy savings. The difference between incumbent technology of 'tinted or reflective' window films and advanced window films is described, along with a description of market barriers for widespread adoption.

TECHNOLOGY CLASSIFICATIONS

There are a range of window film types for most window applications. The window film products currently on the market can be broadly classified into the following categories:

- Sun control
- Safety and security
- Decorative tint

The focus of the assessment is to research advanced films, low-e and spectrally selective, which fall into the 'Sun control' category.

Window films can range in performance properties, tint, and application. In general, window films are 2-7 mils (50–175 microns) thick and have a minimum of three layers, with

a variety of technologies applied for varying performance properties[1]. The three layers consist of water activated or pressure-sensitive adhesive layer (attaches to the glass), polyester film, and a scratch-resistant layer. A variety of technologies including tints, low-e, and UV radiation blockers can be added to the window film make-up to enhance the films performance properties.

After conducting interviews with several key industry groups such as the International Window Film Association (IWFA), National Fenestration Rating Council (NFRC) and staff at Lawrence Berkeley National Lab (LBNL), it was determined there are two classifications based on where the film is applied, i.e. interior or exterior; and three main technology classifications (Figure 1):

- Low-e (low emissivity)
- Spectrally Selective (UV radiation blockers), and
- Tinted (typically solar reflective and/or absorptive)

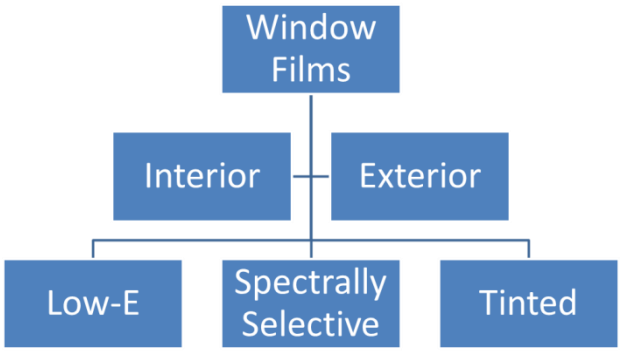

FIGURE 1: TECHNOLOGY CLASSIFICATIONS

The definitions of Low-e and Spectrally Selective films have no formal criteria set by the industry, rather general rules of thumb. The following criteria are rough guidelines LBNL and other industry players use to categorize these technologies:

Note: The terms U-factor, SHGC, VT and emissivity are explained under the Section NFRC Certified Products Directory.

- Low-Emissivity: Low-emissivity, or low-e, films are determined by the surface emittance and the thermal resistance offered by the films as 1) emissivity is ≤ 0.20, 2) U-factor ≤ 0.90. A film with these characteristics will significantly reduce the heat transfer through the window/window film assembly. This can be achieved through using low-emissivity materials such as polypropylene or by layers manipulation.
- Spectrally Selective: Spectrally Selective films are films with a VT/SHGC >1.2 and a u-factor of < 1.1. Typically, these films allow most of the visible light

[1] http://www.eereblogs.energy.gov/buildingenvelope/file.axd?file=2011%2F12%2Fwindow_films_fs.pdf

spectrum to go through, while reflecting short-wave and some long-wave infrared and UV radiation[2].

- Tinted: Tinted films have a wide range of performance properties and work by absorbing solar energy at the window surface thus reducing the direct transmission into the building. These films range in color, and properties; and are installed for a variety of reasons other than high energy savings, such as aesthetics.

WINDOW FILM PERFORMANCE

ELECTROMAGNETIC SPECTRUM OF SOLAR ENERGY

To understand the technology behind window films and their associated performance, an understanding of how the sun's energy or electromagnetic radiation impacts buildings is discussed. There are a variety of energy spectrums, or wave lengths, created by the sun. Figure 2 shows the electromagnetic spectrum and the associated wave lengths for each type of wave length. The three spectrums affecting buildings, materials and occupants everyday are Ultra Violet (UV), Visible Light, and Infrared (IR) energy.

Ultra Violet (UV): Approximately 10 nm to 380 nm wavelength. UV energy cannot be seen by the human eyes; however, some UV energy can be harmful to humans if extended exposure to certain types of UV occurs. UV can be broken into three categories: UVA, UVB, and UVC. The majority of UVC is rejected by earth's atmosphere, and never reaches the earth's surface[3]. Both UVA and UVB energy reach the earth's surface and can impact humans. Standard float glass will reject most of the UVB, and clear double pane windows can reject almost all of it. Therefore, the primary focus of the window industry has been to block UVA energy. UVA energy can only be stopped through the use of coatings or films applied to windows that are able to reflect or absorb the UVA spectrum of light. While UV energy can have harmful impact on humans or fade color of materials exposed to it, its heat content is minimal, and so blockage of UV energy has little to no impact on the heating/cooling needs of a building.

Visible Light: Approximately 380 nm and 760 nm wavelength. Visible light is a tiny portion of the sun's spectrum, and the only portion the human eye can see. Visible light is characterized by daylight and the colors of the rainbow. Therefore, this is the portion of the spectrum most noticeable by humans if a window has a lower visible transmittance commonly found in tinted windows.

Infrared (IR): Approximately 760 nm to 1000 nm (1 mm) wavelength. Infrared energy is classified as heat energy produced by the sun, also experienced by humans as radiant heat or sensed heat. This type of energy is not visible to the human eye, but can be sensed as heat.

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2 http://www.eereblogs.energy.gov/buildingenvelope/file.axd?file=2011%2F12%2Fwindow_films_fs.pdf

3 http://www.edtm.com/Energy_Transmission_Measurements.htm

- Near – Near infrared (NIR) energy is the heat energy someone can feel when standing in the sun. This is the type of energy buildings are designed to "control" because it can be transferred through windows resulting in a space being heated up. By decreasing the amount of near infrared transmission through a window, the heat in a space can be managed in summer months and hot climates. The amount of infrared energy rejected is related to windows Solar Heat Gain Coefficient (SHGC).
- Far – Far infrared energy (FIR), or long-wave radiation, can be described as sensed or perceived warmth from a heated surface. This heat can be from a furnace in the home or heat added to a building from a window surface heating up from the sun. FIR occurs when the sun's NIR radiant energy is converted into long-wave infrared energy by being emitted by a medium such as window or furnishing. The conversion of NIR to FIR is what humans perceive as warmth on a surface such as a desk, or a person's skin.

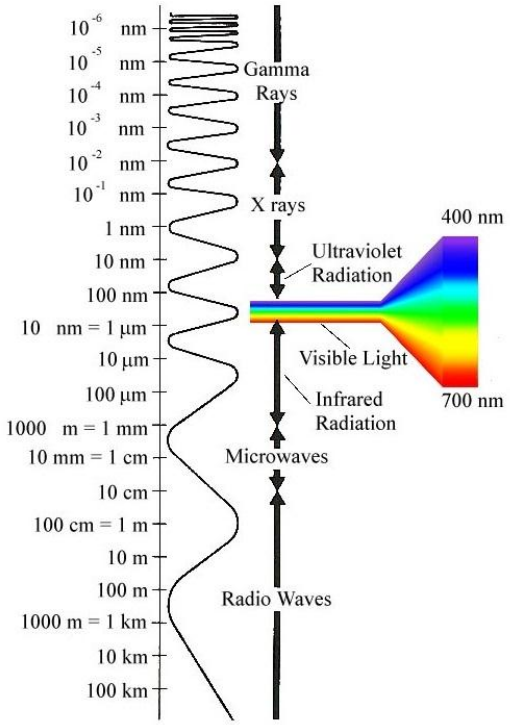


FIGURE 2: ELECTROMAGNETIC SPECTRUM[4]

WINDOW FILM TECHNOLOGY

As outlined above, the sun's energy can be categorized into different wavelengths which pass through windows. The technology behind 'advanced' window films is directed towards rejecting or blocking UV and Infrared energy, as opposed to that of some 'tinted' window films, which work by absorbing solar radiation. This reduces the effectiveness because the absorbed energy will heat the glazing surface and a portion of that energy will be transferred into the room. Some advanced films also offer high visible transmittance in

[4] http://www.lib.utexas.edu/chem/info/spectrum.html

order to allow visible light (daylight), into a space while still rejecting some of the solar infrared. Idealized transmittances of spectrally selective and low-e films are described below and outline in Figure 4.

Figure 3 below shows window surfaces 1-4 for a dual-pane window. Surface 1 is always to the outside. Window films are typically applied on surface 4 of a dual-pane window or on surface 1 if the window film is an exterior film.

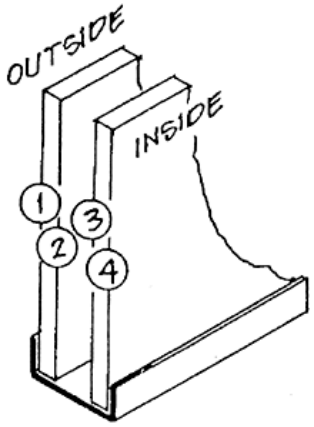


FIGURE 3: WINDOW SURFACES 1-4 FOR A DUAL-PANE WINDOW

Low-e: Low-e coatings reflect far infrared, or long-wave energy either before entering a building or keep the heat energy inside a building, depending on what surface the low-e coating is placed. Since low-e advanced window films are applied on the interior, they fall on surface 2 (single pane) or surface 4 (double pane). This is expected to be helpful in hot climates, as it will allow the **FIR** energy (heat) absorbed and re-radiating back into the building to be rejected, reducing heat gain through the windows. Figure 4 shows the visible and solar infrared, NIR, portion of the solar spectrum addressed by low-e coatings.

Spectrally Selective: Spectrally selective films are designed to provide low solar heat gain by cutting out **NIR**, while also allowing high amounts of visible transmittance. This is also expected to be an advantage in hot sunny climates, as spectrally selective films provide lower solar heat gain coefficient (SHGC) while still maintaining a clear look and high visible transmittance (VT). This allows additional savings from daylighting by turning off electric lights in the daytime using photocontrols.

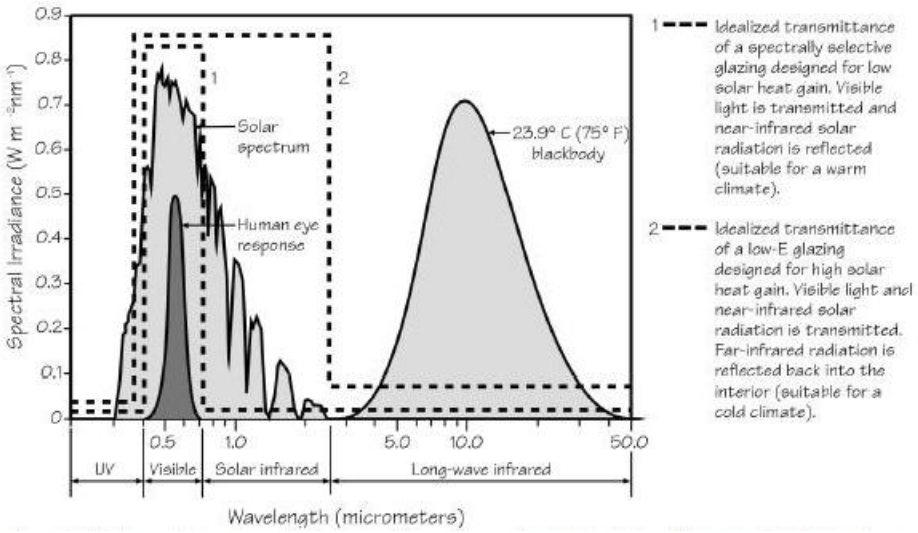


FIGURE 4: IDEALIZED TRANSMITTANCE OF SPECTRALLY SELECTIVE AND LOW-E PRODUCTS[5]

WINDOW FILM SELECTION

The choice of window film, as well as the choice of surface on which it is applied, can be made to optimize for either cooling savings, or heating savings, but not both.

Typically in most California climates, and in most commercial buildings, cooling energy is higher than heating energy, which means window films that optimize for cooling savings work better. So windows with lower SHGC, and low-e films applied on surface 2 or 4 are likely to perform well. However in residential buildings, this may not be the case. Depending on climate and window to wall ratios, a residential building, and some light commercial buildings may need optimization for heating savings.

Savings from daylighting, on the other hand are dependent on how clear the window film is, so a higher VT film will result in greater lighting energy savings.

Another important aspect of window film is its impact on the indoor environment quality. A very low VT (typically low SHGC) film will tend to create a dull and gloomy environment, associated with loss in productivity[6] (CEC PIER 2003).

Since window films properties are static in nature, this choice needs to be made carefully with a good understanding of heating, cooling, lighting needs and indoor environmental quality of a building.

[5] Sensitivity of Fenestration Solar Gain to Source Spectrum and Angle of Incidence. ASHRAE Transactions 10, R. McCluney, June 1996

[6] Windows and Offices: A Study of Office Worker Performance and the Indoor Environment. California Energy Commission, Heschong Mahone Group, October 2003. Publication No. P500-03-082-A-9

NFRC Certified Products Directory

Physical Properties Characterization

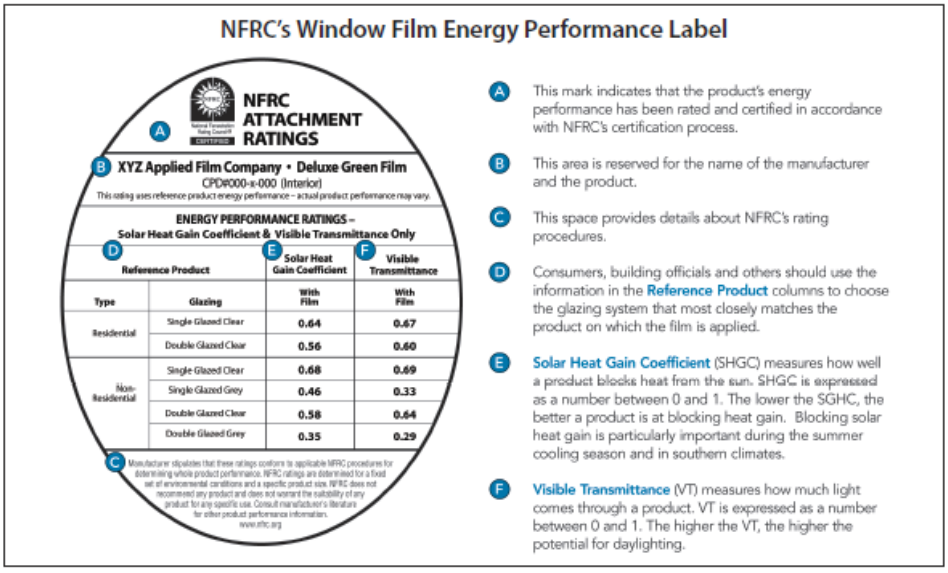
Currently, NFRC reports on the following physical properties of window films: solar heat gain coefficient (SHGC), visible transmittance (VT) and u-factor.

SHGC is the fraction of incident solar radiation admitted through a window. SHGC is expressed as a number between 0 and 1. The lower a window film's solar heat gain coefficient, the less solar heat it transmits.

U-factor is a measure of the rate of heat loss or gain through a material or assembly. The lower the U-factor, the greater a window's resistance to heat flow and the better its insulating value. Advanced window (low-e) films can reduce the U-factor by suppressing radiative heat flow. It should be noted that window films do not lower u-factor by increasing resistance in the traditional sense, as one would get through adding another pane of glass or increasing the air gap in a window assembly. Instead, they impact how much heat absorbed by the glass is radiated into the space. This inward flowing component of the absorbed solar heat is called its **emissivity (e)**.

VT is the fraction of the visible spectrum, weighted by the sensitivity of the eye that is transmitted through the glazing. VT is expressed as a number between 0 and 1. The lower a window film's visible transmittance, the darker it appears.

Of these properties, U-factor is not listed on the NFRC Window Film Energy Performance Label Figure 5. However, the u-factor can be found in NFRC's Certified Products Directory (CPD)[7]. The CPD is a database of products tested according to NFRC guidelines. Window films are referred to as 'Applied Film' in the CPD and currently 286 window film products from twelve manufacturers listed in the database.



[7] http://cpd.nfrc.org/cpd2/

FIGURE 5: NFRC WINDOW FILM ENERGY PERFORMANCE LABEL[8]

PRODUCT TESTING PROCEDURES

Each applied film product is tested on six reference window types, listing the following characteristics in Figure 6: operator type, frame, glazing, and U-factor. The testing guidelines for U-factor, SHGC, and VT can be found in two documents: NFRC 100A-2012, Procedure for Determining Fenestration Attachment Product U-Factors[9], and NFRC 200-2012, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence[10].

Reference Product			U-factor Btu/h·ft²·°F	
Operator Type	Reference Frame	Reference Glazing	no film	with film*
Residential Fixed	Aluminum	3mm (1/8 in) clear	1.087	
Non-Residential Window-wall	Aluminum	6mm (1/4 in) clear	1.015	
		6mm (1/4 in) grey	1.015	
Residential Fixed	Aluminum	3mm (1/8 in) clear 3mm (1/8 in) clear 7mm (1/4 in) gap	0.710	
Non-Residential Window-wall	Aluminum	6mm (1/4 in) clear 6mm (1/4 in) clear 12.7mm (1/2 in) gap	0.593	
		6mm (1/4 in) grey 6mm (1/4 in) clear 12.7mm (1/2 in) gap	0.593	

FIGURE 6: NFRC REFERENCE WINDOW CHARACTERISTICS

There are a host of other physical properties manufacturers typically report on, but not all are rated by NFRC. Some of these include: emissivity, total solar energy transmitted, UV light rejected, glare reduction, visible light reflected, heat loss reduction, shading coefficient, luminous efficacy, and solar heat reduction. Many of these additional properties are obtained by using other notable testing guidelines: American Society of Heating, Refrigeration, and Air Conditioning (ASHRAE) and American Society for Testing and Materials (ASTM).

ANALYSIS OF WINDOW FILMS DATA IN NFRC CPD

Applied window film products from almost all major window film manufacturers are in the NFRC Certified Products Directory (CPD) [11]. The CPD provides NFRC rated performance specs for a total of 286 window films from 9 manufacturers. The manufacturers are:

[8] http://www.nfrc.org/documents/WindowFilmfactsheet.pdf

[9] http://www.nfrc.org/documents/NFRC100A-2010.pdf

[10] http://nfrc.org/documents/NFRC200-2010_E1A4.pdf

[11] http://cpd.nfrc.org/cpd2/ (CPD data from NFRC website as of May 2012)

- 3M
- Solutia
- Hanita Coatings
- Madico, Inc.
- Nexfil
- Bekaert Specialty Films, LLC
- Commonwealth laminating and Coating, Inc.
- Johnson Laminating
- Southwall Technologies (owned by Solutia)

From this we identified Low-e films as having a U-factor of 0.9 or lower and spectrally selective films as having a VT/SHGC > 1.2.

An analysis of this database revealed the following:

- 3% of the total products were found to be low-e (9 products), while 8% of the total products were found to be spectrally selective (24 products). The remaining 89% of films (253 products) represent non-advanced or traditional tinted films making up the majority of the products in the database.
- Low-e and spectrally selective films (advanced window films) are offered by 7 of the 9 manufacturers.
- 2 products, both by the same company, qualified as both low-e and spectrally selective.

We analyzed the range of SHGC, VT, and U-factor for all window film product, as well as spectrally selective and low-e products on a single pane 3mm clear substrate. The analysis graphs can be found in the Appendix.

The following could be concluded from this analysis:

- Of all 286 window film products, most window films fall in the low-to-medium clear range of 0.1 – 0.4 VT. Most low-e products have very low 0.1 - 0.3 VT, while most spectrally selective films products have a much higher 0.5 -0.6 VT. This indicates that a low-e film is likely to also be a very dark window film, while a spectrally selective film is most likely to have a clearer appearance.
- Similarly most window films fall in a low-to-medium range of 0.3 – 0.4 SHGC. Most low-e products have very low 0.1 - 0.3 SHGC, while most spectrally selective films products have a slightly higher 0.3 -0.5 SHGC. Since a lower SHGC is likely to give a better performance in hot-sunny climates, this indicates that low-e films are likely to perform better thermally in such climates, than spectrally selective. However, when savings from daylighting are factored in, the clearer (high VT) properties of the spectrally selective films are expected to provide an advantage over low-e films in lighting energy savings.

MARKET BARRIERS

Based on the interviews conducted with window film manufacturers and other researchers, two market barriers were identified – measure cost and installer training. The cost of advanced window films is the primary reason for its limited market growth and adoption. By

incenting advanced window film products, greater adoption is likely and will provide momentum for technology adoption. A second barrier noted was installer training. For certain advanced window film products, training is required for the installer before the manufacturer allows the installer to work with the product. The specific knowledge required currently limits the number of installers who have been given permission by the manufacturer to install the product, which thereby limits the number of installations that can be completed. By providing educational support to installers, customers have a greater pool of installers to work with and will likely translate to greater market adoption

ASSESSMENT OBJECTIVES

The primary objective of this project is to provide unbiased, technically sound information that will allow customers, trade professionals, manufacturers, energy efficiency program administrators, and other stakeholders to make informed decisions about window film and advanced blinds such that both long-term energy savings and owner/occupant satisfaction can be optimized. Phase 1 of this project addresses the following high-level questions:

- Energy Savings
  - Do new low-e window films meet manufacturer claims of significantly reducing heating loads?
  - What is the potential for cost-effective energy savings for PG&E customers for low-e films, and how does that compare to other films?
  - What are the most important factors that affect the magnitude of energy savings and what is their relative impact?
  - What is the indirect energy impact of applied films from reduction in daylighting potential and can this be mitigated by spectrally selective films?

A secondary objective of this project is to provide data that will directly inform PG&E's incentive strategy to fit the needs of the customer, maximize cost-effective energy savings, and align with long-term energy efficiency goals. Important data to meet this objective include:

- Energy and demand savings various building types and climate zones to determine Unit Energy Savings
- Costs for materials and installation to determine Incremental Measure Cost
- Product lifetime and warranty to determine Effective Useful Lifetime
- Customer decision-making process and factors that may inform "free-ridership" for existing and future incentives
- Range of options for various physical properties of commercially available films

TECHNOLOGY/PRODUCT EVALUATION

The technology evaluation was based on three data collection activities:

- Literature review of previously conducted advanced films assessments
- Surveys conducted with market players, and
- Visual field assessment of buildings with advanced films

This section provides the information collected from those activities.

LITERATURE REVIEW

HMG conducted a comprehensive review of existing literature and data available on window films. The objectives of this review were to 1) identify existing sources of information and available data to avoid unnecessary duplication of effort and identify gaps, 2) collect additional information necessary to characterize the technologies and market, and foundational data required for subsequent tasks.

LITERATURE REVIEW OF EXISTING STUDIES & RESEARCH

Existing research and studies on window film performance has been limited thus far to primarily simulation studies. Of the existing studies only one has been conducted by a third party, while the majority of studies have been conducted by window film manufacturers. The knowledge of window film performance tested in the field with occupants is limited.

IWFA. ENERGY ANALYSIS FOR WINDOW FILMS APPLICATIONS IN NEW AND EXISTING HOMES AND OFFICES

The International Window Film Association released a study titled "Energy Analysis for Window Films Applications in New and Existing Homes and Offices"[12] in February 2012. Conducted by Consol, Inc., the basis of this study was to simulate new and existing commercial and residential building energy savings and return on investment (ROI) based on different window film properties.

The study took manufacturer and NFRC ratings to characterize window films into three groups: good, better, and best. The better and best categories represent spectrally selective and low-E technologies, respectively, however the study does not define low-e and spectrally selective films. It is hence difficult to gauge if the two categories for low-e and spectrally selective in this study match the performance characteristics associated with these technologies.

To determine building energy savings, simulation modeling provided the basis for the analysis. Two models were developed for the study – a Micropas residential model and Energy Plus commercial models. The new home met T24 standards with the exception of the baseline windows, not being code compliant (clear, dual-pane, 0.71 U-factor, 0.63 SHGC).

The results of this study indicate window film has a payback of 1-43 years in new construction, depending on the climate zone. In existing homes window film can save 1-2 TDV per $100 spent on double-pane glass, and over 2 TDV per $100 spent on single-pane glass. For commercial new construction, the study found window films were not an attractive energy efficiency option due to the low ROI. However, in existing offices the ROI ranges from $6-68 annually, depending on climate zone (ConSol, 2012). Other conclusions of the study found that window films with standard SHGC have as good, if not better ROI

[12] http://www.iwfa.com/ConsumerInfo/CAEnergySavingsStudy.aspx

than spectrally selective or low-E films. Also, the energy saved by low U-factor options is outweighed in office buildings by the higher cost for the two technologies. Overall, the potential for the most energy savings can be seen in existing buildings, office buildings being the most ideal due to the large amount of glazing and cooling load demand.

Upon review, the IFWA study findings and results did not provide direct applicability into this report's study. The IFWA study baseline conditions do no match specifications required under current California building code, limiting applicability of the savings analysis. In addition, cost analysis was based on internal Consol's product cost databases and kept confidential. This meant that results could not be analyzed by others to either replicate the results, or provide further analysis.

RONGXIN, YIN., ET AL. CASE STUDY: ENERGY SAVINGS FROM SOLAR WINDOW FILM IN TWO COMMERCIAL BUILDINGS IN SHANGHAI.

The second study reviewed, "Case Study: Energy Savings from Solar Window Film in Two Commercial Buildings in Shanghai,"[13] analyzed the energy savings of window films through simulation and measured monthly electrical consumption. The study used eQuest to simulate annual building performance with and without window film on a curtain wall glazing system both in interior and exterior applications. The results showed the performance of the window films varied, depending on the type of film and how it was applied (Yin, 2011). The study also reviled the shading coefficient and solar heat gain coefficient can be decreased by 44% and 22% when applied to the outside and inside of existing windows, respectively. In addition, the effects on daylighting were not significant in this building. The build had a 90% window to wall ratio, which means that even with low VT film, there was enough daylight available to provide daylighting savings. However, the authors indicate future window film studies should also focus on the indoor illumination levels, along with the whole building energy usage.

DEBUSK, STEVE. MEASURING THE SAVINGS FROM ENERGY-CONTROL WINDOW FILM INSTALLATION USING IPMVP OPTIONS C AND D.

The study, "Measuring the Savings From Energy-Control Window Film Installation Using IPMVP Options C and D Solutia Performance Films"[14], was conducted by Solutia Performance Films with assistance from Johnson Controls in the analysis of the results. The study's field site was located in a suburb near Chicago, IL. The purpose of this was to focus on window film performance in climates with more heating than cooling degree days, the typical application for window films. In an effort to produce conclusive evidence on the energy savings of the window films, Solutia used Options C & D of the International Performance Measurement and Verification Protocol (IPMVP). These methods of verification include a whole-building method using utility bill analysis, Option C, and calibrated simulation, Option D. The buildings conditioned space is 59,000 square feet with 9,200 square feet of glazing, the windows are single-pane bronze tinted glass, and is heated and cooled by room unit ventilators. Solutia's LLumar® E-1220 Low-E film was installed and the study noted that it reduced the windows solar heat gain by 67% and improved the U-value of single-pane windows by 23%.

[13] Rongxin, Yin., et al., (2012). "Case study: Energy savings from solar window film in two commercial buildings in Shanghai." Energy and Buildings. 45 (2012) pg. 132-140.

[14] http://www.bomaconvention.org/boma2012/CUSTOM/Case%20Study%20Solutia.pdf

The comparison of Options C and D resulted in very close energy savings. Option C resulted in an annual energy savings of 8.8% and Option D 8.4%. In addition, the simple payback of the Options C and D being 2.65 and 2.77, respectively. By using both methods of actual energy use and simulation, the study concluded using simulation software, such as DOE2, is a valid means of determining energy savings. In addition, the author points out that the analysis of utility bills does not account for weather conditions or occupancy behaviors, which is the case in many similar studies of this nature.

Fact Sheets

Several fact sheets on window films and their performance ratings have been produced by numerous organizations and manufacturer organizations. The Department of Energy's Lawrence Berkeley National Lab has developed a fact sheet (included in the Appendix) outlining window film applications, guidance on different types of application, thermal performance ratings (NFRC), and the pros and cons of applying window films. The fact sheet provides a good overview of the basic knowledge a consumer needs to know when considering installing window films.

The National Fenestration Rating Council (NFRC) has also developed a fact sheet (included in the Appendix) describing the importance of ratings in fenestration products, and provides consumers a guide to understanding the rating label associated with window film products. The third piece of literature outlining window films is in the form of a booklet published by the International Window Film Association (IWFA). This association is a member based organization in which their members each receive NFRC ratings for each of their products. The booklet provides consumers with definitions of common terms, applications, and benefits to installing window films.

Each piece of literature is a source consumers can use to gather an understanding of applications, terms, benefits, and rating information.

Information Gaps

Thus far, research has primarily consisted of simulation studies using the DOE2 engine, and in some cases using actual monthly utility data to calibrate the models. While simulation has been a proven method of predicting energy savings, there is a lack of field research to support window film performance once installed and methods of doing so.

A second conclusion of the literature review is that there are no formally established criteria set for advanced films such as low-E and spectrally selective. The window film industry has some rough guidelines for the two advanced technology classifications, but remains somewhat different among manufacturers.

Survey of Market Players

Telephone interviews with key market players, including manufacturers, vendors and trade professionals, were conducted to gain insight into the market, regarding: top commercial applications and motivations, material and installation costs, and warranty information. The survey instrument used to collect the data is located in the Appendix.

Of the vendors and trade professionals serving Northern California interviewed, the majority install window film primarily in commercial office buildings. The most commonly installed type of film has an SHGC ranging from 0.27 to 0.40, and a VT of 0.13 to 0.34. The majority of these films can be categorized as traditional "tinted" films, with approximately 15% of

their total installs being films considered Advanced, low-e or spectrally selective. When asked, there was no general consensus regarding a formal definition of what low-e or spectrally selective is. Rather, most described these films as "adding additional benefit" over traditional tinted films. On average, the trade professionals were able to provide a breakdown of what they would consider tinted versus advanced films, these being: 70% tinted and 30% advanced films. Cost can be considered one of the barriers for a customer to choose a traditional "tinted" window film over a more advanced product, which may result in more energy savings.

There are a variety of reasons customers are motivated to install window film, the top three, being: thermal comfort, energy savings and aesthetics. Many customers who install window film are motivated due to occupant complaints of thermal discomfort or HVAC system's reaching capacity. Most customers are initially attracted to installing window film because of the low cost compared to replacing windows or other energy efficiency measures they were considering.

For the purposes of this survey, we gathered material and labor cost data for: low-e, spectrally selective, and traditional tinted films. On average, the range in costs for materials, per square foot, in each category was: $5.00-$7.00 for low-e, $7.00-$10.00 for spectrally selective, and $4.00-$5.50 for tinted films. The incremental cost over traditional tinted film thus ranges from $1-$4.5/sf. Labor cost to install both tinted and advanced films was the same and ranged from $1.50-$2.50, per square foot, to 50% of the material cost; labor to install films can vary depending upon union rates, ladder work, and after hours or weekend work.

Most manufacturers offer standard warranties for each of their products. All manufacturers offer a lifetime warranty on residential window film applications. For commercial applications the warranty on average is between 10-15 years for both traditional and advanced films. However, warranties are subject to negotiation depending upon existing window type (i.e. low-e coating) and age, and solar exposure conditions.

EXISTING WINDOW FILMS INSTALLATION EVALUATIONS

This section summarizes the findings from six window film installations conducted to understand the non-energy impacts and decision-making factors for window film technologies. These impacts include aesthetics, visual and thermal comfort, installation quality, and maintenance issues. Information was gathered via direct observation and solicitation of experience from on-site occupants and building managers.

In general we found that occupants are most satisfied with window films, when they are the least noticeable. In two locations, window film had begun to peel off, which was likely the result of adhesive failure over a long time (close to 20yrs). Occupants were unsatisfied with the window films there, mainly due to its poor appearance, and the noticeable heating of the window surface. In another installation, where dark tinted film had been applied over single pane windows, the occupants complained about window surface heating up the space appeared too "dull" and "gloomy" due to lack of daylight. In the newer installations, and especially ones with the high visible transmittance window films, the occupants as well as the building managers were very satisfied with the appearance and performance of the films.

At least two building managers had noticed that their chillers were idling more often after the installation of window films. Maintaining control over building load in the summers seems to be a common reason to install window films, along with alleviating occupant complains about heat from windows.

All building managers we interviewed that participated in the PG&E Incentive program were very satisfied with their experience, and the incentive level offered by PG&E.

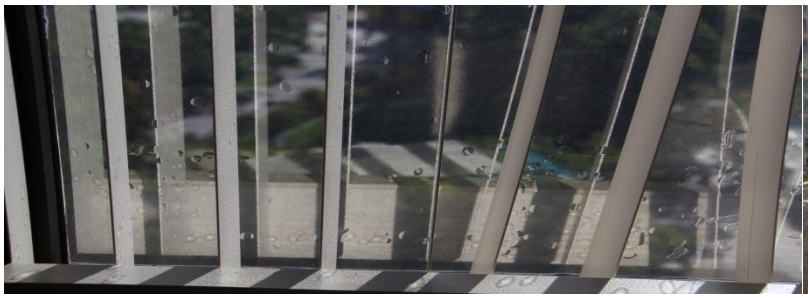
SITE 1 – SAN JOSE, CA

Building Type: High rise office building

Window Type: Single pane, clear

Installed Film Product: Traditional Tint Film




CONDITION OF FILM

The film was installed over 20 years ago and showed signs of failure in many places. The film in each observed space had failed in a variety of ways. These include: cracks ranging from small patterns to large cracks, peeling, bubbling, and cloudy in appearance. The window film also appeared to have not failed in some windows.

OCCUPANT/BUILDING OPERATOR EXPERIENCE

Building occupants expressed their dislike of the existing window film primarily due to its appearance. The occupants described their view to the outdoors as unpleasant and are waiting in anticipation for the film to be replaced. Onsite maintenance staff indicated the film peels off, bubbles, and cracks on all facades of the building. The most frequent occupant complaint from the window film is of its visual appearance and the West façade heating up in the afternoon hours.

HMG Observations

The glazing on the West façade was hot to the touch and heat radiating off the window was apparent. The failure was likely the result of old age of the film and the adhesive giving away. This was not in line with expected performance of window films on single pane windows which led us to conclude that the thermal performance of the film has been compromised.

PG&E Incentive Feedback

Not applicable.

SITE 2 – REDWOOD CITY, CA

Building Type: High rise office building

Window Type: Single pane, clear

Installed Film Product: Hüper Optik Fusion 20

CONDITION OF FILM

The film was installed in the last 3 years and has no noticeable visual failures.

OCCUPANT/BUILDING OPERATOR EXPERIENCE

Building occupants expressed improved thermal comfort since the films installation. Building operator reported the chillers are idling more frequently and do not run at full capacity. There has also been a decline in utility bills; how much savings from the film is unknown due to other energy efficiency measures also installed within the last 3 years

HMG Observations

Film appears to have no visual failures. Visible light in the office spaces is high and view from windows to the outdoors is clear.

PG&E Incentive Feedback

Customer is satisfied with incentive received through the deemed rebate program. Customer is interested in installing film on another building that has double pane windows. Under the current requirements of the deemed rebate program the building would not qualify.

SITE 3 – SAN JOSE, CA

Building Type: Low rise office building

Window Type: Single pane, clear

Installed Film Product: Dark Tinted Film





CONDITION OF FILM

The overall condition of the film was good. There were some areas near the edges of the window where the film was starting to peel back. Unknown if this was a signs of adhesive failure, or occupants interacting with the windows.

OCCUPANT/BUILDING OPERATOR EXPERIENCE

Building occupants expressed uncomfortable thermal conditions during later afternoon hours. Building operator expressed no other issues with film except for occupant complaints of thermal comfort.

HMG Observations

Film appears to have no visual failures. Base window is clear with a dark tinted film. Due to low VT of film the visible light into the space is minimal making its appearance "gloomy". The windows are also hot to the touch during afternoon hours, thus increasing heat gains into the space.

PG&E Incentive Feedback

Not applicable.

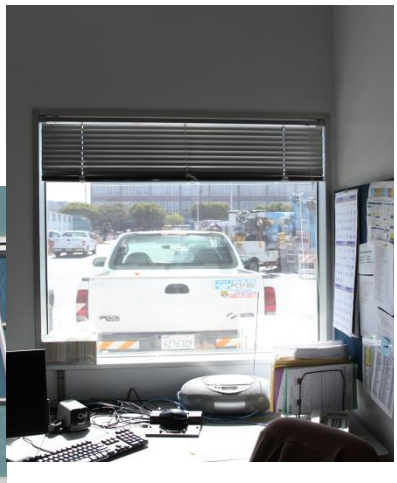
SITE 4 – SAN FRANCISCO, CA

Building Type: Mid rise office building

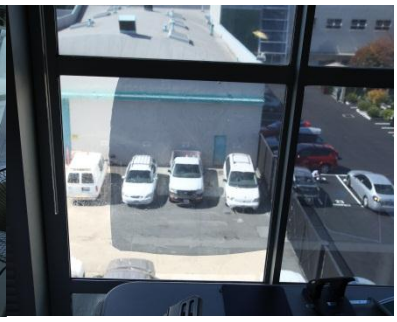
Window Type: Single pane, clear

Installed Film Product: Tinted Film









CONDITION OF FILM

The film was installed over 10 years ago and has begun to peel off in many areas leading to poor visual quality. The film in each observed space had failed in a variety of ways. These include: peeling and bubbling in appearance. The window film also appeared to have not failed in some windows.

OCCUPANT/BUILDING OPERATOR EXPERIENCE

Building occupants expressed dislike of the appearance of the window film because of its failures. The bubbling appearance restricts their view to the outdoors which results in some occupants peeling manually the film off on their windows.

HMG Observations

Film appears to be a dark tinted film with low visible transmittance. Film failures were consistent throughout building and noticeable on the interior and exterior.

PG&E Incentive Feedback

Not applicable.

SITE 5 – SAN JOSE, CA

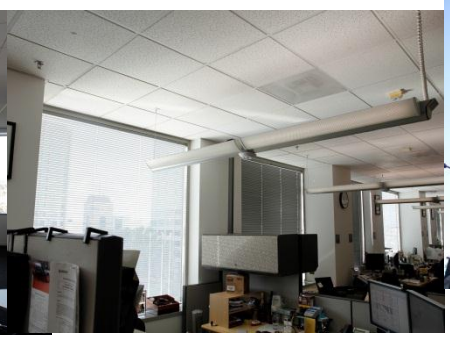
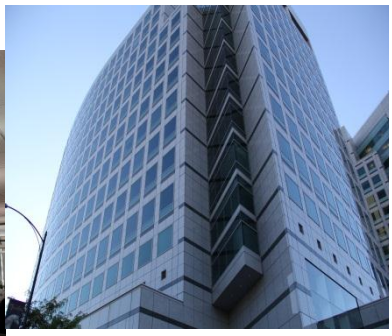
Building Type: High rise office building

Window Type: Double pane laminate, clear

Installed Film Product: SolarGard Hilite 70 – Spectrally Selective





CONDITION OF FILM

Film was installed in 2008 and appears to remain in good condition. Some small areas of failure were observed on the laminate glass layer of the window, which may be a result of the applied film trapping heat within the window. This however had not affected the films appearance.

OCCUPANT/BUILDING OPERATOR EXPERIENCE

Since window film was installed there have not been any complaints of thermal discomfort or aesthetics of the windows. Building operator indicated before film was installed their chillers would often reach capacity. After film was installed the load can be managed and chillers no longer reach capacity on peak demand events.

HMG Observations

Window film was installed on the South and West facades of the building. No noticeable difference in appearance or amount of daylighting was observed between façades with or without window film. In general the film was unnoticeable; however, a few spots showed the laminate glass was affected. On these areas, the window had a smooth surface despite the noticeable change in the window. It was concluded that the laminate glass under the window film had heated up and showed signs of failure as a result of heat trapped between two fused laminate layers and window film.

PG&E Incentive Feedback

Building operator indicated satisfaction with PG&E incentive program. They participate in many PG&E programs and are overall satisfied with the assistance, technologies, and incentives received.

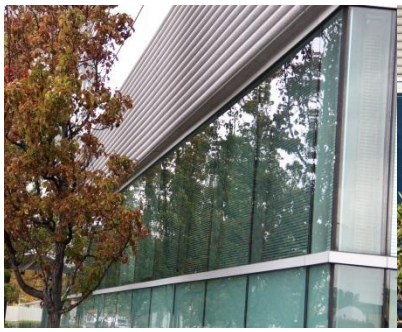
SITE 6 – REDWOOD CITY, CA

Building Type: Mid rise office building

Window Type: Single and double pane laminate, clear

Installed Film Product: 3M Prestige 70 – Spectrally Selective



CONDITION OF FILM

Film was installed in 2009 and has remained in overall good condition. Some small areas of failure were observed on the laminate glass layer of the window, which may be a result of the applied film trapping heat within the window. This however had not affected the films overall appearance.

OCCUPANT/BUILDING OPERATOR EXPERIENCE

Window film was installed to make occupants more comfortable on the South and West facades. Since the film has been installed occupant complaints of decreased. Building operator indicated the occupants like the film and did not notice any difference in daylighting after film was applied, owing to its high visible transmittance. Cleaning of the

windows remains the same as before film was installed. The building operator has not been tracking HVAC performance, so could not comment of any change in energy use.

HMG Observations

Window film was installed on the South and West facades of the building. No noticeable difference in appearance or amount of daylighting was observed between façades with or without widow film. In general the film was unnoticeable; however, several spots showed the laminate glass was affected. On that area, the window had a smooth surface despite the noticeable change in the window. It was concluded that the laminate glass under the window film had heated up and showed signs of failure as a result of heat trapped between two fused laminate layers and window film.

PG&E Incentive Feedback

Building operator indicated satisfaction with PG&E incentive program. Incentive process was easy and helped to offset the cost of an energy efficiency measure that was going to be done regardless of available incentives.

SIMULATION METHODOLOGY

This section describes the simulation methodology used to provide an assessment of energy savings potential of the different advanced as well as tinted window films. The simulation runs and their results, included in this report, are Phase 1 of the Emerging Technologies assessment of advanced window films. Phase 2 of this project involves field monitoring spaces with advanced window films. It should be noted that results from Phase 2 will serve as a means to "true-up" the savings estimated here using whole building energy simulation.

SIMULATION PLAN

To understand the impact of various window films, whole building energy simulations were conducted using EnergyPlus 7.2.0. Updated in October 2012, this is the most recent energy analysis and thermal load simulation program available from the Department of Energy (DOE).

To perform this analysis, we wanted to simulate a building that would be representative of a typical commercial building. Substantial research has already been completed by the DOE to develop prototype EnergyPlus models. Building on this previous work, a base model was developed using the Pacific Northwest National Laboratory's (PNNL) Commercial Prototype Building Models. These prototype models were derived from the DOE's Commercial Reference Building Models, with inputs from ASHRAE 90.1, ASHRAE Ventilation Standard 62.1, and the Commercial Building Energy Consumption Survey (CBECS).

Specifically, the 90.1-2010 Medium Office model was chosen as a starting point. This is a 3-story office building with a floor area of 53,600sf. The building is separated into four perimeter zones and one core zone for each floor, in addition to plenum zones below floors. This building has a packaged air conditioning unit, which also includes a gas furnace. The HVAC system has a terminal box with a damper and electric reheat. Both the air conditioning and the heating systems are set to the minimum ASHRAE 90.1 requirements. In ASHRAE climate zone 3C (San Francisco), these are an 80% efficient gas furnace with electric reheat, and an AC with a coefficient of performance (COP) of 3.4.

The original prototype files and detailed inputs can be found here: http://www.energycodes.gov/901-prototype-building-models-medium-office.

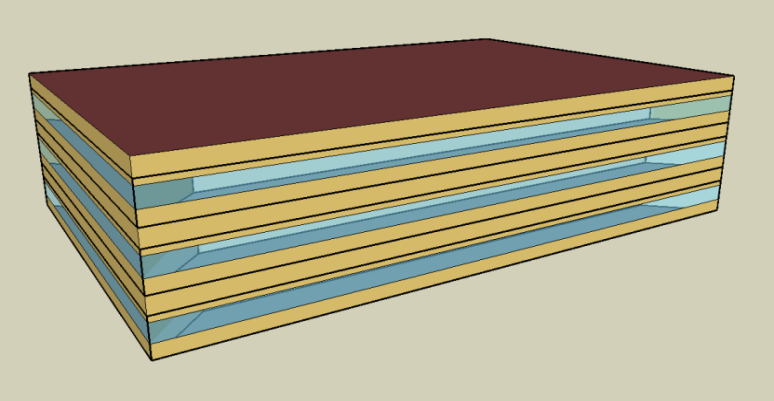


FIGURE 7: PNNL 90.1-2010 MEDIUM OFFICE BUILDING

SIMULATION PARAMETERS

3,840 annual simulations were run changing the six variables indicated in the table in Figure 8. In order to study the impact of different window films on different base windows, six base windows were created, including single pane clear, each with four types of window films and a base case with no film. Other interior conditions such as presence of window blinds/shades and daylighting controls were yes/no variables; two gross-Window to Wall Ratios (Gross-WWR[15]) were considered 33% and 66%; and simulations were run for all 16 California Climate Zones.

[15] Gross-WWR is the total window area divided by the total wall area in the building, which includes wall are in the plenum space

Variable	Count	Details					
Base Windows	6	Single Clear,	Single Tinted,	Double Clear,	Double Tinted,	Double Low-e Clear,	Double Low-e Tinted
Window Films	5	No Film (Base case),	Typical Tint Film,	Spec. Selective Film,	Low-e Film,	Spec. Selective + Low-e Film	
Window Shades	2	Yes,	No				
Daylighting	2	On,	Off				
Gross-WWR	2	33%,	66%				
Climate Zones	16	1-16					
Total Simulation Runs	3,840						

FIGURE 8: SIMULATION PARAMETERS

For each simulation, the following data was gathered:

- End uses: Annual heating, cooling, interior lights, fans, and total energy end uses. (kBtu/sf)
- Peak demand: Peak electric demand, by month. (W/sf)
- Loads: Sensible cooling, latent cooling, and sensible heating, by zone (kBtu/sf)

Peak demand was calculated in a way such that it is closest to what a building owner may experience on their monthly billing cycles. PG&E defines peak period as 12PM to 7PM on weekdays between June 1 and September 30. First the highest energy use hour during this peak period was identified for each of the four months (June - Sept). The average of these four values is reported as the 'peak electric demand' in W/sf for each run. Then to calculate percent demand savings, the hour with the peak electric energy use for each of the four months, for a simulation run with window film is compared the hour with the peak electric energy use for the same month, for a simulation run without window films. These may not be the same hour (clock time), but are peak hours for the two cases (with and without film) in the same month. A percent demand savings is thus calculated for each month. The average of these four values is then reported as 'percent demand savings'.

BASE WINDOWS AND WINDOW FILMS

Six base windows with four different types of window films were modeled for the simulation study. The process of modeling these windows involved using OPTICS 5[16], a software from LBNL, that allows a user to select any window film from the International Glazing Database (IGDB) and apply it on any substrate glazing also from the IGDB. The assembly if glazing

[16] http://windows.lbl.gov/software/optics/optics.html

and window film was then exported to WINDOW 6[17], another software from LBNL, that allows a user to assemble a whole window, complete with frame, spacer and glazing choices. This assembly of the whole window was then exported as an EnergyPlus IDF file, which was then imported into the EnergyPlus building model for running the annual whole-building energy simulation.

The six base windows were: single pane, double pane, and double pane low-e, each clear and tinted. These six base windows cover typical window types in commercial buildings, and offer the opportunity to study the impact of window films on windows outside the current scope of PG&E's window film program (namely single pane clear).

The four window films selected for this project were: a low-e film, a spectrally selective film, and a film that qualified as both low-e and spectrally selective and a traditional tint film. The first three films were the 'advanced' window films category, while the fourth represented properties of a window film which would currently qualify under PG&E's window film rebate program. A fifth case with no window film was also modeled to serve as a base case for comparison. Properties of each combination of base window and film are outlined in Figure 9.

[17] http://windows.lbl.gov/software/window/window.html

Case No.	Window Film	Base Window	SHGC	VT	U-factor
1	None	6 mm (1/4in.) clear	0.78	0.76	0.95
		6 mm (1/4in.) tinted	0.53	0.36	0.94
		6 mm (1/4in.) clear, 6 mm (1/4in.) clear	0.63	0.66	0.57
		6 mm (1/4in.) tinted, 6 mm (1/4in.) clear	0.44	0.32	0.57
		6 mm (1/4in.) low-e, 6 mm (1/4in.) clear	0.30	0.51	0.44
		6 mm (1/4in.) low-e tinted, 6 mm (1/4in.) clear	0.32	0.32	0.45
2	Traditional Tint	6 mm (1/4in.) clear	0.36	0.20	0.92
		6 mm (1/4in.) tinted	0.33	0.10	0.92
		6 mm (1/4in.) clear, 6 mm (1/4in.) clear	0.45	0.18	0.57
		6 mm (1/4in.) tinted, 6 mm (1/4in.) clear	0.34	0.09	0.57
		6 mm (1/4in.) low-e, 6 mm (1/4in.) clear	0.25	0.14	0.44
		6 mm (1/4in.) low-e tinted, 6 mm (1/4in.) clear	0.27	0.09	0.45
3	Spectrally Selective	6 mm (1/4in.) clear	0.45	0.58	0.92
		6 mm (1/4in.) tinted	0.38	0.28	0.91
		6 mm (1/4in.) clear, 6 mm (1/4in.) clear	0.51	0.52	0.57
		6 mm (1/4in.) tinted, 6 mm (1/4in.) clear	0.37	0.25	0.57
		6 mm (1/4in.) low-e, 6 mm (1/4in.) clear	0.29	0.40	0.43
		6 mm (1/4in.) low-e tinted, 6 mm (1/4in.) clear	0.29	0.25	0.45
4	Low-e	6 mm (1/4in.) clear	0.24	0.18	0.75
		6 mm (1/4in.) tinted	0.23	0.09	0.70
		6 mm (1/4in.) clear, 6 mm (1/4in.) clear	0.32	0.17	0.50
		6 mm (1/4in.) tinted, 6 mm (1/4in.) clear	0.25	0.08	0.51
		6 mm (1/4in.) low-e, 6 mm (1/4in.) clear	0.21	0.12	0.41
		6 mm (1/4in.) low-e tinted, 6 mm (1/4in.) clear	0.22	0.08	0.42
5	Spectrally Selective + Low-e	6 mm (1/4in.) clear	0.24	0.28	0.56
		6 mm (1/4in.) tinted	0.21	0.14	0.56
		6 mm (1/4in.) clear, 6 mm (1/4in.) clear	0.30	0.26	0.45
		6 mm (1/4in.) tinted, 6 mm (1/4in.) clear	0.23	0.12	0.45
		6 mm (1/4in.) low-e, 6 mm (1/4in.) clear	0.20	0.19	0.38
		6 mm (1/4in.) low-e tinted, 6 mm (1/4in.) clear	0.21	0.12	0.39

FIGURE 9: SUMMARY OF WINDOW FILMS USED IN SIMULATION

This method of using OPTICS 5, WINDOW 6 and Energy Plus is the most accurate method of modeling and simulating window films, and is expected to provide the most reliable results.

INTERIOR SHADES

Each building was modeled with and without interior shades. For the buildings with shades, interior roller shades were modeled and controlled when the incident solar radiation reached 50 W/m2.

The roller shade model properties defined in EnergyPlus are given in Figure 10.

It should be noted that we have learned from the national labs working on the development of EnergyPlus that blinds and shades in whole buildings programs like EnergyPlus (as well as eQuest, DOE2) have known limitations / bugs in the way heat gains into the space is

calculated. Further details of these limitations were not available at the time of writing this report.

While shades/blinds are an important part of the assessment, and are expected to have an impact on savings from window films, the knowledge of known limitations in the shades model means the results with shades may not be very accurate.

Roller Shade Properties	Value
Solar transmittance at normal incidence	0.3
Solar Reflectance (same for front and back side)	0.5
Visible Transmittance at normal incidence	0.3
Visible reflectance (same for front and back side)	0.5
IR Emissivity (same for front and back side)	0.9
IR Transmittance	0.05
Thickness	0.003
Conductivity	0.1 W/m-K
Shade to glass distance	0.1 m
Top Opening Multiplier	0
Bottom Opening Multiplier	0
Left-Side Opening Multiplier	0.5
Right-Side Opening Multiplier	0.5
Air-Flow Permeability	0

FIGURE 10: ROLLER SHADE INPUT TO ENERGYPLUS

DAYLIGHTING

Each building was also modeled with and without daylighting control. For the buildings with daylighting control, the illuminance setpoint was 322.9 lux (30 footcandles). The daylighting controls used a stepped control with three settings, where the lights were turned off completely when the illuminance setpoint was reached.

WINDOW TO WALL RATIO

All buildings were simulated with both 33% and 66% window to wall ratios (WWR). For the 33% WWR, the original inputs from the PNNL models were used. To increase to 66% WWR, all window heights were doubled, with head heights placed 1" from the ceiling.

CLIMATE ZONES

Each building was simulated in all 16 California Climate Zones, using the weather files available from EnergyPlus.

RESULTS

This section provides the results and analysis from the whole building energy simulations conducted to determine impact of window films on commercial (office) buildings. Note that this report only addresses commercial (office) buildings. Results for residential buildings will be included as part of Phase 2 Report on Field Evaluation.

In order to study the impact of different window films on different base windows, six base windows were created, and each base window was modeled with four types of window films and a base case with no film. Other interior conditions such as presence of window blinds/shades and daylighting controls were yes/no variables; two gross-WWR were considered 33% and 66%; and simulations were run for all 16 California Climate Zones. These resulted in a total of 3,840 simulations runs.

All simulations were run using the latest version of EnergyPlus, on a Medium Office Building model. Further details about the building model and simulation parameters are provided in the Simulation Methodology section of this report.

These simulations results provide a preliminary understanding of the magnitude of savings from window films, and the impact of window films on different base windows. Results from field monitoring in Phase 2 of this project, to be completed by end of 2013, will be used to determine how much of these savings can be reasonably expected in real building installations.

WHOLE BUILDING ENERGY SIMULATION RESULTS

This section provides results for the various simulation runs. For brevity, only results tables for PG&E climate zones, CZ 13 (inland, cooling dominated), and gross-WWR 66% are included in this section. The results for the rest of the climate zones and gross-WWR 33% are included in the appendix.

The tables below show 'Whole Bldg Energy Use (kBtu/sf)', 'HVAC Energy Use (kBtu/sf)' and 'Peak Electric Demand (W/sf)' for each of the six base window types, and with four types of window films as well as a base case with no window film. Percent energy savings and percent demand savings are calculated relative to the base case with no window film. Please refer to Section on Simulation Parameters for details of how peak demand and demand savings were calculated. While the whole building energy use shows how much energy consumption of the building has reduced, the HVAC energy use shows just the impact on the HVAC system, which consists of the sum of heating, cooling, and fan energy only.

Tables in Figure 11 through Figure 14 provide energy and demand savings for CZ 13. The following trends were observed across all results.

- 'Single pane clear' windows have the greatest savings from window films, followed by 'single pane tinted' and then 'double pane clear' windows, which show incrementally lower savings.
- 'Double pane low-e' windows had the least savings from window films. This is not surprising as this is the most efficient base window case. Only 'low-e' film, and 'spectrally selective + Low-e' films provided some savings, which may not persist when operable window shades are considered.

- The advanced films, namely 'low-e' and 'spectrally selective + low-e' advanced films consistently showed significantly greater savings than the 'traditional tint' film.
- 'Spectrally selective' advanced film only had higher savings than 'traditional tint' film when daylighting controls were modeled, along with operated window shades.
- Savings from window films are lower if the simulation model includes operable window shades.
- When window shades are introduced, base case (no window film) energy use decreases significantly, but energy use in cases with window films does not decrease by the same magnitude. This results in lower energy savings from window films.
- If the building has automatic daylighting controls, and window shades, adding window films does not always result in whole building energy savings. If the base window is single pane clear, the cooling energy savings typically outweigh the loss in savings due to lower light levels, however if the base window is 'double pane' or 'double pane low-e', the choice of window film must be made carefully to ensure the balance of heat gains and light results in positive savings.
- While the magnitudes of savings differ by climate zone, the percent savings due to any given type of window film was found to be similar across inland and coastal climates. Coastal climates had only slightly lower savings than inland climates.

Overall the results show that advanced window films (low-e, spectrally selective and low-e + spectrally selective), can potentially save more energy than traditional tinted films, in almost all climate zones in California. This is especially true for single pane windows – clear and tinted, since they are the least efficient window type considered.

The results also indicate that with these advanced window films, savings are possible in buildings with base windows other than just single pane clear, which has been the limited scope of the current PG&E rebate program. **Single pane tinted** windows show savings with both traditional tinted and advanced window films, but the magnitude of these savings is lower than with single pane clear windows. **Double pane clear** and **double pane tinted** windows only show consistent savings with advanced window films. **Double pane low-e clear and tinted** only show marginal savings with the highest performing advanced window films, and these savings were not found consistently across all cases considered. Savings with double pane low-e windows was close to zero or negative, when window shades are considered.

Results With No Daylighting Controls

This section presents and describes results for the simulation runs with no automatic daylighting controls.

Climate Zone 13
Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	47.44	--	29.16	--	5.01	--	44.03	--	25.75	--	4.78	--	38.10	--	19.82	--	4.00	--
Traditional Tint Film	42.98	9.4%	24.70	15.3%	4.30	14.3%	41.96	4.7%	23.68	8.0%	4.45	6.9%	37.84	0.7%	19.56	1.3%	3.95	1.3%
Spectrally Selective Film	43.97	7.3%	25.69	11.9%	4.48	10.5%	42.47	3.5%	24.19	6.1%	4.53	5.1%	37.87	0.6%	19.59	1.2%	3.95	1.1%
Low-e Film	39.47	16.8%	21.19	27.3%	3.91	22.0%	39.52	10.2%	21.24	17.5%	4.10	14.2%	37.11	2.6%	18.83	5.0%	3.85	3.6%
Spectrally Selective + Low-e Film	38.58	18.7%	20.30	30.4%	3.94	21.5%	39.00	11.4%	20.71	19.5%	4.06	15.1%	36.83	3.3%	18.55	6.4%	3.83	4.1%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	45.48	--	27.20	--	4.71	--	41.36	--	23.08	--	4.39	--	38.54	--	20.26	--	4.06	--
Traditional Tint Film	43.16	5.1%	24.88	8.5%	4.31	8.5%	40.29	2.6%	22.01	4.7%	4.21	4.2%	38.09	1.2%	19.81	2.2%	3.98	2.0%
Spectrally Selective Film	43.67	4.0%	25.39	6.6%	4.42	6.2%	40.62	1.8%	22.34	3.2%	4.27	2.8%	38.30	0.6%	20.02	1.1%	4.02	1.0%
Low-e Film	40.36	11.2%	22.08	18.8%	4.04	14.3%	38.81	6.2%	20.53	11.1%	4.00	8.9%	37.24	3.4%	18.96	6.4%	3.86	4.9%
Spectrally Selective + Low-e Film	38.95	14.4%	20.67	24.0%	3.97	15.7%	38.21	7.6%	19.93	13.7%	3.95	10.1%	37.05	3.8%	18.77	7.3%	3.86	4.8%

Figure 11: Results by Climate Zone - CZ13, Daylighting OFF, NO window shades, 66% gross-WWR, Comparing Across Base Windows

Figure 11 provides results for all six base windows and the four window film types for climate zone 13, with no daylighting controls i.e. Daylighting is OFF, and the model has NO window shades. The gross WWR for the medium office building is 66

The results show that with no window shades, 'single pane clear' windows can achieve as much as 18.7% savings in energy use, 30.4% savings in HVAC energy use, and up to 22% reduction in peak electric demand when compared to no window films case. This result represents the theoretical maximum savings for this building model and climate.

The savings were slightly lower for 'single pane tinted' and 'double pane clear' windows, followed by 'double pane tinted' windows. The savings were significantly lower for 'double pane low-e' clear and tinted windows, with a maximum of only 3.8% savings in energy use, 7.3% savings in HVAC energy use and 4.9% reduction in peak electric demand.

Across these results it can be seen that 'low-e films' and 'spectrally selective + low-e' films perform better than the 'traditional tint' film, i.e. non-advanced window film. The advanced 'spectrally selective' film showed a lower performance than even the 'traditional tint' film. On reviewing this result further, we noted that the whole building energy use, especially when there are no daylighting controls, are driven by the solar heat gain coefficient, or SHGC. The 'traditional tint' film has a lower SHGC (SHGC = 0.36) compared to the 'Spectrally Selective' film (SHGC = 0.45).

The best whole building energy savings were from the 'spectrally selective + low-e' window film, regardless of base window.

While these savings values are a theoretical maximum for window films, a building with no window shades/blinds is not a very realistic case. Most buildings have window shades or blinds, which are expected to interact with the savings from window films.

Climate Zone 13

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	41.53	--	23.24	--	4.16	--	39.93	--	21.65	--	4.19	--	36.85	--	18.57	--	3.83	--
Traditional Tint Film	40.04	3.6%	21.76	6.4%	3.88	6.6%	39.68	0.6%	21.40	1.1%	4.13	1.4%	36.95	-0.3%	18.67	-0.6%	3.84	-0.3%
Spectrally Selective Film	40.47	2.5%	22.19	4.5%	3.98	4.3%	39.86	0.2%	21.58	0.3%	4.17	0.6%	36.91	-0.2%	18.63	-0.3%	3.84	-0.2%
Low-e Film	37.58	9.5%	19.30	17.0%	3.67	11.8%	37.76	5.4%	19.48	10.0%	3.88	7.5%	36.15	1.9%	17.87	3.7%	3.75	2.0%
Spectrally Selective + Low-e Film	36.59	11.9%	18.31	21.2%	3.68	11.5%	36.93	7.5%	18.65	13.9%	3.82	8.7%	35.57	3.5%	17.29	6.9%	3.70	3.4%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	41.26	--	22.98	--	4.10	--	38.72	--	20.43	--	4.00	--	36.95	--	18.67	--	3.83	--
Traditional Tint Film	40.19	2.6%	21.91	4.6%	3.90	4.8%	38.48	0.6%	20.20	1.1%	3.95	1.3%	37.12	-0.5%	18.84	-0.9%	3.85	-0.6%
Spectrally Selective Film	40.46	1.9%	22.18	3.5%	3.97	3.2%	38.62	0.3%	20.34	0.5%	3.98	0.5%	37.10	-0.4%	18.81	-0.8%	3.85	-0.6%
Low-e Film	38.04	7.8%	19.76	14.0%	3.75	8.7%	37.15	4.0%	18.87	7.7%	3.79	5.2%	36.21	2.0%	17.93	4.0%	3.75	2.1%
Spectrally Selective + Low-e Film	36.68	11.1%	18.40	19.9%	3.69	10.0%	36.29	6.3%	18.01	11.9%	3.74	6.6%	35.69	3.4%	17.41	6.7%	3.71	3.1%

FIGURE 12: RESULTS BY CLIMATE ZONE - CZ13, DAYLIGHTING OFF, WITH WINDOW SHADES, 66% GROSS-WWR, COMPARING ACROSS BASE WINDOWS

Figure 12 provides results for all six base windows and the four window film types for climate zone 13, with no daylighting controls i.e. Daylighting is OFF, and the model HAS window shades. The gross WWR for the medium office building is 66%.

The results show that with window shades, 'single pane clear' windows can achieve as much as 11.9% savings in energy use, 21.2% savings in HVAC energy use, and up to 11.8% reduction in peak electric demand when compared to the 'no window films' case. While lower than the result in Figure 11, these runs represent a more realistic case of a building with operated

window shades. Details about the way window shades have been modeled, and a note of accuracy of results from the shades model in EnergyPlus is provided in the Simulation Methodology section.

As found in the 'without shades' case, the savings were slightly lower for 'single pane tinted' and 'double pane clear' windows, followed by 'double pane tinted' windows. In both the double-pane cases, the savings from 'traditional tint' film and the 'spectrally selective' film are close to zero. The savings were significantly lower for 'double pane low-e' clear and tinted windows, with a maximum of only 3.5% savings in energy use, 6.9% savings in HVAC energy use and 3.4% reduction in peak electric demand.

In these results again we find that that 'low-e film' and 'spectrally selective + low-e' film perform better than the 'traditional tint' film. Also, due to the lack of daylighting controls in the model, the energy savings driver was SHGC, and so 'spectrally selective' film showed a lower performance than the 'traditional tint' film.

The best whole building energy savings were from the 'spectrally selective + low-e' window film, regardless of base window.

With 'double-pane low-e clear' base window, the choice of window film becomes very significant. The results indicate that adding a 'traditional tint' or a 'spectrally selective' film to a 'double-pane low-e clear' base window results in almost no change in whole building energy use. We expect this to be due to interaction of the window shades layer with the window film layer and the low-e coating in the base window.

Results With Daylighting Controls

This section presents and describes results for the simulation runs with automatic daylighting controls. The controls automatically switched lights off in three equal steps, in response to available daylight every hour, up to the set point of 30 fc. When this setpoint was reached, the lights were turned completely off. The lights in the primary daylit zone (1 head height away from windows) were controlled separately than the light in the secondary daylit zone (2 head height away). The remaining lights were not controlled by daylight.

Climate Zone 13

Daylighting On (30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	44.33	--	26.05	--	4.56	--	40.84	--	22.56	--	4.32	--	34.92	--	16.64	--	3.54	--
Traditional Tint Film	40.07	9.6%	21.79	16.4%	3.85	15.6%	38.94	4.6%	20.66	8.4%	3.99	7.6%	34.87	0.1%	16.59	0.3%	3.50	1.1%
Spectrally Selective Film	40.95	7.6%	22.67	13.0%	4.03	11.6%	39.32	3.7%	21.04	6.7%	4.08	5.7%	34.71	0.6%	16.43	1.3%	3.50	1.1%
Low-e Film	36.57	17.5%	18.29	29.8%	3.45	24.3%	36.53	10.5%	18.25	19.1%	3.64	15.7%	34.15	2.2%	15.87	4.6%	3.41	3.6%
Spectrally Selective + Low-e Film	35.55	19.8%	17.27	33.7%	3.48	23.8%	35.90	12.1%	17.62	21.9%	3.61	16.5%	33.83	3.1%	15.55	6.6%	3.39	4.3%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	42.45	--	24.17	--	4.26	--	38.27	--	19.99	--	3.94	--	35.40	--	17.12	--	3.60	--
Traditional Tint Film	40.51	4.6%	22.23	8.0%	3.90	8.5%	37.72	1.4%	19.44	2.7%	3.83	2.7%	35.49	-0.3%	17.21	-0.5%	3.61	-0.2%
Spectrally Selective Film	40.71	4.1%	22.43	7.2%	3.97	6.8%	37.57	1.8%	19.29	3.5%	3.81	3.2%	35.20	0.5%	16.92	1.1%	3.56	1.1%
Low-e Film	36.57	13.8%	18.29	24.3%	3.45	19.0%	36.27	5.2%	17.99	10.0%	3.63	7.9%	34.65	2.1%	16.37	4.3%	3.51	2.5%
Spectrally Selective + Low-e Film	36.08	15.0%	17.80	26.3%	3.51	17.6%	35.33	7.7%	17.05	14.7%	3.51	10.9%	34.15	3.5%	15.87	7.3%	3.43	4.8%

FIGURE 13: RESULTS BY CLIMATE ZONE - CZ13, DAYLIGHTING ON, NO WINDOW SHADES, 66% GROSS-WWR, COMPARING ACROSS BASE WINDOWS

Figure 13 provides results for all six base windows and the four window film types for climate zone 13, with daylighting controls i.e. Daylighting is ON, and the model has NO window shades. The gross WWR for the medium office building is 66%.

The results show that with no window shades, 'single pane clear' windows can achieve as much as 19.8% savings in energy use, up to 33.7% savings in HVAC energy use, and up to 24.3% reduction in peak electric demand when compared to no window films case.

The savings were slightly lower for 'single pane tinted' and 'double pane clear' windows, followed by 'double pane tinted' windows. The savings were significantly lower for 'double pane low-e' clear and tinted windows, with a maximum of only 12.1% savings in energy use, 21.9% savings in HVAC energy use and 16.5% reduction in peak electric demand.

These results follow a very similar trend as seen in the model with no daylighting and no shades (Figure 11) with slightly increase energy savings across all cases.

We expected to see the 'Spectrally Selective' film perform better than 'traditional tint' film, with daylighting on. However, on further analysis we found that daylighting saturates in almost all cases - since there are no window shades in the model. This means that the impact of higher VT on daylighting, that the 'Spectrally Selective' films offer, is not "seen" in these results.

While these savings values are a theoretical maximum for window films, a building with no window shades/blinds is not a very realistic case. Most buildings have window shades or blinds, which are expected to interact with the savings from window films.

Climate Zone 13

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.47	--	20.19	--	3.70	--	36.79	--	18.51	--	3.73	--	33.72	--	15.44	--	3.37	--
Traditional Tint Film	37.75	1.9%	19.47	3.6%	3.57	3.6%	37.49	-1.9%	19.21	-3.8%	3.86	-3.5%	35.12	-4.1%	16.84	-9.0%	3.63	-7.6%
Spectrally Selective Film	37.50	2.5%	19.22	4.8%	3.52	4.8%	36.77	0.0%	18.49	0.1%	3.70	0.6%	33.87	-0.4%	15.59	-1.0%	3.39	-0.5%
Low-e Film	35.14	8.7%	16.86	16.5%	3.30	10.9%	35.30	4.0%	17.02	8.0%	3.55	4.7%	34.05	-1.0%	15.77	-2.1%	3.50	-3.7%
Spectrally Selective + Low-e Film	33.92	11.8%	15.64	22.5%	3.27	11.7%	34.17	7.1%	15.89	14.1%	3.43	7.8%	33.49	0.7%	15.21	1.5%	3.44	-1.8%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.43	--	20.15	--	3.66	--	35.87	--	17.59	--	3.57	--	34.07	--	15.79	--	3.42	--
Traditional Tint Film	38.75	-0.8%	20.47	-1.6%	3.73	-2.0%	37.28	-3.9%	19.00	-8.0%	3.82	-6.8%	35.90	-5.4%	17.62	-11.6%	3.73	-9.0%
Spectrally Selective Film	37.81	1.6%	19.53	3.0%	3.57	2.4%	36.02	-0.4%	17.74	-0.9%	3.61	-1.1%	34.45	-1.1%	16.17	-2.4%	3.50	-2.5%
Low-e Film	36.38	5.3%	18.10	10.1%	3.53	3.4%	35.68	0.5%	17.40	1.1%	3.62	-1.3%	34.75	-2.0%	16.47	-4.3%	3.58	-4.8%
Spectrally Selective + Low-e Film	34.72	9.6%	16.44	18.4%	3.44	6.0%	34.49	3.8%	16.21	7.8%	3.52	1.4%	33.94	0.4%	15.66	0.8%	3.50	-2.5%

FIGURE 14: RESULTS BY CLIMATE ZONE - CZ13, DAYLIGHTING ON, WITH WINDOW SHADES, 66% GROSS-WWR, COMPARING ACROSS BASE WINDOWS

Figure 14 provides results for all six base windows and the four window film types for climate zone 13, with daylighting controls i.e. Daylighting is ON, and the model HAS window shades. The gross WWR for the medium office building is 66%.

The results show that with window shades, 'single pane clear' windows can achieve as much as 11.8% savings in energy use, 22.5% savings in HVAC energy use, and up to 11.7% reduction in peak electric demand when compared to no window films case. Results for the single pane window are lower than the result in Figure 12, these runs represent a more realistic case of a

building with operated window shades. Details about the way window shades have been modeled, and a note of accuracy of results from the shades model in EnergyPlus is provided in the Simulation Methodology section.

The savings were slightly lower for 'single pane tinted' and 'double pane clear' windows, and noticeably lower for 'double pane tinted'. The savings were significantly lower for 'double pane low-e' clear and tinted windows, with most window films resulting in negative savings (or increase in energy use) and a maximum of 0.7% savings in energy use, 1.5% savings in HVAC energy use, and an increase in peak electric demand.

In general the 'low-e film' and 'spectrally selective + low-e' film perform better than the 'traditional tint' film. With automatic daylighting controls, and window shades, the energy savings driver is no longer the SHGC. Lighting energy use is now a significant part of the whole building energy use, and so the 'spectrally selective' film has a better performance than the 'traditional tint' film.

The best whole building energy savings were from the 'spectrally selective + low-e' window film, regardless of base window.

With 'double-pane low-e' base window, the choice of window film becomes extremely significant. The results indicate that adding almost any window film to a 'double-pane low-e' base window may increase energy use in the building. We expect this to be due to interaction of the window shades layer with the window film layer and the low-e coating in the base window.

Impact of Type of Base Window

In Climate Zone 13, in all cases, whole building energy use was the lowest in the buildings with 'double pane low-e' windows. In almost all cases, the highest whole building energy use was seen in the buildings with 'single pane clear' windows. The only exceptions occurred in buildings with the 'low-e' film or the 'spectrally selective + low-e' film. When these films are applied, buildings with 'double pane' windows used slighting more energy than the buildings with 'single' pane windows. Here, the decrease in heating energy use is outweighed by the increase in cooling and lighting energy.

Overall, single pane clear windows have the greatest savings from window films. Double pane clear windows show slightly lower savings compared to single pane clear. In general window films are expected to have a very minor impact on double pane low-e windows. Only low-e film, and spectrally selective + low-e films can provide some savings, which may not persist when operable window shades are considered.

Impact of Type of Window Film

In all buildings with 'single pane' windows, applying any window film resulted in lower whole building energy use as compared to the base case with no film. For the 'double pane' window buildings, in almost all cases, the base case building with no film had the highest whole building energy use. The only exception occurred in a building with daylighting and window shades. Here, applying a 'traditional tint' film resulted in slightly higher energy use and the 'spectrally selective' film resulted in no energy savings. However, in this case the 'low-e' film and the 'spectrally selective + low-e' films both resulted in overall energy savings. In general, both of these films outperformed the 'traditional tint' film and the 'spectrally selective' film, resulting in significantly higher whole building energy use savings and peak electric demand reduction.

Impact of Window Blinds/Shades

Simulation results show that operable window shades can significantly impact savings from window films. In Climate Zone 13, in all cases, installing operable roller shades resulted in decreased whole building energy use and peak electrical demand. Since the buildings are all using less energy to start with, installing windows films in combination with shades results in lower energy savings from window films.

Impact of Daylighting Controls

Turning on daylighting decreases energy use for all cases. With daylighting on and no operable shades, relative savings due to window films increase and resulted in lower whole building energy use and peak electric demand in all cases.

However, when shades are modeled with daylighting control, there was a decrease in the percent savings. For 'single pane' windows with daylighting control and shades, all films resulted in lower whole building energy use and peak electric demand. In contrast, when the same films were installed on 'double pane low-e' windows, installing any film resulted in an increase in the peak electric demand. And only the 'spectrally selective + low-e' film resulted in lower whole building energy use, with minor savings of 0.7%.

Daylighting controls played an important role in increase the relative savings from 'spectrally selective' films compared to 'traditional tint' film. In most cases, 'traditional tint' outperforms 'spectrally selective' film, due to its lower SHGC. However, with daylighting controls, and importantly window shades, lighting energy savings begin to play a significant role in the whole building energy use. In this case, 'spectrally selective' film has higher performance than 'traditional tint'.

Impact of Climate Zone

In the previous sections, we looked at the impact of a variety of variables in Climate Zone 13. However, we also wanted to understand how these variables affected energy use and demand across climate zones. Figure 15, Figure 16, and Figure 17 show the results for whole building energy use and peak electric demand for 'single pane clear', 'double pane clear', and 'double pane low-e' windows, respectively. These results are for buildings with 66% WWR, shades, and no daylighting in Climates Zones 2, 3, 4, 11, 12, and 13.

Base Window **Single Pane Clear**

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	CZ 2						CZ 3						CZ 4					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.80	--	19.53	--	4.00	--	34.98	--	16.71	--	3.56	--	37.80	--	19.53	--	3.87	--
Traditional Tint Film	37.31	1.3%	19.04	2.5%	3.74	6.5%	34.25	2.1%	15.98	4.4%	3.15	11.5%	36.71	2.9%	18.43	5.6%	3.62	6.3%
Spectrally Selective Film	37.40	1.1%	19.12	2.1%	3.83	4.2%	34.43	1.6%	16.16	3.3%	3.25	8.7%	37.00	2.1%	18.72	4.1%	3.71	4.1%
Low-e Film	34.88	7.7%	16.61	15.0%	3.53	11.9%	32.51	7.1%	14.24	14.8%	3.00	15.9%	34.67	8.3%	16.39	16.0%	3.42	11.4%
Spectrally Selective + Low-e Film	33.63	11.0%	15.36	21.4%	3.49	12.7%	31.83	9.0%	13.56	18.9%	3.06	14.0%	33.92	10.3%	15.64	19.9%	3.44	11.1%

	CZ 11						CZ 12						CZ 13					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	41.55	--	23.27	--	4.15	--	39.65	--	21.37	--	4.09	--	41.53	--	23.24	--	4.16	--
Traditional Tint Film	40.49	2.5%	22.21	4.5%	3.87	6.7%	38.58	2.7%	20.30	5.0%	3.82	6.6%	40.04	3.6%	21.76	6.4%	3.88	6.6%
Spectrally Selective Film	40.74	1.9%	22.46	3.5%	3.97	4.4%	38.85	2.0%	20.57	3.7%	3.91	4.3%	40.47	2.5%	22.19	4.5%	3.98	4.3%
Low-e Film	37.52	9.7%	19.25	17.3%	3.65	12.1%	36.15	8.8%	17.87	16.4%	3.61	11.8%	37.58	9.5%	19.30	17.0%	3.67	11.8%
Spectrally Selective + Low-e Film	35.99	13.4%	17.71	23.9%	3.65	12.1%	35.02	11.7%	16.74	21.7%	3.61	11.7%	36.59	11.9%	18.31	21.2%	3.68	11.5%

FIGURE 15: RESULTS BY BASE WINDOW - SINGLE PANE CLEAR, DAYLIGHTING OFF, WITH WINDOW SHADES, 66% GROSS-WWR, COMPARING ACROSS CLIMATE ZONES

As seen in Figure 15, installing any window film on a single pane clear window results in lower whole building energy use and peak electric demand in all six climate zones, as compared to the base case building. The 'low-e' film and the 'spectrally selective+ low-e' film resulted in significantly higher savings when compared to the 'traditional tint' film and the 'spectrally selective' film. The difference in percent energy and demand savings between inland climates and coastal climates with a single pane window was small.

Base Window Double Pane Clear

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	CZ 2						CZ 3						CZ 4					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.57	--	17.30	--	4.04	--	33.82	--	15.55	--	3.66	--	36.49	--	18.22	--	3.89	--
Traditional Tint Film	35.55	0.0%	17.28	0.1%	3.97	1.6%	33.75	0.2%	15.47	0.5%	3.55	3.0%	36.31	0.5%	18.03	1.0%	3.84	1.3%
Spectrally Selective Film	35.63	-0.2%	17.36	-0.4%	4.01	0.8%	33.84	-0.1%	15.57	-0.1%	3.61	1.2%	36.45	0.1%	18.18	0.2%	3.87	0.6%
Low-e Film	34.14	4.0%	15.87	8.2%	3.73	7.7%	32.52	3.8%	14.25	8.4%	3.34	8.8%	34.80	4.6%	16.53	9.3%	3.61	7.1%
Spectrally Selective + Low-e Film	33.49	5.9%	15.21	12.0%	3.62	10.4%	32.07	5.2%	13.80	11.3%	3.27	10.6%	34.26	6.1%	15.98	12.3%	3.56	8.4%

	CZ 11						CZ 12						CZ 13					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.75	--	20.47	--	4.17	--	37.71	--	19.43	--	4.12	--	39.93	--	21.65	--	4.19	--
Traditional Tint Film	38.64	0.3%	20.36	0.5%	4.12	1.4%	37.57	0.4%	19.29	0.7%	4.06	1.4%	39.68	0.6%	21.40	1.1%	4.13	1.4%
Spectrally Selective Film	38.76	-0.0%	20.48	-0.0%	4.15	0.6%	37.70	0.0%	19.43	0.0%	4.09	0.6%	39.86	0.2%	21.58	0.3%	4.17	0.6%
Low-e Film	36.75	5.2%	18.47	9.8%	3.86	7.5%	35.87	4.9%	17.59	9.5%	3.81	7.4%	37.76	5.4%	19.48	10.0%	3.88	7.5%
Spectrally Selective + Low-e Film	35.84	7.5%	17.56	14.2%	3.79	9.2%	35.11	6.9%	16.83	13.4%	3.75	8.9%	36.93	7.5%	18.65	13.9%	3.82	8.7%

FIGURE 16: RESULTS BY BASE WINDOW - DOUBLE PANE CLEAR, DAYLIGHTING OFF, WITH WINDOW SHADES, 66% GROSS-WWR, COMPARING ACROSS CLIMATE ZONES

For the buildings with 'double pane clear' windows, shown in Figure 16, again the 'low-e' film and the 'spectrally selective+low-e' film always resulted in lower whole building energy use and peak electric demand, although the savings are lower than those seen in the 'single pane' window cases. For the 'traditional tint' film and the 'spectrally selective' film, the savings were generally small. The difference in percent energy and demand savings between inland climates and coastal climates with a single pane window was small.

Base Window **Double Pane Low-e Clear**

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	CZ 2						CZ 3						CZ 4					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.26	--	14.99	--	3.67	--	30.77	--	12.50	--	3.30	--	32.66	--	14.39	--	3.57	--
Traditional Tint Film	33.38	-0.3%	15.10	-0.8%	3.68	-0.2%	30.80	-0.1%	12.52	-0.2%	3.31	-0.1%	32.68	-0.0%	14.40	-0.1%	3.58	-0.3%
Spectrally Selective Film	33.34	-0.2%	15.06	-0.5%	3.68	-0.1%	30.79	-0.0%	12.51	-0.1%	3.30	0.1%	32.66	-0.0%	14.39	-0.0%	3.57	-0.2%
Low-e Film	32.86	1.2%	14.58	2.7%	3.53	4.0%	30.62	0.5%	12.35	1.2%	3.21	2.7%	32.45	0.6%	14.18	1.5%	3.50	1.8%
Spectrally Selective + Low-e Film	32.47	2.4%	14.20	5.2%	3.36	8.6%	30.54	0.8%	12.27	1.9%	3.15	4.8%	32.33	1.0%	14.05	2.3%	3.43	3.9%

	CZ 11						CZ 12						CZ 13					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.62	--	17.34	--	3.80	--	34.94	--	16.66	--	3.76	--	36.85	--	18.57	--	3.83	--
Traditional Tint Film	35.75	-0.4%	17.47	-0.8%	3.81	-0.2%	35.06	-0.3%	16.78	-0.7%	3.77	-0.3%	36.95	-0.3%	18.67	-0.6%	3.84	-0.3%
Spectrally Selective Film	35.70	-0.2%	17.42	-0.5%	3.80	-0.1%	35.01	-0.2%	16.73	-0.4%	3.76	-0.2%	36.91	-0.2%	18.63	-0.3%	3.84	-0.2%
Low-e Film	35.01	1.7%	16.74	3.5%	3.72	2.2%	34.38	1.6%	16.11	3.3%	3.68	2.0%	36.15	1.9%	17.87	3.7%	3.75	2.0%
Spectrally Selective + Low-e Film	34.44	3.3%	16.16	6.8%	3.63	4.6%	33.89	3.0%	15.61	6.3%	3.63	3.3%	35.57	3.5%	17.29	6.9%	3.70	3.4%

FIGURE 17: RESULTS BY BASE WINDOW - DOUBLE PANE LOW-E CLEAR, DAYLIGHTING OFF, WITH WINDOW SHADES, 66% GROSS-WWR, COMPARING ACROSS CLIMATE ZONES

Figure 17 shows the results for buildings with 'double pane low-e clear' windows. Installing 'low-e' film and 'spectrally selective+ low-e' film always resulted in lower whole building energy use and peak electric demand. Whole building energy savings in these cases ranged from 0.5% in CZ 3 to 3.5% in CZ13. In contrast, for the same films installed on 'single pane clear' windows, the whole building energy savings ranged from 7.1% in CZ3 to 13.4% in CZ 11. It should also be noted that installing either the 'traditional tint' film or the 'spectrally selective' film on double pane low-e windows resulted in an increase in whole building energy use and peak electric demand for all six climate zones. With double pane low-e windows, the difference between inland and coastal climate zones becomes noticeable.

RECOMMENDATIONS

Recommendations will be deferred will be deferred until the Phase 2 report, to be completed by December 31st 2013. Phase 2 study will include filed evaluations and analysis which are expected to provide a more in-depth analysis of savings from window films as found in on-site evaluations.

Recommendations in Phase 2 report will be on how PG&E could continue product development for this technology. These may include:

- Revision of existing incentives and development of new incentives, including
  - Product requirements (climate zone, optical and thermal properties, warranty, etc.)
  - Customer/project eligibility criteria
  - Calculation methods for Deemed and Customized Retrofit incentives
  - Inspection methods
- Target customers by location, building type, customer segment, or other attributes
- Bundling opportunities with other energy efficiency measures
- Needs/opportunities for codes and standards development
- Important decision-making information that should be provided to customers

APPENDICES

MARKET ACTOR SURVEY INSTRUMENT

PG&E Window Film Assessment - Market Players Interview Guide

General

Date			
Manufacturer			
HMG Interviewer			
Interviewee		**Position**	

Are you someone with knowledge about your product line of window films?	
If no, who would be a good person to talk to in your company?	

Describe the PG&E study - explain that we are collecting information to help PG&E determine a better incentive for window films. Tell them we are very interested the window films world.

Product Information

Which are your top three products for commercial applications?

	Product Name	**Reason**
Product 1		
Product 2		
Product 3		

Which are your top three products for residential applications?

	Product Name	**Reason**
Product 1		
Product 2		
Product 3		

In your product line, how many are low-e and spectrally selective films?	
How many are other category?	

How do you define low-e and Spectrally Selective? What is your criteria?	
Can you list your low-e and Spectrally Selective products?(ask if they would rather send an email)	
How long have your low-e and Spectrally Selective products been on the market?	
Who do you typically sell these (low-e and SS) films to?	

Other

What are some of the motivations for installing window film?
(Check all that apply)

PG&E Rebate	☐	
Energy Savings	☐	
Aesthetics	☐	
Thermal Comfort	☐	
Visual Comfort	☐	
Other	☐ Describe:	

Do you sell other energy efficiency products besides window films, as options for customers that want more energy savings? If yes, how do you promote window films over these other EE products?

How do you typically reach out to potential building owners?	
What is the typical warranty period for window films you sell? If it ranges by product, get a range	
What is the procedure to uninstall window films if a client is unsatisfied?	
What research has been done to support your products energy savings claims? Ask for testing procedures	

Can you give us a range of cost for the following three types of window films?
Cost in $/sf of product - without bulk discount and without cost of labor - within PG&E territory (say SF)

Low-E	
Spectrally Selective	
Other	

NFRC CPD Analysis Graphs

Solar Heat Gain Coefficient (SHGC)

In the scatter plot shown in Figure 18 below, SHGC values for all products in the NFRC CPD (n=286) plotted in blue. Also, on the same graph are all low-e films (n=9) plotted in red, and spectrally selective films (n=24) plotted in green. The base window here is single pane clear 3mm. Its SHGC is shown with a line on the scatter plot. The graph at the bottom of Figure 18 shows the same data as a histogram. Higher bars mean more products fall in the bins of SHGC on the x-axis. The graphs shows a large concentration of the low-e products in the low 0.1 – 0.2 SHGC ranges, while the spectrally selective films products are more concentrated in the slightly higher 0.3 -0.4 SHGC range. Most window film fall in the 0.2 – 0.5 SHGC range.

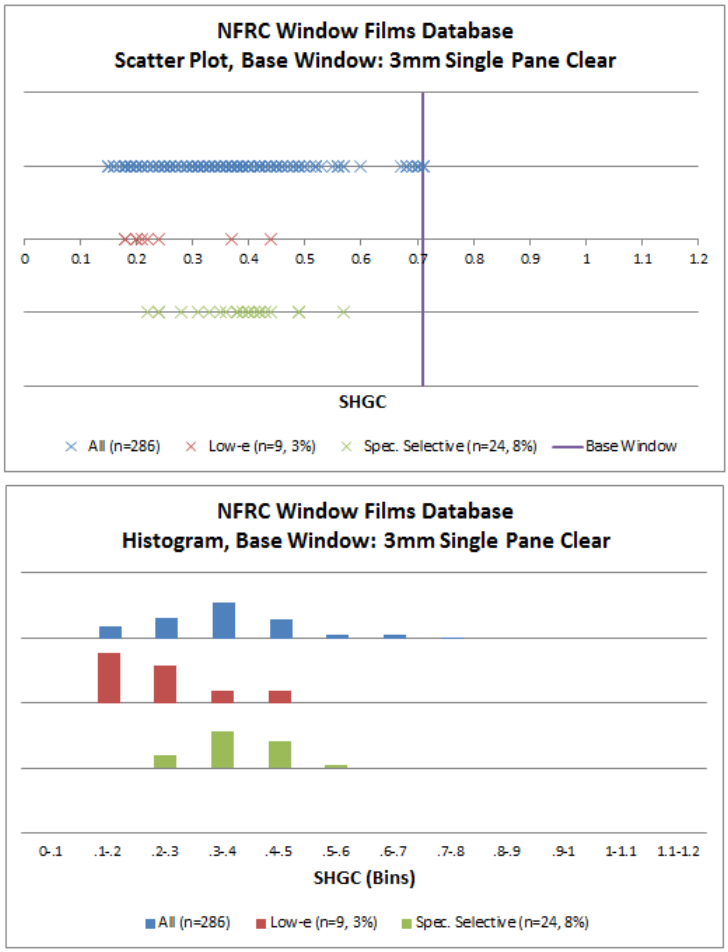


Figure 18: NFRC Window Films Database SHGC Distribution, 3mm (1/8in.) Clear

Visible Transmittance

In the scatter plot shown in Figure 19 below, VT values for all products in the NFRC CPD (n=286) plotted in blue. Also, on the same graph are all low-e films (n=9) plotted in red, and spectrally selective films (n=24) plotted in green. The base window here is single pane

clear 3mm. Its VT is shown with a line on the scatter plot. The graph at the bottom shows the same data as a histogram. Higher bars mean more products fall in the bins of VT on the x-axis. The graphs shows most low-e products fall in the 0.1 - 0.3 VT range, while the spectrally selective films products are more concentrated in the higher 0.5 -0.7 VT range. Another observation from the graph is the most window films tend to be darker in the 0.1 - 0.4 range.

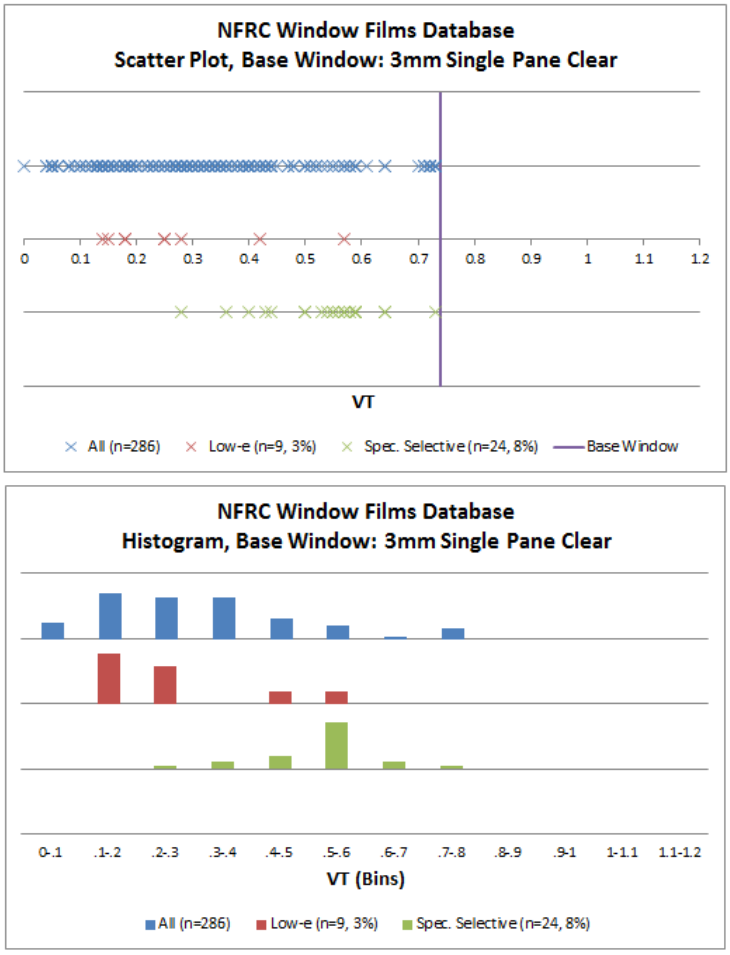


FIGURE 19: NFRC WINDOW FILMS DATABASE VT DISTRIBUTION, 3MM (1/8IN.) CLEAR

U-FACTOR

In the scatter plot shown in Figure 20 below, U-factor values all products in the NFRC CPD (n=211) are plotted in blue. The total number of entries for u-factor is lower for U-factor because at least one window film manufacturer does not have U-factor values for their products, which accounts for the missing 75 products. Also, on the same graph are all low-e films (n=9) plotted in red, and spectrally selective films (n=21) plotted in green. The graph at the bottom shows the same data as a histogram. Higher bars mean more products fall in the bins of U-factor on the x-axis. The graphs shows most low-e products fall in the 0.7 - 0.9 U-factor range, while the spectrally selective films products are more concentrated in the higher 0.9 -1.1 U-factor range. Another observation from the graph is the most window films tend to in the higher 1.0 – 1.2 range.

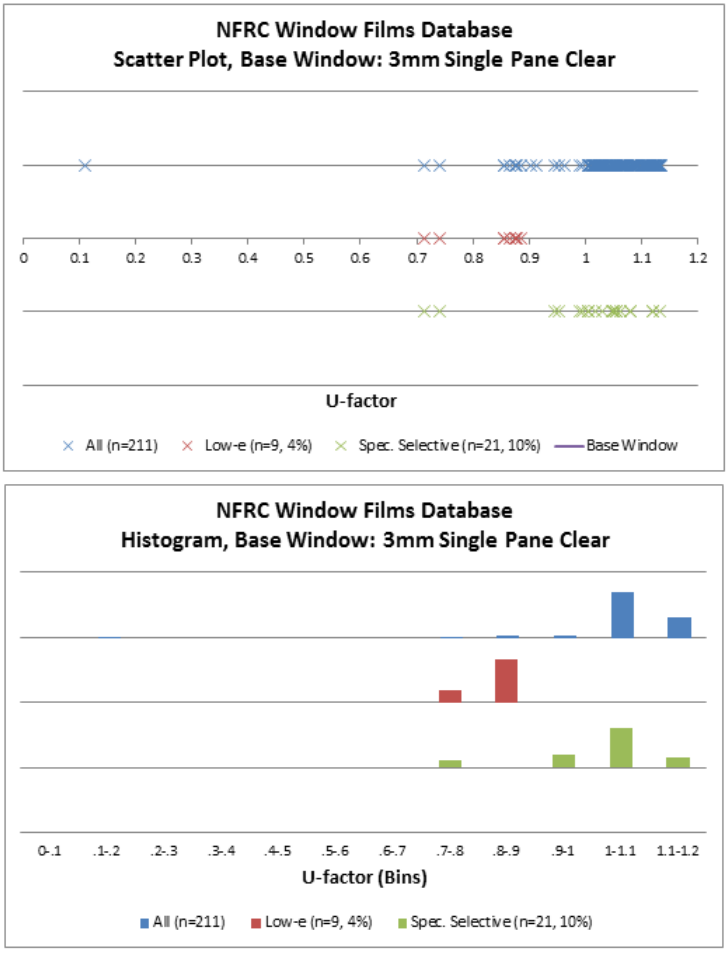


FIGURE 20: NFRC WINDOW FILMS DATABASE U-FACTOR DISTRIBUTION, 3MM (1/8N.) CLEAR

DOE WINDOW FILMS FACT SHEET

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Window Retrofit Option
Surface-Applied Window Films

Description

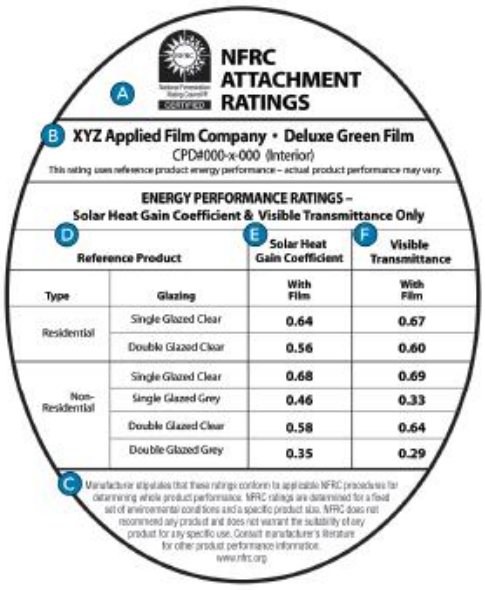
State-of-the-art surface-applied window films are designed to improve window performance by rejecting temperature increases from sunlight (solar heat gain), protecting against glare and ultraviolet (UV) exposure, offering a wide range of choices in the amount of light transmitted through the window (visible transmittance or VT), and in a few cases, increasing thermal insulation. Window films typically cannot be adjusted or readily removed. Because of the range of film types, there are products that are useful in almost every climate and for every window application.

Window films can be professionally applied by a skilled installer or are available for do-it-yourself projects at home improvement stores. Films are typically about 2–7 mils thick (50–175 microns) and come on rolls 36 to 72 inches (1–2 meters) wide. Films have a minimum of three layers: a pressure-sensitive or water-activated clear adhesive layer (against the glass), a polyester film layer, and a scratch-resistant coating. Films for safety/security function will be substantially thicker. A variety of other technologies that tune the film for different performance properties can be added to this basic configuration: tints, low-emissivity (low-e) coatings, and UV radiation blockers. Spectrally selective low-e coatings are preferred because they block some portions of the sunlight spectrum to reduce unwanted solar heat gain while allowing other portions of the spectrum to pass through the window, which maintains

Surface-applied window films can be installed by do-it-yourselfers, but professional installation is recommended. After thorough and specialized cleaning, the installer will apply a solution to the window surface prior to rolling and squeegeeing the film.

Photo: Solutia Performance Films

NFRC's Window Film Energy Performance Label



A This mark indicates that the product's energy performance has been rated and certified in accordance with NFRC's certification process.

B This area is reserved for the name of the manufacturer and the product.

C This space provides details about NFRC's rating procedures.

D Consumers, building officials and others should use the information in the **Reference Product** columns to choose the glazing system that most closely matches the product on which the film is applied.

E **Solar Heat Gain Coefficient** (SHGC) measures how well a product blocks heat from the sun. SHGC is expressed as a number between 0 and 1. The lower the SGHC, the better a product is at blocking heat gain. Blocking solar heat gain is particularly important during the summer cooling season and in southern climates.

F **Visible Transmittance** (VT) measures how much light comes through a product. VT is expressed as a number between 0 and 1. The higher the VT, the higher the potential for daylighting.

visibility. Some films absorb, rather than reflect, solar radiation. This reduces their effectiveness because the absorbed energy will heat the glazing surface and a portion of that energy will be transferred into the room. If the film is applied to the interior side of a window, this residual heat will be greater, negatively affecting the comfort for those in the room.

Rapidly developing window film technologies include low-e, thermo-chromic (changing transmittance with temperature), and electro-chromic (changing transmittance with an electric current) window films.

Overall Thermal Performance

For a specific application, users can assess the amount of solar heat gain through a window with film based on the solar heat gain coefficient (SHGC) and visible transmittance (VT) rating listed on the film's *National Fenestration Rating Council* (NFRC) label (see page 1). Window films were the first—and so far only—window attachment option to be rated by the NFRC.

When To Consider

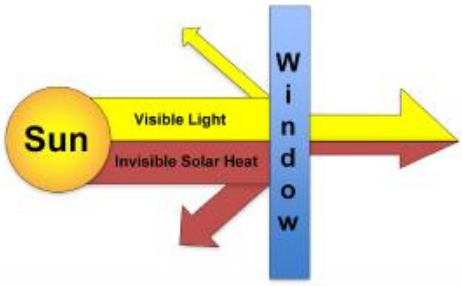
- Solar gain through existing window results in overheating or uncomfortable glare.
- Homeowner does not want to block key views with awnings or other window attachments that interfere with view.
- Home has large areas of glass that would be prohibitively expensive and/or awkward to replace or treat with other retrofits such as storm windows or insulating blinds.
- Homeowner is concerned about UV fading of artwork and furnishings near windows.

The window on the left has no film; the window on the right does. How much a film alters the appearance of the window (inside and out) depends on a number of variables and is difficult to generalize because there are currently so many different films.

Photo: Solutia Performance Films

Terminology

Spectrally selective means transparent to some wavelengths of the solar spectrum and reflective to others. Typical spectrally selective coatings are transparent to visible light and reflect short-wave and long-wave infrared as well as UV radiation. Spectral selectivity can be achieved with low-e coatings and/or high-performance tints.



Graphic: LBNL

Where to use

- Sunny, clear-sky climates: medium to low SHGC and VT films
- Non low-e products: climates with moderate to significant cooling requirements
- Low-e products: all locations

When to consider this retrofit—Ownership

x	Homeowner
	Apartment Renter – Long Term
	Apartment Renter – Short Term
x	Live in a Condo*
x	Live in a Historical District*

* Condominium regulations or historic building codes may require the use of higher-VT and lower-reflectance window films that maintain appearance from the outside.

When to consider this retrofit—Window conditions

x	Existing window single-glazed
x	Existing window double-glazed, no low-e*
x	Existing window double-glazed with low-e

* Applying a non-low-e surface film to a low-e window makes the most sense

Key Benefits

- Reduce solar heat gain through windows (many different films are available with widely varying solar heat gain rejection properties)
- Reduce heat loss when low-e coating is applied as the innermost exposed layer of the film
- Reduce glare and eye strain (some films are designed specifically for these benefits)
- Block UV very effectively (95-99.9%)
- Provide privacy (films with high reflectance or "mirroring")
- Enhance security and safety (some films designed specifically for these benefits)
- No operation or maintenance

Key Drawbacks

- Undesirable interior "mirroring" with interior films that have high reflectance
- Reduce winter solar heat gain (in heating-dominated climates)
- Increase condensation potential when low-e coating is the innermost exposed layer of the film
- Higher-absorbing films will reduce energy savings and decrease comfort
- Do not reduce air leakage
- May increase need for electric lighting (films with lower VT)
- Once installed, require special procedures and release agents to remove (should be done by professionals only)

Aesthetics

- Darkening of windows (degree of darkening dependent on product; higher-VT films result in almost no change in light transmitted)

Tips/Cautions

- Look for an NFRC rating label for solar heat gain coefficient (SHGC) and visible transmittance (VT); manufacturers can provide other performance data, such as UV blockage, U-factor (indicates rate of heat loss), glare reduction, and security functions.
- Look for transferable lifetime warranty.
- Having a professional install or remove film is recommended.
- High-VT films and some films with spectrally selective low-e coatings result in minimal change in transparency or appearance.

Recommended Installer

x	Do it Yourself
	Carpenter
x	Manufacturer or supplier

Once applied, films are treated and maintained just like the original glass. Today's state-of-the-art films are more scratch and UV-resistant.

Photo: Solutia Performance Films

Complementary Options

Compatible with any window attachment but work best with:

- Exterior storm windows
- Window unit air sealing

Operation

None

Considerations

	1	2	3	4	5
Ease of Installation (1 = easier)			x	x (DIY)	
Availability (1 = more available)	x (DIY)		x		
Cost Details (1= lower cost)	x (DIY)	x			

Average Total Cost for 30- by 60-inch window	
Do it Yourself	$10
Standard solar control	$80
Spectrally-selective	$125

Digging Deeper

Energy Modeling Tools for Professionals

x	*RESFEN*
x	*EnergyPlus-based modeling tools*
x	*WINDOW 6*
x	Other: Manufacturer web-based calculators; look for evidence that such calculators are effective, such as endorsement by Lawrence Berkeley National Laboratory

High performance surface-applied film in production being inspected for defects. Note the series of lamps that help in assessing film quality.

Photo: Solutia Performance Films

References

"Measuring the Savings from Energy-control Window Film Installations Using IPMVP Options C and D"

To find window films, use this internet search term: surface applied window film

For more information visit: ***www.windowattachments.org***

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NFRC WINDOW FILMS FACT SHEET

NFRC's Window Film Certification and Labeling Program

Window film manufacturers may certify their products' energy performance ratings according to the National Fenestration Rating Council (NFRC) certification process. NFRC's certification program provides an independent, third-party verification of window film performance so consumers can compare products and make informed choices based on their individual energy performance needs.

Film Certification Benefits

- Increased credibility for the manufacturer and increased value to the consumer.
- Demonstrated commitment by window film manufacturers to verify product energy performance.
- A level playing field for manufacturers, whether large or small, to demonstrate their products' certified energy performance ratings.

NFRC's Certification Process

To earn NFRC certification, each participating manufacturer must follow the process outlined in NFRC's certification documents. Briefly, the process is as follows:

1 The film manufacturer contacts NFRC and requests certification authorization of its product(s).

2 NFRC sends a packet of information to the manufacturer, including an NFRC Applied Film Manufacturer License Agreement. The license agreement and associated documents must be signed and returned to NFRC before certification authorization may be generated.

3 The manufacturer must submit their film's optical properties for acceptance in the International Glazing Database (IGDB hosted by Lawrence Berkeley National Labs at UC-Berkeley) according to NFRC's Verification Program for Optical Spectral Data (NFRC 302).

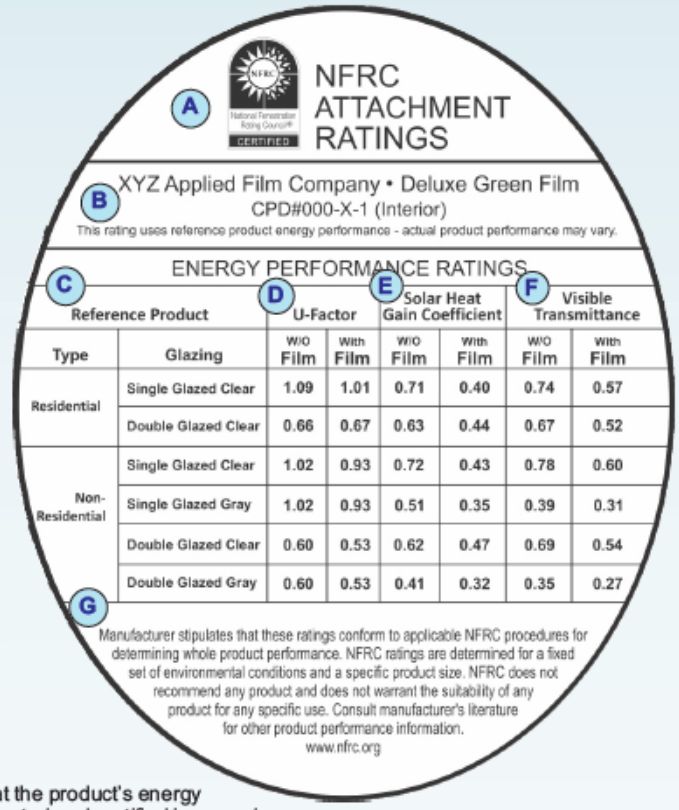
4 The manufacturer contacts and chooses an NFRC-accredited simulation laboratory. The laboratory determines the product's energy performance ratings by using the optical properties from the IGDB for computer simulation.

5 The manufacturer selects an NFRC licensed Certification and Inspection Agency (IA) to review the simulation results for accuracy and to conduct an in-plant inspection of the film manufacturer. Once the IA has determined that all certification requirements have been met, it generates a Certification Authorization Report (CAR) and uploads this information into the NFRC Certified Product Directory (CPD). The manufacturer may now place these approved performance rating values on NFRC labelsCertification authorization is valid for four years and may be renewed.

For more information

NFRC has additional information for window film manufacturers on its website at www.nfrc.org. The site includes the NFRC Certified Products Directory. If you need further information, please contact our offices at 301-589-1776.

NFRC's Window Film Energy Performance Label



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B This area is reserved for the name of the manufacturer and the product.

C Consumers, building officials, and others should use the information in the **Reference Product** columns to choose the glazing system that most closely matches the product on which the film is applied.

D **U-factor** measures how well a product prevents heat from escaping a home or building. U-factor ratings generally fall between 0.20 and 1.20. The lower the U-factor, the better a product is at keeping heat in. U-factor is particularly important during the winter heating season. This label displays U-factor in U.S. units. Labels on products sold in markets outside the United States may display U-factor in metric units.

E **Solar Heat Gain Coefficient** (SHGC) measures how well a product blocks heat from the sun. SHGC is expressed as a number between 0 and 1. The lower the SHGC, the better a product is at blocking heat gain. Blocking solar heat gain is particularly important during the summer cooling season and in Southern climates.

F **Visible Transmittance** (VT) measures how much light comes through a product. VT is expressed as a number between 0 and 1. The higher the VT, the higher the potential for daylighting.

G This space provides details about NFRC's rating procedures.

NFRC administers an independent, uniform rating and labeling system for the energy performance of fenestration products, including windows, curtain walls, doors, and skylights.

For more information on NFRC, please visit our Website at www.nfrc.org or contact NFRC directly at 301.589.1776.

SIMULATION RUN RESULTS

WINDOW TO WALL RATIO: 66%

Climate Zone 1
Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.79	--	18.52	--	4.12	--	33.75	--	15.48	--	4.01	--	30.74	--	12.47	--	3.32	--
Traditional Tint Film	35.63	3.2%	17.35	6.3%	3.28	20.5%	33.09	2.0%	14.81	4.3%	3.65	8.9%	30.74	0.0%	12.47	0.0%	3.28	1.3%
Spectrally Selective Film	35.66	3.1%	17.39	6.1%	3.50	15.1%	33.21	1.6%	14.93	3.5%	3.73	7.0%	30.73	0.1%	12.45	0.1%	3.29	1.1%
Low-e Film	33.19	9.8%	14.91	19.5%	2.94	28.6%	31.97	5.3%	13.70	11.5%	3.33	16.9%	30.55	0.6%	12.27	1.6%	3.15	5.0%
Spectrally Selective + Low-e Film	31.73	13.8%	13.45	27.3%	3.13	24.0%	31.58	6.4%	13.31	14.0%	3.35	16.4%	30.50	0.8%	12.22	2.0%	3.14	5.5%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.16	--	14.89	--	3.32	--	30.95	--	12.68	--	3.24	--	30.00	--	11.72	--	3.13	--
Traditional Tint Film	32.93	0.7%	14.65	1.6%	2.99	9.9%	30.82	0.4%	12.55	1.1%	3.13	3.4%	29.96	0.1%	11.69	0.3%	3.05	2.6%
Spectrally Selective Film	32.89	0.8%	14.61	1.8%	3.13	5.9%	30.85	0.3%	12.58	0.8%	3.17	2.2%	29.98	0.1%	11.70	0.1%	3.09	1.3%
Low-e Film	31.65	4.6%	13.38	10.2%	2.87	13.5%	30.44	1.7%	12.17	4.0%	3.03	6.4%	29.80	0.6%	11.53	1.6%	2.99	4.4%
Spectrally Selective + Low-e Film	30.79	7.1%	12.52	15.9%	2.97	10.3%	30.24	2.3%	11.97	5.6%	3.03	6.3%	29.79	0.7%	11.52	1.7%	3.00	4.1%

Climate Zone 1

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.41	--	16.13	--	3.30	--	32.10	--	13.82	--	3.44	--	30.36	--	12.09	--	3.13	--
Traditional Tint Film	34.39	0.0%	16.12	0.1%	2.86	13.0%	32.18	-0.3%	13.91	-0.6%	3.33	3.2%	30.47	-0.4%	12.19	-0.9%	3.13	-0.1%
Spectrally Selective Film	34.30	0.3%	16.03	0.7%	3.00	8.7%	32.20	-0.3%	13.93	-0.8%	3.37	2.1%	30.43	-0.2%	12.16	-0.6%	3.13	0.0%
Low-e Film	32.29	6.2%	14.01	13.2%	2.74	16.4%	31.17	2.9%	12.90	6.7%	3.14	8.7%	30.14	0.7%	11.86	1.9%	3.06	2.3%
Spectrally Selective + Low-e Film	31.00	9.9%	12.73	21.1%	2.88	12.5%	30.63	4.6%	12.36	10.6%	3.11	9.5%	29.89	1.6%	11.61	3.9%	2.94	6.0%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.13	--	13.85	--	2.90	--	30.38	--	12.11	--	3.02	--	29.69	--	11.42	--	2.97	--
Traditional Tint Film	32.04	0.3%	13.76	0.6%	2.73	5.8%	30.38	0.0%	12.11	0.0%	2.98	1.3%	29.75	-0.2%	11.48	-0.5%	2.98	-0.2%
Spectrally Selective Film	32.00	0.4%	13.72	0.9%	2.81	3.3%	30.39	-0.0%	12.12	-0.1%	3.00	0.7%	29.73	-0.1%	11.46	-0.4%	2.98	-0.3%
Low-e Film	30.89	3.9%	12.61	8.9%	2.72	6.2%	29.97	1.4%	11.69	3.4%	2.91	3.8%	29.60	0.3%	11.32	0.8%	2.93	1.4%
Spectrally Selective + Low-e Film	30.20	6.0%	11.92	13.9%	2.78	4.5%	29.74	2.1%	11.47	5.3%	2.83	6.6%	29.54	0.5%	11.27	1.3%	2.84	4.4%

Climate Zone 1

Daylighting On (30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	31.86	--	13.58	--	2.83	--	29.36	--	11.09	--	2.97	--	27.67	--	9.39	--	2.66	--
Traditional Tint Film	32.61	-2.4%	14.33	-5.5%	2.49	11.7%	30.41	-3.5%	12.13	-9.4%	3.00	-1.0%	29.02	-4.9%	10.75	-14.4%	2.84	-6.8%
Spectrally Selective Film	31.89	-0.1%	13.61	-0.2%	2.54	10.0%	29.55	-0.6%	11.28	-1.7%	2.92	1.9%	27.85	-0.7%	9.57	-1.9%	2.66	-0.2%
Low-e Film	30.38	4.6%	12.11	10.8%	2.36	16.3%	29.16	0.7%	10.88	1.9%	2.74	7.9%	28.45	-2.8%	10.17	-8.3%	2.68	-0.9%
Spectrally Selective + Low-e Film	28.83	9.5%	10.56	22.3%	2.47	12.8%	28.32	3.6%	10.04	9.4%	2.63	11.4%	28.18	-1.9%	9.91	-5.5%	2.62	1.2%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	30.05	--	11.78	--	2.52	--	28.33	--	10.06	--	2.61	--	27.77	--	9.49	--	2.54	--
Traditional Tint Film	31.36	-4.3%	13.08	-11.1%	2.59	-2.9%	29.86	-5.4%	11.59	-15.2%	2.88	-10.1%	29.26	-5.4%	10.99	-15.7%	2.87	-13.2%
Spectrally Selective Film	30.20	-0.5%	11.92	-1.2%	2.44	3.3%	28.66	-1.1%	10.38	-3.2%	2.65	-1.3%	28.10	-1.2%	9.82	-3.4%	2.63	-3.5%
Low-e Film	30.14	-0.3%	11.87	-0.7%	2.52	-0.2%	29.35	-3.6%	11.08	-10.1%	2.70	-3.2%	29.02	-4.5%	10.74	-13.1%	2.75	-8.4%
Spectrally Selective + Low-e Film	29.27	2.6%	10.99	6.7%	2.51	0.3%	28.89	-2.0%	10.61	-5.5%	2.63	-0.8%	28.71	-3.4%	10.44	-9.9%	2.65	-4.3%

Climate Zone 2

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	41.75	--	23.48	--	4.82	--	38.32	--	20.05	--	4.59	--	34.01	--	15.74	--	3.85	--
Traditional Tint Film	39.29	5.9%	21.02	10.5%	4.14	14.0%	37.06	3.3%	18.79	6.3%	4.28	6.8%	33.91	0.3%	15.64	0.6%	3.80	1.5%
Spectrally Selective Film	39.68	5.0%	21.40	8.8%	4.32	10.3%	37.34	2.5%	19.07	4.9%	4.36	5.0%	33.92	0.3%	15.64	0.6%	3.80	1.3%
Low-e Film	36.24	13.2%	17.97	23.5%	3.77	21.9%	35.39	7.6%	17.12	14.6%	3.95	14.0%	33.53	1.4%	15.25	3.1%	3.69	4.2%
Spectrally Selective + Low-e Film	34.94	16.3%	16.67	29.0%	3.79	21.3%	34.98	8.7%	16.71	16.6%	3.90	15.0%	33.42	1.7%	15.15	3.8%	3.59	6.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	40.72	--	22.44	--	4.54	--	36.56	--	18.29	--	4.23	--	34.32	--	16.04	--	3.91	--
Traditional Tint Film	39.58	2.8%	21.30	5.1%	4.16	8.3%	36.00	1.5%	17.73	3.1%	4.05	4.1%	34.11	0.6%	15.84	1.3%	3.83	2.2%
Spectrally Selective Film	39.71	2.5%	21.44	4.5%	4.26	6.1%	36.16	1.1%	17.88	2.2%	4.11	2.8%	34.21	0.3%	15.94	0.7%	3.87	1.0%
Low-e Film	37.02	9.1%	18.74	16.5%	3.89	14.2%	35.00	4.3%	16.73	8.5%	3.85	8.9%	33.63	2.0%	15.35	4.3%	3.70	5.4%
Spectrally Selective + Low-e Film	35.49	12.8%	17.22	23.3%	3.83	15.7%	34.56	5.5%	16.29	10.9%	3.79	10.3%	33.57	2.2%	15.30	4.6%	3.63	7.2%

Climate Zone 2

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.80	--	19.53	--	4.00	--	35.57	--	17.30	--	4.04	--	33.26	--	14.99	--	3.67	--
Traditional Tint Film	37.31	1.3%	19.04	2.5%	3.74	6.5%	35.55	0.0%	17.28	0.1%	3.97	1.6%	33.38	-0.3%	15.10	-0.8%	3.68	-0.2%
Spectrally Selective Film	37.40	1.1%	19.12	2.1%	3.83	4.2%	35.63	-0.2%	17.36	-0.4%	4.01	0.8%	33.34	-0.2%	15.06	-0.5%	3.68	-0.1%
Low-e Film	34.88	7.7%	16.61	15.0%	3.53	11.9%	34.14	4.0%	15.87	8.2%	3.73	7.7%	32.86	1.2%	14.58	2.7%	3.53	4.0%
Spectrally Selective + Low-e Film	33.63	11.0%	15.36	21.4%	3.49	12.7%	33.49	5.9%	15.21	12.0%	3.62	10.4%	32.47	2.4%	14.20	5.2%	3.36	8.6%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.92	--	19.65	--	3.95	--	34.87	--	16.59	--	3.85	--	33.34	--	15.07	--	3.68	--
Traditional Tint Film	37.50	1.1%	19.23	2.1%	3.76	4.7%	34.81	0.2%	16.54	0.4%	3.80	1.3%	33.51	-0.5%	15.24	-1.1%	3.70	-0.4%
Spectrally Selective Film	37.53	1.0%	19.25	2.0%	3.82	3.2%	34.86	0.0%	16.59	0.1%	3.83	0.6%	33.47	-0.4%	15.20	-0.9%	3.70	-0.5%
Low-e Film	35.24	7.1%	16.97	13.6%	3.59	9.0%	33.80	3.1%	15.53	6.4%	3.64	5.4%	32.91	1.3%	14.64	2.9%	3.53	4.1%
Spectrally Selective + Low-e Film	33.78	10.9%	15.50	21.1%	3.50	11.4%	33.11	5.1%	14.83	10.6%	3.50	9.0%	32.57	2.3%	14.29	5.2%	3.38	8.2%

Climate Zone 2

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.02	--	16.75	--	3.56	--	32.64	--	14.37	--	3.58	--	30.37	--	12.09	--	3.23	--
Traditional Tint Film	35.28	-0.7%	17.01	-1.6%	3.41	4.2%	33.58	-2.9%	15.31	-6.5%	3.68	-2.6%	31.73	-4.5%	13.46	-11.3%	3.40	-5.3%
Spectrally Selective Film	34.72	0.9%	16.44	1.8%	3.39	4.9%	32.77	-0.4%	14.50	-0.9%	3.56	0.6%	30.54	-0.6%	12.27	-1.4%	3.20	0.9%
Low-e Film	32.73	6.5%	14.46	13.7%	3.14	11.9%	31.93	2.2%	13.65	5.0%	3.37	5.8%	30.98	-2.0%	12.70	-5.0%	3.17	1.6%
Spectrally Selective + Low-e Film	31.26	10.7%	12.99	22.4%	3.04	14.7%	30.97	5.1%	12.70	11.6%	3.19	11.1%	30.61	-0.8%	12.34	-2.0%	3.04	5.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.36	--	17.09	--	3.51	--	32.26	--	13.99	--	3.42	--	30.71	--	12.44	--	3.25	--
Traditional Tint Film	36.24	-2.5%	17.97	-5.2%	3.57	-1.8%	33.76	-4.6%	15.49	-10.7%	3.65	-6.7%	32.45	-5.7%	14.18	-14.0%	3.54	-8.8%
Spectrally Selective Film	35.16	0.6%	16.89	1.2%	3.41	2.7%	32.50	-0.8%	14.23	-1.7%	3.44	-0.5%	31.06	-1.1%	12.78	-2.8%	3.27	-0.8%
Low-e Film	33.80	4.4%	15.52	9.2%	3.36	4.2%	32.51	-0.8%	14.24	-1.8%	3.43	-0.2%	31.62	-3.0%	13.35	-7.3%	3.29	-1.4%
Spectrally Selective + Low-e Film	32.05	9.4%	13.77	19.4%	3.17	9.7%	31.52	2.3%	13.24	5.3%	3.18	7.0%	31.00	-0.9%	12.72	-2.3%	3.11	4.3%

Climate Zone 3

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.67	--	20.40	--	4.46	--	36.43	--	18.16	--	4.27	--	31.10	--	12.82	--	3.52	--
Traditional Tint Film	35.93	7.1%	17.66	13.4%	3.63	18.6%	35.11	3.6%	16.84	7.3%	3.91	8.5%	31.03	0.2%	12.76	0.5%	3.43	2.7%
Spectrally Selective Film	36.44	5.8%	18.17	10.9%	3.84	13.9%	35.42	2.8%	17.14	5.6%	4.04	5.4%	31.04	0.2%	12.76	0.5%	3.44	2.3%
Low-e Film	33.61	13.1%	15.33	24.8%	3.22	27.7%	33.60	7.8%	15.33	15.6%	3.53	17.4%	30.86	0.7%	12.59	1.8%	3.30	6.3%
Spectrally Selective + Low-e Film	32.91	14.9%	14.64	28.2%	3.38	24.2%	33.38	8.4%	15.11	16.8%	3.52	17.6%	30.84	0.8%	12.57	2.0%	3.18	9.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.42	--	19.14	--	4.09	--	34.56	--	16.28	--	3.85	--	32.88	--	14.61	--	3.58	--
Traditional Tint Film	36.15	3.4%	17.88	6.6%	3.61	11.9%	33.96	1.7%	15.69	3.7%	3.60	6.5%	32.64	0.7%	14.37	1.6%	3.43	4.2%
Spectrally Selective Film	36.37	2.8%	18.09	5.5%	3.73	8.8%	34.13	1.2%	15.86	2.6%	3.67	4.7%	32.76	0.4%	14.49	0.8%	3.51	2.1%
Low-e Film	34.32	8.3%	16.04	16.2%	3.30	19.4%	33.14	4.1%	14.86	8.7%	3.37	12.5%	32.21	2.1%	13.93	4.6%	3.31	7.5%
Spectrally Selective + Low-e Film	33.31	11.0%	15.04	21.4%	3.27	20.2%	32.88	4.8%	14.61	10.3%	3.31	14.0%	32.21	2.0%	13.94	4.6%	3.24	9.6%

Climate Zone 3

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.98	--	16.71	--	3.56	--	33.82	--	15.55	--	3.66	--	30.77	--	12.50	--	3.30	--
Traditional Tint Film	34.25	2.1%	15.98	4.4%	3.15	11.5%	33.75	0.2%	15.47	0.5%	3.55	3.0%	30.80	-0.1%	12.52	-0.2%	3.31	-0.1%
Spectrally Selective Film	34.43	1.6%	16.16	3.3%	3.25	8.7%	33.84	-0.1%	15.57	-0.1%	3.61	1.2%	30.79	-0.0%	12.51	-0.1%	3.30	0.1%
Low-e Film	32.51	7.1%	14.24	14.8%	3.00	15.9%	32.52	3.8%	14.25	8.4%	3.34	8.8%	30.62	0.5%	12.35	1.2%	3.21	2.7%
Spectrally Selective + Low-e Film	31.83	9.0%	13.56	18.9%	3.06	14.0%	32.07	5.2%	13.80	11.3%	3.27	10.6%	30.54	0.8%	12.27	1.9%	3.15	4.8%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.93	--	16.66	--	3.40	--	33.02	--	14.75	--	3.42	--	31.97	--	13.69	--	3.30	--
Traditional Tint Film	34.40	1.5%	16.13	3.2%	3.14	7.5%	32.94	0.2%	14.67	0.5%	3.33	2.7%	32.12	-0.5%	13.84	-1.1%	3.31	-0.3%
Spectrally Selective Film	34.50	1.2%	16.23	2.6%	3.22	5.2%	33.01	0.0%	14.74	0.1%	3.38	1.2%	32.09	-0.4%	13.82	-0.9%	3.32	-0.5%
Low-e Film	32.84	6.0%	14.56	12.6%	3.04	10.4%	32.12	2.7%	13.85	6.1%	3.16	7.8%	31.59	1.2%	13.32	2.7%	3.20	3.2%
Spectrally Selective + Low-e Film	31.89	8.7%	13.62	18.2%	3.02	11.2%	31.64	4.2%	13.37	9.4%	3.13	8.8%	31.35	1.9%	13.07	4.5%	3.16	4.5%

Climate Zone 3

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.09	--	13.82	--	3.14	--	30.80	--	12.53	--	3.22	--	28.28	--	10.01	--	2.87	--
Traditional Tint Film	32.16	-0.2%	13.89	-0.5%	2.81	10.5%	31.73	-3.0%	13.46	-7.4%	3.29	-2.0%	29.86	-5.6%	11.59	-15.8%	3.09	-7.7%
Spectrally Selective Film	31.66	1.4%	13.38	3.1%	2.83	9.9%	30.89	-0.3%	12.62	-0.7%	3.16	2.0%	28.56	-1.0%	10.29	-2.8%	2.87	0.1%
Low-e Film	30.25	5.7%	11.98	13.3%	2.63	16.2%	30.24	1.8%	11.96	4.5%	3.01	6.7%	29.56	-4.5%	11.29	-12.8%	2.91	-1.3%
Spectrally Selective + Low-e Film	29.27	8.8%	11.00	20.4%	2.67	15.1%	29.46	4.4%	11.19	10.7%	2.91	9.8%	29.46	-4.2%	11.19	-11.8%	2.85	0.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.28	--	14.01	--	2.98	--	30.33	--	12.06	--	3.02	--	29.24	--	10.96	--	2.91	--
Traditional Tint Film	33.11	-2.6%	14.84	-5.9%	2.94	1.5%	31.87	-5.1%	13.60	-12.8%	3.18	-5.3%	31.04	-6.2%	12.77	-16.5%	3.17	-9.3%
Spectrally Selective Film	32.07	0.7%	13.79	1.5%	2.84	5.0%	30.59	-0.9%	12.32	-2.2%	3.01	0.6%	29.62	-1.3%	11.35	-3.5%	2.96	-1.7%
Low-e Film	31.35	2.9%	13.08	6.6%	2.84	4.9%	30.80	-1.5%	12.53	-3.9%	2.96	2.3%	30.27	-3.5%	12.00	-9.4%	3.01	-3.5%
Spectrally Selective + Low-e Film	30.10	6.7%	11.83	15.5%	2.78	6.8%	30.01	1.1%	11.74	2.7%	2.91	3.9%	29.74	-1.7%	11.46	-4.6%	2.92	-0.2%

Climate Zone 4

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	42.49	--	24.22	--	4.70	--	39.80	--	21.53	--	4.45	--	33.11	--	14.84	--	3.72	--
Traditional Tint Film	38.90	8.5%	20.62	14.8%	3.99	15.0%	38.09	4.3%	19.82	7.9%	4.13	7.1%	33.00	0.3%	14.73	0.7%	3.68	1.2%
Spectrally Selective Film	39.64	6.7%	21.36	11.8%	4.18	11.1%	38.50	3.3%	20.23	6.0%	4.22	5.1%	33.01	0.3%	14.74	0.7%	3.68	1.0%
Low-e Film	36.07	15.1%	17.79	26.5%	3.65	22.4%	36.20	9.0%	17.93	16.7%	3.82	14.2%	32.76	1.1%	14.48	2.4%	3.59	3.6%
Spectrally Selective + Low-e Film	35.37	16.8%	17.10	29.4%	3.67	21.8%	35.94	9.7%	17.67	17.9%	3.78	15.1%	32.70	1.3%	14.42	2.8%	3.57	4.0%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	40.88	--	22.60	--	4.40	--	37.50	--	19.22	--	4.08	--	35.44	--	17.16	--	3.77	--
Traditional Tint Film	39.12	4.3%	20.84	7.8%	4.01	8.9%	36.66	2.2%	18.39	4.3%	3.91	4.2%	35.09	1.0%	16.81	2.1%	3.70	1.9%
Spectrally Selective Film	39.46	3.5%	21.19	6.3%	4.10	6.8%	36.91	1.6%	18.64	3.0%	3.96	2.9%	35.26	0.5%	16.98	1.1%	3.74	1.0%
Low-e Film	36.87	9.8%	18.60	17.7%	3.75	14.7%	35.59	5.1%	17.32	9.9%	3.73	8.6%	34.48	2.7%	16.20	5.6%	3.59	4.8%
Spectrally Selective + Low-e Film	35.77	12.5%	17.49	22.6%	3.70	15.8%	35.27	5.9%	17.00	11.6%	3.68	9.8%	34.45	2.8%	16.17	5.8%	3.60	4.7%

Climate Zone 4

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.80	--	19.53	--	3.87	--	36.49	--	18.22	--	3.89	--	32.66	--	14.39	--	3.57	--
Traditional Tint Film	36.71	2.9%	18.43	5.6%	3.62	6.3%	36.31	0.5%	18.03	1.0%	3.84	1.3%	32.68	-0.0%	14.40	-0.1%	3.58	-0.3%
Spectrally Selective Film	37.00	2.1%	18.72	4.1%	3.71	4.1%	36.45	0.1%	18.18	0.2%	3.87	0.6%	32.66	-0.0%	14.39	-0.0%	3.57	-0.2%
Low-e Film	34.67	8.3%	16.39	16.0%	3.42	11.4%	34.80	4.6%	16.53	9.3%	3.61	7.1%	32.45	0.6%	14.18	1.5%	3.50	1.8%
Spectrally Selective + Low-e Film	33.92	10.3%	15.64	19.9%	3.44	11.1%	34.26	6.1%	15.98	12.3%	3.56	8.4%	32.33	1.0%	14.05	2.3%	3.43	3.9%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.63	--	19.36	--	3.81	--	35.44	--	17.17	--	3.72	--	34.18	--	15.91	--	3.57	--
Traditional Tint Film	36.87	2.0%	18.59	4.0%	3.57	6.6%	35.28	0.5%	17.01	0.9%	3.68	1.2%	34.34	-0.5%	16.07	-1.0%	3.59	-0.5%
Spectrally Selective Film	37.03	1.6%	18.75	3.1%	3.70	3.1%	35.39	0.2%	17.12	0.3%	3.71	0.5%	34.32	-0.4%	16.04	-0.9%	3.59	-0.5%
Low-e Film	35.06	6.8%	16.78	13.3%	3.49	8.4%	34.28	3.3%	16.01	6.8%	3.54	5.0%	33.66	1.5%	15.39	3.3%	3.50	2.0%
Spectrally Selective + Low-e Film	33.99	9.7%	15.71	18.8%	3.44	9.7%	33.70	4.9%	15.43	10.1%	3.49	6.4%	33.34	2.5%	15.06	5.3%	3.45	3.5%

Climate Zone 4

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.78	--	16.51	--	3.42	--	33.34	--	15.07	--	3.45	--	30.08	--	11.80	--	3.13	--
Traditional Tint Film	34.47	0.9%	16.20	1.9%	3.23	5.9%	34.16	-2.4%	15.88	-5.4%	3.55	-3.0%	31.67	-5.3%	13.40	-13.5%	3.36	-7.4%
Spectrally Selective Film	34.08	2.0%	15.80	4.3%	3.27	4.6%	33.37	-0.1%	15.09	-0.2%	3.42	0.6%	30.35	-0.9%	12.07	-2.3%	3.14	-0.4%
Low-e Film	32.28	7.2%	14.01	15.1%	3.05	10.9%	32.37	2.9%	14.09	6.4%	3.28	4.8%	31.31	-4.1%	13.03	-10.4%	3.23	-3.2%
Spectrally Selective + Low-e Film	31.25	10.1%	12.98	21.4%	3.03	11.6%	31.51	5.5%	13.23	12.2%	3.18	7.6%	31.16	-3.6%	12.88	-9.2%	3.11	0.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.84	--	16.56	--	3.38	--	32.61	--	14.34	--	3.30	--	31.31	--	13.04	--	3.16	--
Traditional Tint Film	35.47	-1.8%	17.20	-3.8%	3.38	0.1%	34.13	-4.7%	15.85	-10.6%	3.53	-7.0%	33.17	-5.9%	14.89	-14.3%	3.45	-9.2%
Spectrally Selective Film	34.44	1.1%	16.17	2.4%	3.23	4.5%	32.82	-0.7%	14.55	-1.5%	3.33	-0.8%	31.69	-1.2%	13.42	-2.9%	3.23	-2.3%
Low-e Film	33.46	4.0%	15.18	8.3%	3.27	3.3%	32.85	-0.7%	14.58	-1.7%	3.36	-1.8%	32.23	-2.9%	13.95	-7.0%	3.33	-5.3%
Spectrally Selective + Low-e Film	32.08	7.9%	13.80	16.7%	3.18	5.8%	31.94	2.0%	13.67	4.6%	3.25	1.4%	31.61	-0.9%	13.33	-2.3%	3.18	-0.7%

Climate Zone 5

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.99	--	20.71	--	4.15	--	36.95	--	18.67	--	4.02	--	33.14	--	14.86	--	3.31	--
Traditional Tint Film	36.08	7.5%	17.80	14.1%	3.37	18.9%	35.55	3.8%	17.28	7.5%	3.69	8.4%	33.00	0.4%	14.72	1.0%	3.25	1.7%
Spectrally Selective Film	36.64	6.0%	18.37	11.3%	3.58	14.0%	35.88	2.9%	17.61	5.7%	3.77	6.5%	33.01	0.4%	14.73	0.9%	3.27	1.2%
Low-e Film	33.78	13.3%	15.51	25.1%	2.97	28.5%	34.02	7.9%	15.75	15.6%	3.35	16.8%	32.62	1.6%	14.35	3.5%	3.16	4.4%
Spectrally Selective + Low-e Film	33.26	14.7%	14.99	27.6%	3.17	23.7%	33.88	8.3%	15.60	16.4%	3.37	16.3%	32.60	1.6%	14.32	3.6%	3.13	5.3%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.54	--	16.26	--	3.38	--	32.97	--	14.70	--	3.26	--	32.07	--	13.80	--	3.12	--
Traditional Tint Film	33.65	2.6%	15.37	5.5%	3.05	9.8%	32.57	1.2%	14.29	2.8%	3.13	3.9%	31.90	0.5%	13.63	1.2%	3.06	1.8%
Spectrally Selective Film	33.83	2.0%	15.55	4.3%	3.15	7.0%	32.69	0.8%	14.42	1.9%	3.17	2.6%	31.99	0.3%	13.71	0.6%	3.09	0.8%
Low-e Film	32.61	5.6%	14.34	11.8%	2.84	15.6%	32.08	2.7%	13.81	6.0%	3.00	7.8%	31.64	1.4%	13.36	3.2%	2.97	4.6%
Spectrally Selective + Low-e Film	32.18	6.8%	13.91	14.5%	2.93	13.1%	32.00	2.9%	13.73	6.6%	2.97	8.8%	31.67	1.3%	13.40	2.9%	2.97	4.6%

Climate Zone 5

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.21	--	16.93	--	3.34	--	34.22	--	15.94	--	3.42	--	32.37	--	14.09	--	3.15	--
Traditional Tint Film	34.44	2.2%	16.16	4.6%	2.84	14.5%	34.13	0.3%	15.85	0.6%	3.37	1.7%	32.47	-0.3%	14.19	-0.7%	3.15	-0.1%
Spectrally Selective Film	34.64	1.6%	16.37	3.3%	2.99	10.0%	34.24	-0.1%	15.96	-0.1%	3.40	0.8%	32.43	-0.2%	14.15	-0.4%	3.15	-0.1%
Low-e Film	32.70	7.1%	14.42	14.8%	2.74	17.5%	32.89	3.9%	14.61	8.3%	3.15	7.9%	32.01	1.1%	13.74	2.5%	3.07	2.5%
Spectrally Selective + Low-e Film	32.13	8.7%	13.85	18.2%	2.95	11.5%	32.50	5.0%	14.22	10.8%	3.13	8.5%	31.75	1.9%	13.47	4.4%	3.02	3.9%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.86	--	14.58	--	2.95	--	31.94	--	13.67	--	3.01	--	31.48	--	13.21	--	2.98	--
Traditional Tint Film	32.44	1.3%	14.17	2.8%	2.72	7.5%	31.86	0.3%	13.58	0.6%	2.95	2.0%	31.55	-0.2%	13.28	-0.5%	2.98	-0.2%
Spectrally Selective Film	32.54	1.0%	14.26	2.2%	2.77	5.9%	31.91	0.1%	13.64	0.2%	2.97	1.3%	31.55	-0.2%	13.27	-0.5%	2.99	-0.3%
Low-e Film	31.67	3.6%	13.39	8.2%	2.72	7.7%	31.42	1.6%	13.15	3.8%	2.89	4.1%	31.28	0.6%	13.01	1.5%	2.92	2.0%
Spectrally Selective + Low-e Film	31.30	4.8%	13.02	10.7%	2.82	4.5%	31.26	2.1%	12.98	5.0%	2.87	4.8%	31.20	0.9%	12.93	2.1%	2.88	3.3%

Climate Zone 5

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.23	--	13.96	--	2.90	--	31.12	--	12.85	--	3.00	--	29.30	--	11.02	--	2.70	--
Traditional Tint Film	32.25	-0.1%	13.98	-0.1%	2.53	12.3%	32.02	-2.9%	13.75	-7.0%	3.08	-2.7%	30.73	-4.9%	12.46	-13.0%	2.91	-7.8%
Spectrally Selective Film	31.78	1.4%	13.50	3.3%	2.55	11.8%	31.21	-0.3%	12.94	-0.7%	2.97	1.0%	29.46	-0.6%	11.18	-1.5%	2.71	-0.1%
Low-e Film	30.37	5.8%	12.09	13.3%	2.35	18.4%	30.52	1.9%	12.24	4.7%	2.82	6.0%	30.05	-2.6%	11.77	-6.8%	2.77	-2.4%
Spectrally Selective + Low-e Film	29.49	8.5%	11.22	19.6%	2.47	14.5%	29.81	4.2%	11.53	10.2%	2.73	8.9%	29.79	-1.7%	11.51	-4.4%	2.70	-0.1%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	30.46	--	12.18	--	2.56	--	29.63	--	11.36	--	2.66	--	29.25	--	10.97	--	2.62	--
Traditional Tint Film	31.55	-3.6%	13.27	-8.9%	2.57	-1.1%	31.16	-5.1%	12.88	-13.4%	2.85	-7.1%	30.87	-5.5%	12.59	-14.8%	2.86	-9.5%
Spectrally Selective Film	30.46	0.0%	12.18	0.0%	2.44	4.1%	29.92	-1.0%	11.65	-2.5%	2.66	0.0%	29.60	-1.2%	11.32	-3.2%	2.68	-2.3%
Low-e Film	30.64	-0.6%	12.37	-1.5%	2.57	-0.6%	30.55	-3.1%	12.28	-8.1%	2.76	-3.9%	30.43	-4.1%	12.16	-10.8%	2.76	-5.6%
Spectrally Selective + Low-e Film	29.98	1.6%	11.70	3.9%	2.55	0.0%	30.11	-1.6%	11.84	-4.2%	2.69	-1.3%	30.08	-2.8%	11.80	-7.6%	2.70	-3.1%

Climate Zone 6

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	40.35	--	22.07	--	4.39	--	38.85	--	20.57	--	4.20	--	34.54	--	16.26	--	3.55	--
Traditional Tint Film	36.29	10.1%	18.01	18.4%	3.70	15.6%	37.00	4.8%	18.72	9.0%	3.90	7.2%	34.29	0.7%	16.01	1.5%	3.48	2.2%
Spectrally Selective Film	37.22	7.8%	18.94	14.2%	3.88	11.6%	37.46	3.6%	19.18	6.8%	4.00	5.0%	34.32	0.6%	16.04	1.3%	3.48	2.0%
Low-e Film	34.08	15.5%	15.80	28.4%	3.38	23.0%	35.17	9.5%	16.88	17.9%	3.58	14.8%	33.75	2.3%	15.47	4.9%	3.39	4.7%
Spectrally Selective + Low-e Film	34.10	15.5%	15.82	28.3%	3.44	21.5%	35.07	9.7%	16.79	18.4%	3.58	14.9%	33.66	2.5%	15.38	5.4%	3.37	5.1%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.44	--	17.16	--	3.68	--	34.23	--	15.95	--	3.52	--	33.28	--	15.00	--	3.33	--
Traditional Tint Film	34.13	3.7%	15.85	7.7%	3.41	7.6%	33.62	1.8%	15.34	3.8%	3.40	3.5%	33.01	0.8%	14.73	1.8%	3.29	1.4%
Spectrally Selective Film	34.45	2.8%	16.17	5.8%	3.48	5.5%	33.82	1.2%	15.53	2.6%	3.43	2.6%	33.14	0.4%	14.86	0.9%	3.31	0.8%
Low-e Film	33.17	6.4%	14.89	13.2%	3.25	11.9%	33.03	3.5%	14.75	7.5%	3.29	6.5%	32.63	2.0%	14.35	4.4%	3.23	3.1%
Spectrally Selective + Low-e Film	32.94	7.1%	14.66	14.6%	3.22	12.5%	32.95	3.7%	14.67	8.0%	3.27	7.2%	32.65	1.9%	14.37	4.2%	3.20	4.0%

Climate Zone 6

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.67	--	17.38	--	3.62	--	35.51	--	17.23	--	3.69	--	33.53	--	15.25	--	3.37	--
Traditional Tint Film	34.30	3.8%	16.02	7.8%	3.31	8.4%	35.25	0.7%	16.97	1.5%	3.61	2.2%	33.61	-0.2%	15.32	-0.5%	3.38	-0.3%
Spectrally Selective Film	34.72	2.7%	16.44	5.5%	3.45	4.8%	35.43	0.2%	17.15	0.5%	3.64	1.3%	33.57	-0.1%	15.29	-0.3%	3.37	-0.2%
Low-e Film	32.91	7.7%	14.63	15.9%	3.17	12.4%	33.87	4.6%	15.58	9.5%	3.40	7.8%	33.06	1.4%	14.78	3.1%	3.30	2.0%
Spectrally Selective + Low-e Film	32.76	8.1%	14.48	16.7%	3.21	11.2%	33.52	5.6%	15.23	11.6%	3.37	8.8%	32.74	2.3%	14.46	5.2%	3.22	4.4%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.38	--	15.10	--	3.29	--	32.90	--	14.62	--	3.28	--	32.46	--	14.18	--	3.19	--
Traditional Tint Film	32.74	1.9%	14.46	4.3%	3.15	4.2%	32.74	0.5%	14.46	1.1%	3.22	1.9%	32.52	-0.2%	14.24	-0.5%	3.20	-0.3%
Spectrally Selective Film	32.93	1.4%	14.65	3.0%	3.19	3.0%	32.83	0.2%	14.55	0.5%	3.26	0.8%	32.52	-0.2%	14.24	-0.5%	3.20	-0.3%
Low-e Film	32.10	3.8%	13.82	8.5%	3.08	6.3%	32.22	2.1%	13.94	4.6%	3.14	4.5%	32.15	0.9%	13.87	2.2%	3.11	2.4%
Spectrally Selective + Low-e Film	31.87	4.5%	13.59	10.0%	3.06	7.1%	32.03	2.7%	13.75	6.0%	3.09	5.8%	32.01	1.4%	13.73	3.1%	3.09	3.3%

Climate Zone 6

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.48	--	14.20	--	3.19	--	32.24	--	13.96	--	3.23	--	30.28	--	12.00	--	2.93	--
Traditional Tint Film	31.92	1.7%	13.64	3.9%	2.96	6.9%	32.99	-2.3%	14.71	-5.4%	3.33	-3.0%	31.74	-4.8%	13.46	-12.2%	3.15	-7.6%
Spectrally Selective Film	31.62	2.6%	13.34	6.0%	3.00	5.8%	32.21	0.1%	13.93	0.2%	3.20	0.9%	30.41	-0.4%	12.13	-1.1%	2.94	-0.3%
Low-e Film	30.33	6.6%	12.04	15.2%	2.80	12.0%	31.31	2.9%	13.03	6.7%	3.07	5.1%	30.92	-2.1%	12.64	-5.4%	3.02	-3.1%
Spectrally Selective + Low-e Film	29.86	8.1%	11.58	18.4%	2.78	12.6%	30.63	5.0%	12.35	11.5%	2.96	8.3%	30.56	-1.0%	12.28	-2.4%	2.91	0.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	30.74	--	12.46	--	2.92	--	30.34	--	12.06	--	2.93	--	29.93	--	11.65	--	2.84	--
Traditional Tint Film	31.75	-3.3%	13.47	-8.1%	3.02	-3.4%	31.99	-5.4%	13.70	-13.7%	3.12	-6.6%	31.78	-6.2%	13.50	-15.9%	3.09	-8.9%
Spectrally Selective Film	30.59	0.5%	12.31	1.2%	2.85	2.4%	30.62	-0.9%	12.34	-2.4%	2.96	-1.2%	30.33	-1.4%	12.05	-3.5%	2.91	-2.5%
Low-e Film	30.94	-0.6%	12.66	-1.6%	2.92	-0.2%	31.26	-3.0%	12.98	-7.7%	3.01	-2.7%	31.20	-4.3%	12.92	-11.0%	2.99	-5.5%
Spectrally Selective + Low-e Film	30.37	1.2%	12.09	3.0%	2.81	3.7%	30.73	-1.3%	12.45	-3.3%	2.94	-0.4%	30.73	-2.7%	12.45	-6.9%	2.93	-3.2%

Climate Zone 7

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	41.31	--	23.03	--	4.44	--	39.80	--	21.51	--	4.26	--	35.36	--	17.08	--	3.61	--
Traditional Tint Film	37.06	10.3%	18.78	18.5%	3.84	13.6%	37.85	4.9%	19.57	9.1%	3.98	6.5%	35.08	0.8%	16.80	1.7%	3.57	1.1%
Spectrally Selective Film	38.05	7.9%	19.77	14.2%	3.99	10.0%	38.34	3.7%	20.05	6.8%	4.05	4.8%	35.12	0.7%	16.84	1.4%	3.58	0.9%
Low-e Film	34.78	15.8%	16.50	28.4%	3.52	20.7%	35.94	9.7%	17.65	17.9%	3.69	13.4%	34.49	2.5%	16.21	5.1%	3.48	3.5%
Spectrally Selective + Low-e Film	34.87	15.6%	16.58	28.0%	3.55	20.1%	35.84	9.9%	17.56	18.4%	3.67	13.8%	34.38	2.8%	16.09	5.8%	3.45	4.4%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.26	--	17.97	--	3.79	--	35.03	--	16.74	--	3.62	--	34.06	--	15.78	--	3.44	--
Traditional Tint Film	34.86	3.9%	16.58	7.8%	3.57	5.7%	34.38	1.8%	16.10	3.9%	3.51	3.1%	33.76	0.9%	15.48	1.9%	3.39	1.2%
Spectrally Selective Film	35.21	2.9%	16.92	5.8%	3.63	4.1%	34.59	1.3%	16.30	2.6%	3.55	2.1%	33.90	0.5%	15.62	1.0%	3.42	0.6%
Low-e Film	33.88	6.6%	15.59	13.2%	3.42	9.6%	33.76	3.6%	15.47	7.6%	3.40	6.1%	33.35	2.1%	15.07	4.5%	3.32	3.3%
Spectrally Selective + Low-e Film	33.66	7.1%	15.38	14.4%	3.39	10.5%	33.66	3.9%	15.38	8.1%	3.38	6.8%	33.36	2.1%	15.07	4.5%	3.32	3.4%

Climate Zone 7

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.36	--	18.08	--	3.73	--	36.30	--	18.01	--	3.77	--	34.28	--	16.00	--	3.48	--
Traditional Tint Film	34.89	4.1%	16.60	8.2%	3.39	9.2%	35.99	0.8%	17.71	1.7%	3.72	1.5%	34.34	-0.2%	16.06	-0.3%	3.48	-0.3%
Spectrally Selective Film	35.35	2.8%	17.07	5.6%	3.58	4.0%	36.18	0.3%	17.90	0.6%	3.75	0.6%	34.30	-0.1%	16.02	-0.1%	3.48	-0.1%
Low-e Film	33.51	7.8%	15.23	15.8%	3.30	11.6%	34.58	4.7%	16.30	9.5%	3.51	7.0%	33.77	1.5%	15.49	3.2%	3.39	2.5%
Spectrally Selective + Low-e Film	33.43	8.1%	15.15	16.2%	3.33	10.8%	34.22	5.7%	15.94	11.5%	3.45	8.5%	33.44	2.5%	15.16	5.3%	3.34	3.8%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.06	--	15.78	--	3.44	--	33.63	--	15.35	--	3.39	--	33.18	--	14.90	--	3.31	--
Traditional Tint Film	33.37	2.0%	15.09	4.4%	3.28	4.9%	33.45	0.5%	15.17	1.2%	3.36	0.9%	33.24	-0.2%	14.96	-0.3%	3.31	-0.1%
Spectrally Selective Film	33.58	1.4%	15.30	3.1%	3.37	2.2%	33.55	0.2%	15.26	0.5%	3.37	0.4%	33.24	-0.2%	14.96	-0.4%	3.31	-0.1%
Low-e Film	32.74	3.9%	14.46	8.4%	3.24	5.8%	32.92	2.1%	14.64	4.6%	3.28	3.3%	32.85	1.0%	14.57	2.2%	3.26	1.6%
Spectrally Selective + Low-e Film	32.53	4.5%	14.24	9.7%	3.22	6.4%	32.72	2.7%	14.43	5.9%	3.24	4.3%	32.70	1.5%	14.42	3.2%	3.23	2.4%

Climate Zone 7

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.13	--	14.85	--	3.30	--	32.97	--	14.69	--	3.33	--	30.98	--	12.70	--	3.03	--
Traditional Tint Film	32.44	2.1%	14.16	4.6%	3.07	7.1%	33.69	-2.2%	15.41	-4.9%	3.44	-3.3%	32.45	-4.7%	14.17	-11.6%	3.25	-7.0%
Spectrally Selective Film	32.19	2.8%	13.91	6.3%	3.04	7.8%	32.92	0.2%	14.63	0.4%	3.31	0.6%	31.10	-0.4%	12.81	-0.9%	3.04	-0.2%
Low-e Film	30.88	6.8%	12.60	15.1%	2.86	13.4%	31.97	3.0%	13.69	6.8%	3.18	4.5%	31.60	-2.0%	13.31	-4.8%	3.13	-3.2%
Spectrally Selective + Low-e Film	30.48	8.0%	12.20	17.8%	2.92	11.3%	31.29	5.1%	13.01	11.4%	3.06	7.9%	31.22	-0.8%	12.94	-1.9%	3.08	-1.5%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	31.38	--	13.10	--	3.03	--	31.03	--	12.74	--	3.05	--	30.61	--	12.33	--	2.98	--
Traditional Tint Film	32.38	-3.2%	14.10	-7.7%	3.10	-2.4%	32.70	-5.4%	14.42	-13.1%	3.27	-7.2%	32.50	-6.2%	14.22	-15.4%	3.23	-8.4%
Spectrally Selective Film	31.20	0.6%	12.92	1.4%	2.95	2.6%	31.30	-0.9%	13.02	-2.2%	3.09	-1.5%	31.02	-1.3%	12.74	-3.3%	3.05	-2.3%
Low-e Film	31.57	-0.6%	13.29	-1.5%	3.06	-1.0%	31.96	-3.0%	13.67	-7.3%	3.16	-3.9%	31.91	-4.2%	13.63	-10.5%	3.15	-5.8%
Spectrally Selective + Low-e Film	31.01	1.2%	12.72	2.8%	3.00	0.8%	31.41	-1.2%	13.12	-3.0%	3.10	-1.7%	31.41	-2.6%	13.13	-6.5%	3.09	-3.6%

Climate Zone 8

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	42.40	--	24.11	--	4.65	--	40.64	--	22.35	--	4.42	--	35.93	--	17.64	--	3.77	--
Traditional Tint Film	38.08	10.2%	19.79	17.9%	4.02	13.6%	38.65	4.9%	20.37	8.9%	4.15	6.2%	35.65	0.8%	17.37	1.6%	3.72	1.4%
Spectrally Selective Film	39.08	7.8%	20.80	13.8%	4.18	10.0%	39.14	3.7%	20.86	6.7%	4.21	4.8%	35.69	0.7%	17.41	1.3%	3.73	1.1%
Low-e Film	35.61	16.0%	17.33	28.1%	3.69	20.6%	36.65	9.8%	18.37	17.8%	3.85	13.0%	35.05	2.4%	16.77	5.0%	3.64	3.5%
Spectrally Selective + Low-e Film	35.58	16.1%	17.30	28.3%	3.72	20.0%	36.52	10.1%	18.23	18.4%	3.82	13.7%	34.93	2.8%	16.65	5.6%	3.60	4.5%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.05	--	18.77	--	3.96	--	35.63	--	17.35	--	3.77	--	34.53	--	16.25	--	3.57	--
Traditional Tint Film	35.64	3.8%	17.36	7.5%	3.73	5.8%	34.98	1.8%	16.69	3.8%	3.66	3.1%	34.23	0.9%	15.95	1.8%	3.52	1.4%
Spectrally Selective Film	35.99	2.9%	17.71	5.7%	3.79	4.2%	35.19	1.2%	16.91	2.5%	3.70	2.0%	34.38	0.4%	16.09	0.9%	3.54	0.7%
Low-e Film	34.55	6.8%	16.27	13.3%	3.57	9.8%	34.31	3.7%	16.03	7.6%	3.54	6.1%	33.81	2.1%	15.53	4.4%	3.44	3.6%
Spectrally Selective + Low-e Film	34.26	7.5%	15.98	14.9%	3.53	10.8%	34.19	4.0%	15.91	8.3%	3.51	6.9%	33.81	2.1%	15.53	4.4%	3.42	4.1%

Climate Zone 8

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.24	--	18.95	--	3.90	--	36.98	--	18.69	--	3.93	--	34.79	--	16.51	--	3.62	--
Traditional Tint Film	35.77	3.9%	17.49	7.7%	3.65	6.3%	36.69	0.8%	18.41	1.5%	3.86	1.6%	34.87	-0.2%	16.59	-0.4%	3.63	-0.3%
Spectrally Selective Film	36.23	2.7%	17.95	5.3%	3.74	4.1%	36.88	0.3%	18.60	0.5%	3.89	1.0%	34.83	-0.1%	16.55	-0.2%	3.62	-0.2%
Low-e Film	34.22	8.1%	15.94	15.9%	3.47	10.9%	35.19	4.8%	16.91	9.6%	3.66	7.0%	34.26	1.5%	15.98	3.2%	3.53	2.4%
Spectrally Selective + Low-e Film	34.00	8.7%	15.72	17.1%	3.47	11.0%	34.77	6.0%	16.49	11.8%	3.59	8.5%	33.90	2.6%	15.62	5.4%	3.42	5.3%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.72	--	16.44	--	3.59	--	34.14	--	15.86	--	3.53	--	33.61	--	15.33	--	3.42	--
Traditional Tint Film	34.03	2.0%	15.75	4.2%	3.47	3.4%	33.96	0.5%	15.68	1.1%	3.49	1.0%	33.68	-0.2%	15.40	-0.4%	3.42	-0.1%
Spectrally Selective Film	34.24	1.4%	15.95	3.0%	3.51	2.3%	34.07	0.2%	15.78	0.5%	3.51	0.6%	33.68	-0.2%	15.40	-0.4%	3.42	-0.1%
Low-e Film	33.32	4.0%	15.04	8.5%	3.36	6.4%	33.40	2.2%	15.11	4.7%	3.39	4.0%	33.27	1.0%	14.99	2.3%	3.34	2.3%
Spectrally Selective + Low-e Film	33.02	4.9%	14.74	10.4%	3.30	8.0%	33.15	2.9%	14.87	6.2%	3.32	5.9%	33.10	1.5%	14.82	3.3%	3.29	3.8%

Climate Zone 8

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.01	--	15.73	--	3.45	--	33.67	--	15.38	--	3.48	--	31.50	--	13.22	--	3.17	--
Traditional Tint Film	33.33	2.0%	15.05	4.3%	3.31	4.2%	34.38	-2.1%	16.10	-4.6%	3.57	-2.5%	32.97	-4.6%	14.68	-11.1%	3.35	-5.6%
Spectrally Selective Film	33.08	2.7%	14.80	5.9%	3.29	4.6%	33.62	0.1%	15.34	0.3%	3.46	0.6%	31.63	-0.4%	13.35	-0.9%	3.19	-0.4%
Low-e Film	31.60	7.1%	13.32	15.3%	3.08	10.8%	32.59	3.2%	14.30	7.0%	3.30	5.2%	32.09	-1.9%	13.81	-4.4%	3.19	-0.6%
Spectrally Selective + Low-e Film	31.08	8.6%	12.79	18.6%	3.05	11.7%	31.85	5.4%	13.57	11.8%	3.18	8.9%	31.69	-0.6%	13.41	-1.4%	3.08	2.9%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.05	--	13.77	--	3.21	--	31.55	--	13.27	--	3.16	--	31.07	--	12.79	--	3.05	--
Traditional Tint Film	33.02	-3.0%	14.74	-7.0%	3.33	-3.5%	33.19	-5.2%	14.91	-12.3%	3.39	-7.3%	32.92	-6.0%	14.64	-14.5%	3.32	-8.6%
Spectrally Selective Film	31.87	0.6%	13.59	1.3%	3.17	1.5%	31.83	-0.9%	13.54	-2.0%	3.19	-0.9%	31.47	-1.3%	13.19	-3.1%	3.10	-1.7%
Low-e Film	32.14	-0.3%	13.85	-0.6%	3.20	0.6%	32.40	-2.7%	14.12	-6.4%	3.25	-2.8%	32.30	-4.0%	14.01	-9.6%	3.20	-4.6%
Spectrally Selective + Low-e Film	31.49	1.7%	13.21	4.1%	3.07	4.5%	31.83	-0.9%	13.55	-2.1%	3.12	1.2%	31.80	-2.3%	13.52	-5.7%	3.08	-0.8%

Climate Zone 9

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	43.18	--	24.90	--	4.87	--	41.12	--	22.83	--	4.59	--	36.21	--	17.93	--	3.84	--
Traditional Tint Film	38.79	10.2%	20.51	17.6%	4.14	15.1%	39.10	4.9%	20.82	8.8%	4.28	6.7%	35.93	0.8%	17.64	1.6%	3.77	1.9%
Spectrally Selective Film	39.81	7.8%	21.53	13.5%	4.33	11.2%	39.61	3.7%	21.33	6.6%	4.36	5.0%	35.96	0.7%	17.68	1.4%	3.78	1.6%
Low-e Film	36.15	16.3%	17.87	28.2%	3.74	23.2%	37.02	10.0%	18.74	17.9%	3.91	14.8%	35.31	2.5%	17.03	5.0%	3.67	4.7%
Spectrally Selective + Low-e Film	35.99	16.7%	17.71	28.9%	3.76	22.7%	36.83	10.4%	18.55	18.8%	3.88	15.7%	35.17	2.9%	16.89	5.8%	3.64	5.4%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.61	--	19.32	--	4.04	--	35.97	--	17.69	--	3.82	--	34.78	--	16.50	--	3.62	--
Traditional Tint Film	36.17	3.8%	17.89	7.4%	3.78	6.5%	35.31	1.8%	17.03	3.8%	3.71	3.0%	34.48	0.9%	16.20	1.8%	3.57	1.4%
Spectrally Selective Film	36.52	2.9%	18.24	5.6%	3.85	4.7%	35.52	1.3%	17.24	2.6%	3.75	2.0%	34.63	0.4%	16.35	0.9%	3.59	0.7%
Low-e Film	34.99	7.0%	16.71	13.5%	3.61	10.8%	34.62	3.8%	16.34	7.7%	3.58	6.4%	34.05	2.1%	15.77	4.4%	3.50	3.3%
Spectrally Selective + Low-e Film	34.62	7.9%	16.34	15.5%	3.57	11.9%	34.47	4.2%	16.19	8.5%	3.56	6.9%	34.05	2.1%	15.77	4.5%	3.49	3.5%

Climate Zone 9

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.72	--	19.44	--	3.97	--	37.34	--	19.06	--	4.03	--	35.05	--	16.77	--	3.65	--
Traditional Tint Film	36.26	3.9%	17.98	7.5%	3.70	6.8%	37.06	0.7%	18.78	1.5%	3.93	2.5%	35.12	-0.2%	16.84	-0.4%	3.65	-0.2%
Spectrally Selective Film	36.71	2.7%	18.43	5.2%	3.79	4.5%	37.25	0.2%	18.97	0.5%	3.98	1.3%	35.09	-0.1%	16.80	-0.2%	3.65	-0.1%
Low-e Film	34.61	8.2%	16.33	16.0%	3.49	12.0%	35.51	4.9%	17.22	9.6%	3.69	8.3%	34.50	1.6%	16.22	3.3%	3.57	2.2%
Spectrally Selective + Low-e Film	34.31	9.0%	16.03	17.5%	3.50	11.8%	35.04	6.2%	16.76	12.1%	3.64	9.8%	34.12	2.7%	15.84	5.6%	3.51	3.8%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.12	--	16.84	--	3.62	--	34.44	--	16.16	--	3.57	--	33.86	--	15.58	--	3.47	--
Traditional Tint Film	34.43	2.0%	16.15	4.1%	3.50	3.5%	34.26	0.5%	15.98	1.1%	3.53	0.9%	33.92	-0.2%	15.64	-0.4%	3.48	-0.2%
Spectrally Selective Film	34.63	1.4%	16.35	2.9%	3.54	2.4%	34.36	0.2%	16.08	0.5%	3.55	0.4%	33.92	-0.2%	15.64	-0.4%	3.48	-0.2%
Low-e Film	33.66	4.1%	15.38	8.7%	3.40	6.2%	33.68	2.2%	15.40	4.7%	3.44	3.5%	33.51	1.0%	15.23	2.2%	3.42	1.6%
Spectrally Selective + Low-e Film	33.32	5.1%	15.04	10.7%	3.38	6.9%	33.42	3.0%	15.13	6.3%	3.40	4.6%	33.34	1.6%	15.06	3.4%	3.37	2.9%

Climate Zone 9

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.52	--	16.24	--	3.52	--	34.07	--	15.79	--	3.57	--	31.79	--	13.51	--	3.20	--
Traditional Tint Film	33.88	1.9%	15.60	3.9%	3.33	5.4%	34.81	-2.2%	16.53	-4.7%	3.62	-1.2%	33.28	-4.7%	15.00	-11.0%	3.40	-6.2%
Spectrally Selective Film	33.60	2.7%	15.32	5.7%	3.34	5.1%	34.03	0.1%	15.75	0.2%	3.52	1.5%	31.92	-0.4%	13.64	-0.9%	3.21	-0.1%
Low-e Film	32.04	7.2%	13.76	15.3%	3.09	12.3%	32.96	3.3%	14.68	7.0%	3.32	7.0%	32.39	-1.9%	14.11	-4.4%	3.26	-2.0%
Spectrally Selective + Low-e Film	31.42	9.0%	13.14	19.1%	3.07	12.9%	32.16	5.6%	13.88	12.1%	3.22	10.1%	31.96	-0.5%	13.68	-1.3%	3.21	-0.1%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.50	--	14.22	--	3.23	--	31.91	--	13.63	--	3.20	--	31.37	--	13.09	--	3.11	--
Traditional Tint Film	33.44	-2.9%	15.15	-6.6%	3.35	-3.7%	33.50	-5.0%	15.22	-11.7%	3.42	-7.2%	33.17	-5.7%	14.89	-13.7%	3.37	-8.4%
Spectrally Selective Film	32.31	0.6%	14.03	1.3%	3.18	1.5%	32.18	-0.8%	13.90	-2.0%	3.24	-1.4%	31.77	-1.3%	13.49	-3.1%	3.18	-2.2%
Low-e Film	32.51	-0.0%	14.23	-0.1%	3.23	-0.0%	32.71	-2.5%	14.43	-5.9%	3.30	-3.3%	32.57	-3.8%	14.29	-9.1%	3.27	-5.3%
Spectrally Selective + Low-e Film	31.84	2.0%	13.55	4.7%	3.16	2.3%	32.14	-0.7%	13.86	-1.7%	3.21	-0.5%	32.08	-2.2%	13.80	-5.4%	3.19	-2.6%

Climate Zone 10

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	43.88	--	25.59	--	5.01	--	41.64	--	23.36	--	4.76	--	36.59	--	18.31	--	3.97	--
Traditional Tint Film	39.56	9.8%	21.27	16.9%	4.27	14.8%	39.61	4.9%	21.33	8.7%	4.42	7.2%	36.29	0.8%	18.01	1.6%	3.92	1.3%
Spectrally Selective Film	40.55	7.6%	22.27	13.0%	4.48	10.7%	40.12	3.7%	21.84	6.5%	4.51	5.5%	36.34	0.7%	18.05	1.4%	3.92	1.1%
Low-e Film	36.81	16.1%	18.53	27.6%	3.88	22.6%	37.48	10.0%	19.20	17.8%	4.08	14.5%	35.66	2.5%	17.38	5.1%	3.78	4.7%
Spectrally Selective + Low-e Film	36.50	16.8%	18.22	28.8%	3.91	22.0%	37.24	10.6%	18.96	18.8%	4.01	15.9%	35.50	3.0%	17.22	5.9%	3.67	7.6%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.19	--	19.91	--	4.21	--	36.40	--	18.12	--	3.98	--	35.12	--	16.84	--	3.74	--
Traditional Tint Film	36.79	3.7%	18.51	7.1%	3.94	6.4%	35.74	1.8%	17.46	3.7%	3.85	3.1%	34.82	0.9%	16.54	1.8%	3.63	2.9%
Spectrally Selective Film	37.12	2.8%	18.84	5.4%	4.02	4.7%	35.95	1.2%	17.67	2.5%	3.89	2.1%	34.97	0.4%	16.68	0.9%	3.66	2.1%
Low-e Film	35.52	7.0%	17.24	13.4%	3.76	10.8%	35.02	3.8%	16.74	7.6%	3.70	7.1%	34.39	2.1%	16.11	4.4%	3.54	5.2%
Spectrally Selective + Low-e Film	35.07	8.2%	16.79	15.7%	3.66	13.2%	34.84	4.3%	16.56	8.6%	3.59	9.7%	34.37	2.2%	16.08	4.5%	3.50	6.5%

Climate Zone 10

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.40	--	20.12	--	4.13	--	37.80	--	19.51	--	4.16	--	35.39	--	17.11	--	3.76	--
Traditional Tint Film	37.01	3.6%	18.73	6.9%	3.86	6.7%	37.52	0.7%	19.23	1.4%	4.10	1.5%	35.46	-0.2%	17.18	-0.4%	3.77	-0.3%
Spectrally Selective Film	37.44	2.5%	19.16	4.8%	3.95	4.4%	37.70	0.2%	19.42	0.5%	4.14	0.6%	35.42	-0.1%	17.14	-0.2%	3.76	-0.1%
Low-e Film	35.24	8.2%	16.96	15.7%	3.62	12.5%	35.92	5.0%	17.64	9.6%	3.83	8.1%	34.83	1.6%	16.55	3.3%	3.63	3.5%
Spectrally Selective + Low-e Film	34.77	9.5%	16.49	18.0%	3.58	13.6%	35.40	6.4%	17.11	12.3%	3.72	10.6%	34.42	2.7%	16.14	5.7%	3.51	6.6%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.69	--	17.41	--	3.75	--	34.85	--	16.56	--	3.67	--	34.20	--	15.92	--	3.50	--
Traditional Tint Film	35.04	1.8%	16.75	3.7%	3.59	4.5%	34.67	0.5%	16.39	1.1%	3.62	1.4%	34.25	-0.2%	15.97	-0.3%	3.52	-0.4%
Spectrally Selective Film	35.22	1.3%	16.94	2.7%	3.64	3.0%	34.77	0.2%	16.49	0.5%	3.64	0.9%	34.26	-0.2%	15.98	-0.4%	3.53	-0.9%
Low-e Film	34.18	4.2%	15.90	8.7%	3.46	7.9%	34.07	2.2%	15.79	4.7%	3.47	5.6%	33.85	1.0%	15.56	2.2%	3.41	2.6%
Spectrally Selective + Low-e Film	33.75	5.4%	15.47	11.1%	3.38	10.0%	33.78	3.1%	15.50	6.4%	3.39	7.6%	33.66	1.6%	15.38	3.4%	3.32	5.1%

Climate Zone 10

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.21	--	16.92	--	3.68	--	34.52	--	16.24	--	3.70	--	32.15	--	13.87	--	3.31	--
Traditional Tint Film	34.59	1.7%	16.31	3.6%	3.47	5.5%	35.22	-2.0%	16.93	-4.3%	3.77	-1.8%	33.58	-4.4%	15.30	-10.3%	3.49	-5.4%
Spectrally Selective Film	34.33	2.5%	16.04	5.2%	3.50	4.9%	34.48	0.1%	16.20	0.2%	3.68	0.7%	32.26	-0.3%	13.98	-0.8%	3.32	-0.2%
Low-e Film	32.67	7.2%	14.39	15.0%	3.20	13.0%	33.33	3.5%	15.05	7.3%	3.44	7.0%	32.68	-1.6%	14.40	-3.8%	3.31	-0.2%
Spectrally Selective + Low-e Film	31.91	9.4%	13.62	19.5%	3.17	13.9%	32.51	5.8%	14.23	12.4%	3.29	11.0%	32.25	-0.3%	13.97	-0.7%	3.17	4.3%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.07	--	14.79	--	3.37	--	32.32	--	14.04	--	3.30	--	31.73	--	13.44	--	3.16	--
Traditional Tint Film	34.02	-2.9%	15.74	-6.4%	3.44	-2.0%	33.88	-4.8%	15.60	-11.2%	3.50	-5.9%	33.48	-5.5%	15.20	-13.0%	3.41	-8.0%
Spectrally Selective Film	32.90	0.5%	14.62	1.2%	3.29	2.3%	32.57	-0.8%	14.29	-1.8%	3.31	-0.4%	32.10	-1.2%	13.82	-2.8%	3.21	-1.8%
Low-e Film	33.00	0.2%	14.72	0.5%	3.30	2.2%	33.08	-2.4%	14.80	-5.4%	3.34	-1.1%	32.87	-3.6%	14.59	-8.5%	3.29	-4.0%
Spectrally Selective + Low-e Film	32.25	2.5%	13.97	5.5%	3.16	6.3%	32.48	-0.5%	14.19	-1.1%	3.20	3.0%	32.38	-2.0%	14.09	-4.8%	3.13	0.9%

Climate Zone 11

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	46.73	--	28.45	--	5.02	--	42.31	--	24.03	--	4.76	--	36.64	--	18.36	--	3.98	--
Traditional Tint Film	43.16	7.6%	24.88	12.6%	4.30	14.3%	40.64	4.0%	22.36	7.0%	4.43	6.9%	36.48	0.4%	18.20	0.9%	3.93	1.3%
Spectrally Selective Film	43.86	6.1%	25.58	10.1%	4.49	10.6%	41.02	3.0%	22.74	5.4%	4.52	5.1%	36.48	0.4%	18.20	0.9%	3.94	1.1%
Low-e Film	39.30	15.9%	21.02	26.1%	3.90	22.3%	38.38	9.3%	20.11	16.3%	4.09	14.2%	35.88	2.1%	17.61	4.1%	3.82	4.0%
Spectrally Selective + Low-e Film	37.78	19.2%	19.50	31.5%	3.93	21.8%	37.75	10.8%	19.47	19.0%	4.04	15.2%	35.64	2.7%	17.36	5.5%	3.80	4.6%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	45.20	--	26.92	--	4.72	--	40.04	--	21.76	--	4.38	--	37.06	--	18.78	--	4.04	--
Traditional Tint Film	43.40	4.0%	25.12	6.7%	4.32	8.5%	39.22	2.0%	20.94	3.8%	4.20	4.2%	36.75	0.8%	18.47	1.7%	3.96	2.0%
Spectrally Selective Film	43.71	3.3%	25.43	5.5%	4.42	6.2%	39.45	1.5%	21.17	2.7%	4.26	2.8%	36.89	0.5%	18.61	0.9%	4.00	1.0%
Low-e Film	40.16	11.1%	21.88	18.7%	4.03	14.5%	37.80	5.6%	19.53	10.3%	3.99	8.9%	36.03	2.8%	17.75	5.5%	3.83	5.1%
Spectrally Selective + Low-e Film	38.25	15.4%	19.97	25.8%	3.96	16.0%	37.13	7.3%	18.85	13.4%	3.93	10.2%	35.85	3.3%	17.57	6.4%	3.82	5.3%

Climate Zone 11

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	41.55	--	23.27	--	4.15	--	38.75	--	20.47	--	4.17	--	35.62	--	17.34	--	3.80	--
Traditional Tint Film	40.49	2.5%	22.21	4.5%	3.87	6.7%	38.64	0.3%	20.36	0.5%	4.12	1.4%	35.75	-0.4%	17.47	-0.8%	3.81	-0.2%
Spectrally Selective Film	40.74	1.9%	22.46	3.5%	3.97	4.4%	38.76	-0.0%	20.48	-0.0%	4.15	0.6%	35.70	-0.2%	17.42	-0.5%	3.80	-0.1%
Low-e Film	37.52	9.7%	19.25	17.3%	3.65	12.1%	36.75	5.2%	18.47	9.8%	3.86	7.5%	35.01	1.7%	16.74	3.5%	3.72	2.2%
Spectrally Selective + Low-e Film	35.99	13.4%	17.71	23.9%	3.65	12.1%	35.84	7.5%	17.56	14.2%	3.79	9.2%	34.44	3.3%	16.16	6.8%	3.63	4.6%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	41.46	--	23.18	--	4.09	--	37.76	--	19.49	--	3.99	--	35.75	--	17.47	--	3.81	--
Traditional Tint Film	40.67	1.9%	22.39	3.4%	3.90	4.8%	37.62	0.4%	19.35	0.7%	3.94	1.3%	35.94	-0.5%	17.66	-1.1%	3.82	-0.5%
Spectrally Selective Film	40.80	1.6%	22.52	2.9%	3.96	3.3%	37.71	0.1%	19.43	0.3%	3.96	0.6%	35.91	-0.4%	17.63	-0.9%	3.83	-0.5%
Low-e Film	37.95	8.5%	19.67	15.2%	3.73	8.9%	36.26	4.0%	17.98	7.7%	3.77	5.3%	35.10	1.8%	16.82	3.7%	3.72	2.4%
Spectrally Selective + Low-e Film	36.11	12.9%	17.83	23.1%	3.66	10.6%	35.32	6.5%	17.04	12.6%	3.70	7.2%	34.58	3.3%	16.30	6.7%	3.65	4.3%

Climate Zone 11

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.70	--	20.43	--	3.69	--	35.78	--	17.51	--	3.71	--	32.71	--	14.43	--	3.34	--
Traditional Tint Film	38.41	0.8%	20.13	1.5%	3.55	3.9%	36.62	-2.3%	18.34	-4.8%	3.83	-3.1%	34.05	-4.1%	15.77	-9.3%	3.58	-7.1%
Spectrally Selective Film	37.99	1.8%	19.71	3.5%	3.52	4.9%	35.85	-0.2%	17.58	-0.4%	3.69	0.6%	32.89	-0.5%	14.61	-1.2%	3.36	-0.4%
Low-e Film	35.33	8.7%	17.05	16.5%	3.27	11.4%	34.51	3.6%	16.23	7.3%	3.52	5.2%	33.08	-1.1%	14.80	-2.5%	3.43	-2.7%
Spectrally Selective + Low-e Film	33.58	13.2%	15.30	25.1%	3.23	12.5%	33.30	6.9%	15.02	14.2%	3.39	8.6%	32.51	0.6%	14.23	1.4%	3.35	-0.0%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.85	--	20.58	--	3.65	--	35.13	--	16.85	--	3.55	--	33.10	--	14.82	--	3.38	--
Traditional Tint Film	39.35	-1.3%	21.07	-2.4%	3.71	-1.5%	36.50	-3.9%	18.22	-8.1%	3.79	-6.7%	34.82	-5.2%	16.54	-11.6%	3.68	-8.9%
Spectrally Selective Film	38.38	1.2%	20.11	2.3%	3.56	2.7%	35.33	-0.6%	17.05	-1.2%	3.59	-1.0%	33.47	-1.1%	15.19	-2.5%	3.46	-2.4%
Low-e Film	36.43	6.2%	18.15	11.8%	3.50	4.3%	34.91	0.6%	16.63	1.3%	3.59	-1.0%	33.74	-1.9%	15.46	-4.3%	3.53	-4.2%
Spectrally Selective + Low-e Film	34.32	11.7%	16.04	22.0%	3.39	7.3%	33.66	4.2%	15.38	8.8%	3.45	3.0%	32.92	0.5%	14.65	1.2%	3.40	-0.6%

Climate Zone 12

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	44.66	--	26.38	--	4.93	--	41.20	--	22.92	--	4.69	--	35.94	--	17.66	--	3.93	--
Traditional Tint Film	41.05	8.1%	22.77	13.7%	4.23	14.2%	39.50	4.1%	21.22	7.4%	4.37	6.9%	35.77	0.5%	17.49	1.0%	3.88	1.3%
Spectrally Selective Film	41.77	6.5%	23.49	11.0%	4.41	10.5%	39.90	3.2%	21.62	5.7%	4.45	5.1%	35.78	0.5%	17.50	0.9%	3.89	1.1%
Low-e Film	37.80	15.4%	19.52	26.0%	3.84	22.0%	37.42	9.2%	19.14	16.5%	4.03	14.1%	35.21	2.0%	16.93	4.2%	3.78	3.8%
Spectrally Selective + Low-e Film	36.71	17.8%	18.43	30.1%	3.87	21.4%	36.94	10.3%	18.66	18.6%	3.99	15.0%	35.02	2.6%	16.74	5.2%	3.76	4.3%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	43.05	--	24.77	--	4.63	--	38.89	--	20.61	--	4.31	--	36.32	--	18.04	--	3.99	--
Traditional Tint Film	41.26	4.2%	22.98	7.2%	4.24	8.4%	38.06	2.1%	19.78	4.0%	4.13	4.2%	36.00	0.9%	17.72	1.8%	3.91	2.0%
Spectrally Selective Film	41.59	3.4%	23.31	5.9%	4.35	6.2%	38.30	1.5%	20.02	2.8%	4.19	2.8%	36.15	0.5%	17.87	0.9%	3.95	1.0%
Low-e Film	38.61	10.3%	20.33	17.9%	3.97	14.2%	36.81	5.3%	18.54	10.1%	3.94	8.8%	35.32	2.7%	17.05	5.5%	3.79	5.0%
Spectrally Selective + Low-e Film	37.13	13.8%	18.85	23.9%	3.91	15.7%	36.30	6.7%	18.02	12.6%	3.88	10.1%	35.21	3.0%	16.93	6.1%	3.79	5.0%

Climate Zone 12

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	39.65	--	21.37	--	4.09	--	37.71	--	19.43	--	4.12	--	34.94	--	16.66	--	3.76	--
Traditional Tint Film	38.58	2.7%	20.30	5.0%	3.82	6.6%	37.57	0.4%	19.29	0.7%	4.06	1.4%	35.06	-0.3%	16.78	-0.7%	3.77	-0.3%
Spectrally Selective Film	38.85	2.0%	20.57	3.7%	3.91	4.3%	37.70	0.0%	19.43	0.0%	4.09	0.6%	35.01	-0.2%	16.73	-0.4%	3.76	-0.2%
Low-e Film	36.15	8.8%	17.87	16.4%	3.61	11.8%	35.87	4.9%	17.59	9.5%	3.81	7.4%	34.38	1.6%	16.11	3.3%	3.68	2.0%
Spectrally Selective + Low-e Film	35.02	11.7%	16.74	21.7%	3.61	11.7%	35.11	6.9%	16.83	13.4%	3.75	8.9%	33.89	3.0%	15.61	6.3%	3.63	3.3%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	39.51	--	21.23	--	4.03	--	36.69	--	18.42	--	3.93	--	35.03	--	16.75	--	3.76	--
Traditional Tint Film	38.74	2.0%	20.46	3.6%	3.84	4.8%	36.55	0.4%	18.27	0.8%	3.88	1.2%	35.21	-0.5%	16.93	-1.1%	3.78	-0.5%
Spectrally Selective Film	38.89	1.6%	20.61	2.9%	3.90	3.2%	36.64	0.1%	18.37	0.3%	3.91	0.5%	35.18	-0.4%	16.90	-0.9%	3.78	-0.5%
Low-e Film	36.55	7.5%	18.27	14.0%	3.68	8.6%	35.37	3.6%	17.09	7.2%	3.73	5.2%	34.44	1.7%	16.16	3.5%	3.68	2.1%
Spectrally Selective + Low-e Film	35.12	11.1%	16.84	20.7%	3.62	10.2%	34.57	5.8%	16.29	11.5%	3.67	6.7%	34.00	2.9%	15.72	6.2%	3.64	3.1%

Climate Zone 12

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.77	--	18.49	--	3.63	--	34.70	--	16.42	--	3.66	--	31.96	--	13.68	--	3.31	--
Traditional Tint Film	36.45	0.9%	18.17	1.7%	3.50	3.6%	35.49	-2.3%	17.21	-4.8%	3.77	-3.2%	33.32	-4.3%	15.04	-9.9%	3.55	-7.2%
Spectrally Selective Film	36.07	1.9%	17.79	3.8%	3.46	4.8%	34.75	-0.1%	16.47	-0.3%	3.64	0.6%	32.13	-0.5%	13.85	-1.2%	3.32	-0.5%
Low-e Film	33.90	7.8%	15.62	15.5%	3.23	11.1%	33.55	3.3%	15.27	7.0%	3.48	4.9%	32.39	-1.3%	14.11	-3.1%	3.42	-3.4%
Spectrally Selective + Low-e Film	32.54	11.5%	14.26	22.8%	3.21	11.7%	32.51	6.3%	14.23	13.4%	3.37	7.9%	31.91	0.2%	13.63	0.4%	3.33	-0.6%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.84	--	18.56	--	3.60	--	34.00	--	15.72	--	3.51	--	32.31	--	14.03	--	3.35	--
Traditional Tint Film	37.39	-1.5%	19.11	-3.0%	3.66	-1.8%	35.41	-4.2%	17.13	-9.0%	3.74	-6.4%	34.06	-5.4%	15.78	-12.5%	3.64	-8.6%
Spectrally Selective Film	36.42	1.1%	18.14	2.3%	3.51	2.5%	34.19	-0.6%	15.91	-1.2%	3.53	-0.6%	32.67	-1.1%	14.39	-2.6%	3.42	-2.0%
Low-e Film	34.99	5.0%	16.71	10.0%	3.46	3.9%	33.98	0.0%	15.70	0.1%	3.54	-0.8%	33.05	-2.3%	14.77	-5.3%	3.51	-4.5%
Spectrally Selective + Low-e Film	33.27	9.7%	14.99	19.2%	3.37	6.3%	32.88	3.3%	14.61	7.1%	3.45	1.9%	32.33	-0.1%	14.05	-0.1%	3.40	-1.2%

Climate Zone 13

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	47.44	--	29.16	--	5.01	--	44.03	--	25.75	--	4.78	--	38.10	--	19.82	--	4.00	--
Traditional Tint Film	42.98	9.4%	24.70	15.3%	4.30	14.3%	41.96	4.7%	23.68	8.0%	4.45	6.9%	37.84	0.7%	19.56	1.3%	3.95	1.3%
Spectrally Selective Film	43.97	7.3%	25.69	11.9%	4.48	10.5%	42.47	3.5%	24.19	6.1%	4.53	5.1%	37.87	0.6%	19.59	1.2%	3.95	1.1%
Low-e Film	39.47	16.8%	21.19	27.3%	3.91	22.0%	39.52	10.2%	21.24	17.5%	4.10	14.2%	37.11	2.6%	18.83	5.0%	3.85	3.6%
Spectrally Selective + Low-e Film	38.58	18.7%	20.30	30.4%	3.94	21.5%	39.00	11.4%	20.71	19.5%	4.06	15.1%	36.83	3.3%	18.55	6.4%	3.83	4.1%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	45.48	--	27.20	--	4.71	--	41.36	--	23.08	--	4.39	--	38.54	--	20.26	--	4.06	--
Traditional Tint Film	43.16	5.1%	24.88	8.5%	4.31	8.5%	40.29	2.6%	22.01	4.7%	4.21	4.2%	38.09	1.2%	19.81	2.2%	3.98	2.0%
Spectrally Selective Film	43.67	4.0%	25.39	6.6%	4.42	6.2%	40.62	1.8%	22.34	3.2%	4.27	2.8%	38.30	0.6%	20.02	1.1%	4.02	1.0%
Low-e Film	40.36	11.2%	22.08	18.8%	4.04	14.3%	38.81	6.2%	20.53	11.1%	4.00	8.9%	37.24	3.4%	18.96	6.4%	3.86	4.9%
Spectrally Selective + Low-e Film	38.95	14.4%	20.67	24.0%	3.97	15.7%	38.21	7.6%	19.93	13.7%	3.95	10.1%	37.05	3.8%	18.77	7.3%	3.86	4.8%

Climate Zone 13

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	41.53	--	23.24	--	4.16	--	39.93	--	21.65	--	4.19	--	36.85	--	18.57	--	3.83	--
Traditional Tint Film	40.04	3.6%	21.76	6.4%	3.88	6.6%	39.68	0.6%	21.40	1.1%	4.13	1.4%	36.95	-0.3%	18.67	-0.6%	3.84	-0.3%
Spectrally Selective Film	40.47	2.5%	22.19	4.5%	3.98	4.3%	39.86	0.2%	21.58	0.3%	4.17	0.6%	36.91	-0.2%	18.63	-0.3%	3.84	-0.2%
Low-e Film	37.58	9.5%	19.30	17.0%	3.67	11.8%	37.76	5.4%	19.48	10.0%	3.88	7.5%	36.15	1.9%	17.87	3.7%	3.75	2.0%
Spectrally Selective + Low-e Film	36.59	11.9%	18.31	21.2%	3.68	11.5%	36.93	7.5%	18.65	13.9%	3.82	8.7%	35.57	3.5%	17.29	6.9%	3.70	3.4%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	41.26	--	22.98	--	4.10	--	38.72	--	20.43	--	4.00	--	36.95	--	18.67	--	3.83	--
Traditional Tint Film	40.19	2.6%	21.91	4.6%	3.90	4.8%	38.48	0.6%	20.20	1.1%	3.95	1.3%	37.12	-0.5%	18.84	-0.9%	3.85	-0.6%
Spectrally Selective Film	40.46	1.9%	22.18	3.5%	3.97	3.2%	38.62	0.3%	20.34	0.5%	3.98	0.5%	37.10	-0.4%	18.81	-0.8%	3.85	-0.6%
Low-e Film	38.04	7.8%	19.76	14.0%	3.75	8.7%	37.15	4.0%	18.87	7.7%	3.79	5.2%	36.21	2.0%	17.93	4.0%	3.75	2.1%
Spectrally Selective + Low-e Film	36.68	11.1%	18.40	19.9%	3.69	10.0%	36.29	6.3%	18.01	11.9%	3.74	6.6%	35.69	3.4%	17.41	6.7%	3.71	3.1%

Climate Zone 13

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.47	--	20.19	--	3.70	--	36.79	--	18.51	--	3.73	--	33.72	--	15.44	--	3.37	--
Traditional Tint Film	37.75	1.9%	19.47	3.6%	3.57	3.6%	37.49	-1.9%	19.21	-3.8%	3.86	-3.5%	35.12	-4.1%	16.84	-9.0%	3.63	-7.6%
Spectrally Selective Film	37.50	2.5%	19.22	4.8%	3.52	4.8%	36.77	0.0%	18.49	0.1%	3.70	0.6%	33.87	-0.4%	15.59	-1.0%	3.39	-0.5%
Low-e Film	35.14	8.7%	16.86	16.5%	3.30	10.9%	35.30	4.0%	17.02	8.0%	3.55	4.7%	34.05	-1.0%	15.77	-2.1%	3.50	-3.7%
Spectrally Selective + Low-e Film	33.92	11.8%	15.64	22.5%	3.27	11.7%	34.17	7.1%	15.89	14.1%	3.43	7.8%	33.49	0.7%	15.21	1.5%	3.44	-1.8%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.43	--	20.15	--	3.66	--	35.87	--	17.59	--	3.57	--	34.07	--	15.79	--	3.42	--
Traditional Tint Film	38.75	-0.8%	20.47	-1.6%	3.73	-2.0%	37.28	-3.9%	19.00	-8.0%	3.82	-6.8%	35.90	-5.4%	17.62	-11.6%	3.73	-9.0%
Spectrally Selective Film	37.81	1.6%	19.53	3.0%	3.57	2.4%	36.02	-0.4%	17.74	-0.9%	3.61	-1.1%	34.45	-1.1%	16.17	-2.4%	3.50	-2.5%
Low-e Film	36.38	5.3%	18.10	10.1%	3.53	3.4%	35.68	0.5%	17.40	1.1%	3.62	-1.3%	34.75	-2.0%	16.47	-4.3%	3.58	-4.8%
Spectrally Selective + Low-e Film	34.72	9.6%	16.44	18.4%	3.44	6.0%	34.49	3.8%	16.21	7.8%	3.52	1.4%	33.94	0.4%	15.66	0.8%	3.50	-2.5%

Climate Zone 14

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	45.36	--	27.07	--	5.21	--	41.93	--	23.65	--	4.96	--	36.70	--	18.42	--	4.13	--
Traditional Tint Film	41.98	7.4%	23.70	12.5%	4.45	14.5%	40.19	4.2%	21.90	7.4%	4.61	7.1%	36.51	0.5%	18.22	1.0%	4.08	1.3%
Spectrally Selective Film	42.63	6.0%	24.34	10.1%	4.65	10.7%	40.59	3.2%	22.31	5.7%	4.70	5.2%	36.52	0.5%	18.24	1.0%	4.09	1.1%
Low-e Film	38.88	14.3%	20.60	23.9%	4.04	22.4%	38.15	9.0%	19.86	16.0%	4.24	14.4%	35.91	2.2%	17.63	4.3%	3.96	4.2%
Spectrally Selective + Low-e Film	37.62	17.1%	19.33	28.6%	4.07	21.8%	37.64	10.2%	19.36	18.1%	4.20	15.3%	35.70	2.7%	17.41	5.4%	3.90	5.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	43.82	--	25.53	--	4.89	--	39.64	--	21.36	--	4.55	--	37.08	--	18.80	--	4.20	--
Traditional Tint Film	42.18	3.7%	23.90	6.4%	4.46	8.7%	38.82	2.1%	20.54	3.8%	4.36	4.3%	36.73	0.9%	18.45	1.9%	4.11	2.0%
Spectrally Selective Film	42.48	3.1%	24.19	5.2%	4.58	6.3%	39.06	1.5%	20.78	2.7%	4.42	2.9%	36.89	0.5%	18.61	1.0%	4.15	1.0%
Low-e Film	39.63	9.5%	21.35	16.4%	4.18	14.6%	37.60	5.1%	19.32	9.5%	4.14	9.1%	36.03	2.8%	17.75	5.6%	3.97	5.4%
Spectrally Selective + Low-e Film	38.05	13.2%	19.77	22.6%	4.10	16.0%	37.06	6.5%	18.77	12.1%	4.06	10.7%	35.89	3.2%	17.61	6.3%	3.93	6.3%

Climate Zone 14

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	40.65	--	22.37	--	4.31	--	38.47	--	20.19	--	4.34	--	35.67	--	17.39	--	3.94	--
Traditional Tint Film	39.75	2.2%	21.47	4.0%	4.01	6.8%	38.32	0.4%	20.04	0.8%	4.28	1.4%	35.77	-0.3%	17.49	-0.6%	3.95	-0.3%
Spectrally Selective Film	39.96	1.7%	21.67	3.1%	4.12	4.4%	38.45	0.1%	20.17	0.1%	4.31	0.6%	35.73	-0.2%	17.45	-0.3%	3.94	-0.2%
Low-e Film	37.31	8.2%	19.03	14.9%	3.79	12.1%	36.67	4.7%	18.38	8.9%	4.01	7.6%	35.10	1.6%	16.82	3.3%	3.82	2.8%
Spectrally Selective + Low-e Film	35.97	11.5%	17.69	20.9%	3.76	12.6%	35.86	6.8%	17.58	12.9%	3.91	9.8%	34.60	3.0%	16.32	6.2%	3.69	6.2%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	40.56	--	22.28	--	4.24	--	37.52	--	19.24	--	4.14	--	35.77	--	17.49	--	3.94	--
Traditional Tint Film	39.89	1.6%	21.61	3.0%	4.04	4.9%	37.38	0.4%	19.09	0.8%	4.09	1.3%	35.93	-0.4%	17.65	-0.9%	3.96	-0.6%
Spectrally Selective Film	40.00	1.4%	21.72	2.5%	4.10	3.3%	37.46	0.2%	19.18	0.3%	4.12	0.6%	35.90	-0.4%	17.62	-0.7%	3.96	-0.6%
Low-e Film	37.68	7.1%	19.40	12.9%	3.87	8.8%	36.20	3.5%	17.92	6.9%	3.92	5.3%	35.17	1.7%	16.88	3.5%	3.83	2.9%
Spectrally Selective + Low-e Film	36.09	11.0%	17.80	20.1%	3.79	10.8%	35.36	5.7%	17.08	11.2%	3.81	7.9%	34.71	3.0%	16.43	6.1%	3.72	5.5%

Climate Zone 14

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.69	--	19.41	--	3.84	--	35.38	--	17.10	--	3.86	--	32.62	--	14.33	--	3.47	--
Traditional Tint Film	37.52	0.5%	19.24	0.9%	3.70	3.6%	36.15	-2.2%	17.87	-4.5%	4.00	-3.5%	33.94	-4.1%	15.66	-9.2%	3.72	-7.0%
Spectrally Selective Film	37.10	1.6%	18.82	3.1%	3.65	4.9%	35.41	-0.1%	17.13	-0.2%	3.84	0.6%	32.75	-0.4%	14.47	-1.0%	3.49	-0.5%
Low-e Film	34.98	7.2%	16.70	14.0%	3.41	11.1%	34.24	3.2%	15.96	6.7%	3.69	4.6%	33.06	-1.4%	14.78	-3.1%	3.56	-2.5%
Spectrally Selective + Low-e Film	33.41	11.4%	15.13	22.1%	3.35	12.5%	33.15	6.3%	14.87	13.0%	3.51	9.1%	32.63	-0.0%	14.34	-0.1%	3.42	1.5%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.80	--	19.52	--	3.79	--	34.72	--	16.44	--	3.71	--	32.94	--	14.66	--	3.53	--
Traditional Tint Film	38.46	-1.7%	20.18	-3.4%	3.86	-1.8%	36.17	-4.2%	17.89	-8.8%	3.95	-6.6%	34.71	-5.4%	16.43	-12.1%	3.83	-8.8%
Spectrally Selective Film	37.44	1.0%	19.16	1.8%	3.70	2.5%	34.92	-0.6%	16.63	-1.2%	3.75	-0.9%	33.30	-1.1%	15.02	-2.5%	3.61	-2.4%
Low-e Film	36.05	4.6%	17.77	9.0%	3.65	3.7%	34.74	-0.0%	16.45	-0.1%	3.73	-0.6%	33.71	-2.3%	15.42	-5.2%	3.66	-3.8%
Spectrally Selective + Low-e Film	34.21	9.5%	15.93	18.4%	3.53	7.1%	33.61	3.2%	15.33	6.8%	3.60	3.1%	33.02	-0.2%	14.73	-0.5%	3.49	1.0%

Climate Zone 15

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	51.89	--	33.60	--	5.21	--	48.87	--	30.59	--	4.97	--	42.01	--	23.72	--	4.14	--
Traditional Tint Film	45.95	11.4%	27.66	17.7%	4.46	14.5%	46.19	5.5%	27.90	8.8%	4.62	7.0%	41.57	1.0%	23.29	1.8%	4.10	1.2%
Spectrally Selective Film	47.40	8.6%	29.12	13.3%	4.66	10.7%	46.87	4.1%	28.58	6.6%	4.71	5.2%	41.63	0.9%	23.35	1.6%	4.10	1.0%
Low-e Film	42.33	18.4%	24.05	28.4%	4.05	22.3%	43.23	11.5%	24.95	18.4%	4.25	14.4%	40.61	3.3%	22.32	5.9%	4.00	3.4%
Spectrally Selective + Low-e Film	41.94	19.2%	23.65	29.6%	4.08	21.8%	42.69	12.7%	24.41	20.2%	4.22	15.1%	40.21	4.3%	21.93	7.6%	3.98	3.9%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	49.28	--	30.99	--	4.90	--	45.60	--	27.31	--	4.56	--	42.51	--	24.23	--	4.21	--
Traditional Tint Film	46.07	6.5%	27.78	10.4%	4.47	8.7%	44.12	3.2%	25.84	5.4%	4.37	4.3%	41.84	1.6%	23.56	2.8%	4.12	2.0%
Spectrally Selective Film	46.87	4.9%	28.59	7.8%	4.59	6.3%	44.58	2.2%	26.30	3.7%	4.43	2.9%	42.17	0.8%	23.89	1.4%	4.16	1.0%
Low-e Film	43.34	12.1%	25.05	19.2%	4.18	14.6%	42.34	7.2%	24.05	11.9%	4.15	9.1%	40.74	4.2%	22.46	7.3%	4.01	4.7%
Spectrally Selective + Low-e Film	42.19	14.4%	23.91	22.9%	4.11	16.1%	41.67	8.6%	23.39	14.4%	4.10	10.1%	40.49	4.8%	22.20	8.4%	4.01	4.7%

Climate Zone 15

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	44.40	--	26.12	--	4.31	--	43.75	--	25.47	--	4.35	--	40.35	--	22.07	--	3.98	--
Traditional Tint Film	42.29	4.8%	24.00	8.1%	4.03	6.7%	43.29	1.1%	25.01	1.8%	4.29	1.4%	40.41	-0.1%	22.12	-0.3%	3.99	-0.3%
Spectrally Selective Film	42.97	3.2%	24.69	5.5%	4.12	4.4%	43.56	0.5%	25.27	0.8%	4.33	0.6%	40.36	-0.0%	22.08	-0.1%	3.99	-0.2%
Low-e Film	40.10	9.7%	21.82	16.5%	3.80	11.9%	41.10	6.1%	22.82	10.4%	4.03	7.5%	39.49	2.1%	21.20	3.9%	3.90	2.0%
Spectrally Selective + Low-e Film	39.46	11.1%	21.18	18.9%	3.82	11.4%	40.25	8.0%	21.96	13.8%	3.97	8.7%	38.81	3.8%	20.52	7.0%	3.84	3.5%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	43.92	--	25.64	--	4.25	--	42.18	--	23.90	--	4.15	--	40.44	--	22.15	--	3.98	--
Traditional Tint Film	42.44	3.4%	24.16	5.8%	4.05	4.8%	41.79	0.9%	23.50	1.6%	4.10	1.3%	40.56	-0.3%	22.28	-0.6%	4.00	-0.6%
Spectrally Selective Film	42.87	2.4%	24.59	4.1%	4.11	3.3%	41.99	0.4%	23.71	0.8%	4.13	0.5%	40.57	-0.3%	22.28	-0.6%	4.00	-0.6%
Low-e Film	40.62	7.5%	22.34	12.9%	3.88	8.7%	40.34	4.4%	22.05	7.7%	3.94	5.2%	39.53	2.3%	21.24	4.1%	3.90	2.1%
Spectrally Selective + Low-e Film	39.53	10.0%	21.24	17.1%	3.83	9.9%	39.46	6.5%	21.17	11.4%	3.88	6.5%	38.95	3.7%	20.66	6.7%	3.85	3.2%

Climate Zone 15

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	66%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	40.97	--	22.68	--	3.84	--	40.28	--	22.00	--	3.88	--	36.92	--	18.64	--	3.51	--
Traditional Tint Film	39.66	3.2%	21.37	5.8%	3.69	3.9%	40.86	-1.4%	22.58	-2.6%	4.01	-3.4%	38.40	-4.0%	20.12	-7.9%	3.77	-7.4%
Spectrally Selective Film	39.58	3.4%	21.30	6.1%	3.66	4.8%	40.13	0.4%	21.84	0.7%	3.85	0.6%	37.01	-0.2%	18.72	-0.5%	3.53	-0.4%
Low-e Film	37.28	9.0%	19.00	16.2%	3.42	11.1%	38.35	4.8%	20.07	8.8%	3.69	5.0%	37.19	-0.7%	18.90	-1.4%	3.63	-3.3%
Spectrally Selective + Low-e Film	36.38	11.2%	18.09	20.2%	3.39	11.8%	37.18	7.7%	18.89	14.1%	3.56	8.1%	36.47	1.2%	18.19	2.4%	3.57	-1.5%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	40.69	--	22.41	--	3.80	--	38.98	--	20.70	--	3.71	--	37.24	--	18.96	--	3.55	--
Traditional Tint Film	40.85	-0.4%	22.57	-0.7%	3.87	-1.8%	40.48	-3.8%	22.19	-7.2%	3.96	-6.8%	39.25	-5.4%	20.97	-10.6%	3.87	-9.0%
Spectrally Selective Film	39.83	2.1%	21.55	3.8%	3.70	2.6%	39.07	-0.2%	20.79	-0.4%	3.74	-1.0%	37.64	-1.1%	19.36	-2.1%	3.63	-2.4%
Low-e Film	38.79	4.7%	20.51	8.5%	3.66	3.5%	38.73	0.6%	20.45	1.2%	3.76	-1.6%	37.95	-1.9%	19.66	-3.7%	3.72	-4.9%
Spectrally Selective + Low-e Film	37.35	8.2%	19.07	14.9%	3.57	5.9%	37.49	3.8%	19.21	7.2%	3.66	1.2%	37.00	0.6%	18.72	1.3%	3.64	-2.5%

Climate Zone 16

Daylighting Off
Window Shades No
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	45.83	--	27.55	--	4.90	--	39.62	--	21.34	--	4.61	--	35.09	--	16.81	--	3.59	--
Traditional Tint Film	45.12	1.5%	26.84	2.6%	3.98	18.8%	38.98	1.6%	20.70	3.0%	4.18	9.3%	35.15	-0.2%	16.87	-0.4%	3.52	1.8%
Spectrally Selective Film	44.85	2.1%	26.57	3.6%	4.26	13.1%	39.05	1.4%	20.77	2.7%	4.30	6.6%	35.11	-0.1%	16.83	-0.2%	3.53	1.6%
Low-e Film	41.26	10.0%	22.98	16.6%	3.47	29.1%	37.39	5.6%	19.11	10.5%	3.74	18.8%	34.84	0.7%	16.56	1.5%	3.37	6.1%
Spectrally Selective + Low-e Film	37.90	17.3%	19.62	28.8%	3.53	28.0%	36.45	8.0%	18.17	14.9%	3.67	20.2%	34.58	1.4%	16.30	3.0%	3.30	8.0%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	45.57	--	27.29	--	4.52	--	38.55	--	20.27	--	4.08	--	35.46	--	17.18	--	3.66	--
Traditional Tint Film	45.46	0.2%	27.18	0.4%	3.96	12.4%	38.47	0.2%	20.19	0.4%	3.82	6.3%	35.48	-0.1%	17.20	-0.1%	3.55	2.8%
Spectrally Selective Film	45.17	0.9%	26.89	1.4%	4.13	8.7%	38.43	0.3%	20.15	0.6%	3.90	4.4%	35.45	0.0%	17.17	0.1%	3.61	1.3%
Low-e Film	41.82	8.2%	23.54	13.7%	3.58	20.7%	37.29	3.3%	19.01	6.2%	3.55	12.9%	35.03	1.2%	16.75	2.5%	3.38	7.5%
Spectrally Selective + Low-e Film	38.55	15.4%	20.27	25.7%	3.48	22.9%	36.32	5.8%	18.05	11.0%	3.46	15.0%	34.76	2.0%	16.48	4.1%	3.34	8.7%

Climate Zone 16

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	43.27	--	24.99	--	3.77	--	37.73	--	19.45	--	3.81	--	34.65	--	16.37	--	3.36	--
Traditional Tint Film	43.58	-0.7%	25.30	-1.3%	3.38	10.3%	37.94	-0.6%	19.66	-1.1%	3.72	2.4%	34.81	-0.4%	16.53	-0.9%	3.37	-0.2%
Spectrally Selective Film	43.27	-0.0%	24.99	-0.0%	3.51	6.8%	37.90	-0.4%	19.62	-0.8%	3.77	1.2%	34.76	-0.3%	16.48	-0.7%	3.36	-0.0%
Low-e Film	39.95	7.7%	21.67	13.3%	3.14	16.5%	36.36	3.6%	18.08	7.0%	3.42	10.3%	34.26	1.1%	15.98	2.4%	3.22	4.0%
Spectrally Selective + Low-e Film	36.91	14.7%	18.63	25.5%	3.15	16.3%	35.22	6.7%	16.94	12.9%	3.33	12.7%	33.72	2.7%	15.44	5.7%	3.13	6.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	43.68	--	25.40	--	3.65	--	37.53	--	19.25	--	3.56	--	34.89	--	16.61	--	3.37	--
Traditional Tint Film	43.77	-0.2%	25.49	-0.4%	3.39	7.3%	37.63	-0.3%	19.35	-0.5%	3.48	2.1%	35.08	-0.5%	16.80	-1.1%	3.38	-0.4%
Spectrally Selective Film	43.52	0.4%	25.24	0.6%	3.48	4.9%	37.58	-0.1%	19.30	-0.2%	3.52	1.0%	35.01	-0.3%	16.73	-0.7%	3.39	-0.6%
Low-e Film	40.19	8.0%	21.91	13.7%	3.21	12.0%	36.28	3.3%	18.00	6.5%	3.29	7.5%	34.43	1.3%	16.15	2.8%	3.22	4.2%
Spectrally Selective + Low-e Film	37.11	15.0%	18.83	25.8%	3.15	13.8%	35.07	6.6%	16.79	12.8%	3.20	10.2%	33.87	2.9%	15.59	6.1%	3.15	6.4%

Climate Zone 16

Daylighting On (30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 66% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	40.89	--	22.61	--	3.41	--	35.16	--	16.88	--	3.48	--	32.17	--	13.89	--	2.96	--
Traditional Tint Film	41.87	-2.4%	23.59	-4.3%	3.08	9.7%	36.18	-2.9%	17.90	-6.0%	3.44	0.9%	33.30	-3.5%	15.03	-8.2%	3.14	-5.9%
Spectrally Selective Film	41.04	-0.4%	22.76	-0.6%	3.10	9.0%	35.39	-0.7%	17.11	-1.4%	3.42	1.8%	32.35	-0.6%	14.07	-1.3%	2.96	0.0%
Low-e Film	38.20	6.6%	19.92	11.9%	2.80	17.9%	34.41	2.1%	16.13	4.4%	3.11	10.6%	32.57	-1.2%	14.29	-2.9%	2.96	-0.0%
Spectrally Selective + Low-e Film	35.03	14.3%	16.75	25.9%	2.76	19.0%	33.02	6.1%	14.74	12.7%	2.96	14.9%	32.07	0.3%	13.79	0.7%	2.86	3.3%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	41.50	--	23.22	--	3.26	--	35.26	--	16.98	--	3.18	--	32.61	--	14.33	--	2.99	--
Traditional Tint Film	42.66	-2.8%	24.38	-5.0%	3.21	1.5%	36.65	-3.9%	18.37	-8.2%	3.33	-4.8%	34.08	-4.5%	15.80	-10.3%	3.23	-8.2%
Spectrally Selective Film	41.54	-0.1%	23.26	-0.2%	3.11	4.6%	35.52	-0.7%	17.24	-1.5%	3.17	0.1%	32.88	-0.8%	14.60	-1.9%	3.04	-1.9%
Low-e Film	38.91	6.2%	20.63	11.2%	3.00	7.9%	35.10	0.4%	16.82	0.9%	3.10	2.4%	33.22	-1.9%	14.94	-4.3%	3.03	-1.5%
Spectrally Selective + Low-e Film	35.61	14.2%	17.33	25.3%	2.89	11.1%	33.62	4.6%	15.34	9.6%	2.97	6.7%	32.42	0.6%	14.14	1.3%	2.92	2.1%

WINDOW TO WALL RATIO: 33%

Climate Zone 1

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

Window Film	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.02	--	13.75	--	3.42	--	30.79	--	12.52	--	3.36	--	29.61	--	11.34	--	3.04	--
Traditional Tint Film	31.48	1.7%	13.21	3.9%	2.95	13.7%	30.51	0.9%	12.24	2.2%	3.20	4.7%	29.61	-0.0%	11.34	-0.0%	3.00	1.3%
Spectrally Selective Film	31.52	1.6%	13.24	3.7%	3.09	9.7%	30.57	0.7%	12.29	1.8%	3.24	3.6%	29.60	0.0%	11.33	0.1%	3.02	0.6%
Low-e Film	30.50	4.7%	12.23	11.0%	2.77	18.8%	30.08	2.3%	11.81	5.7%	3.03	9.8%	29.54	0.3%	11.26	0.7%	2.94	3.0%
Spectrally Selective + Low-e Film	30.01	6.3%	11.74	14.6%	2.95	13.9%	29.97	2.7%	11.70	6.5%	3.03	9.7%	29.52	0.3%	11.25	0.8%	2.91	4.2%

Window Film	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.16	--	14.89	--	3.32	--	30.95	--	12.68	--	3.24	--	30.00	--	11.72	--	3.13	--
Traditional Tint Film	32.93	0.7%	14.65	1.6%	2.99	9.9%	30.82	0.4%	12.55	1.1%	3.13	3.4%	29.96	0.1%	11.69	0.3%	3.05	2.6%
Spectrally Selective Film	32.89	0.8%	14.61	1.8%	3.13	5.9%	30.85	0.3%	12.58	0.8%	3.17	2.2%	29.98	0.1%	11.70	0.1%	3.09	1.3%
Low-e Film	31.65	4.6%	13.38	10.2%	2.87	13.5%	30.44	1.7%	12.17	4.0%	3.03	6.4%	29.80	0.6%	11.53	1.6%	2.99	4.4%
Spectrally Selective + Low-e Film	30.79	7.1%	12.52	15.9%	2.97	10.3%	30.24	2.3%	11.97	5.6%	3.03	6.3%	29.79	0.7%	11.52	1.7%	3.00	4.1%

Climate Zone 1

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	30.99	--	12.72	--	2.96	--	30.09	--	11.82	--	3.09	--	29.46	--	11.18	--	2.92	--
Traditional Tint Film	30.89	0.3%	12.61	0.8%	2.73	7.7%	30.09	0.0%	11.82	0.0%	3.01	2.3%	29.49	-0.1%	11.21	-0.3%	2.92	-0.1%
Spectrally Selective Film	30.88	0.4%	12.60	0.9%	2.78	5.8%	30.11	-0.0%	11.83	-0.1%	3.03	1.7%	29.48	-0.1%	11.20	-0.2%	2.92	0.0%
Low-e Film	30.19	2.6%	11.92	6.3%	2.67	9.5%	29.71	1.3%	11.43	3.3%	2.92	5.2%	29.40	0.2%	11.13	0.5%	2.86	2.2%
Spectrally Selective + Low-e Film	29.81	3.8%	11.54	9.3%	2.75	7.1%	29.55	1.8%	11.28	4.6%	2.84	8.0%	29.38	0.3%	11.11	0.7%	2.79	4.4%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.13	--	13.85	--	2.90	--	30.38	--	12.11	--	3.02	--	29.69	--	11.42	--	2.97	--
Traditional Tint Film	32.04	0.3%	13.76	0.6%	2.73	5.8%	30.38	0.0%	12.11	0.0%	2.98	1.3%	29.75	-0.2%	11.48	-0.5%	2.98	-0.2%
Spectrally Selective Film	32.00	0.4%	13.72	0.9%	2.81	3.3%	30.39	-0.0%	12.12	-0.1%	3.00	0.7%	29.73	-0.1%	11.46	-0.4%	2.98	-0.3%
Low-e Film	30.89	3.9%	12.61	8.9%	2.72	6.2%	29.97	1.4%	11.69	3.4%	2.91	3.8%	29.60	0.3%	11.32	0.8%	2.93	1.4%
Spectrally Selective + Low-e Film	30.20	6.0%	11.92	13.9%	2.78	4.5%	29.74	2.1%	11.47	5.3%	2.83	6.6%	29.54	0.5%	11.27	1.3%	2.84	4.4%

Climate Zone 1

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	28.61	--	10.34	--	2.50	--	27.63	--	9.36	--	2.59	--	27.33	--	9.05	--	2.45	--
Traditional Tint Film	29.71	-3.8%	11.43	-10.6%	2.46	1.3%	28.99	-4.9%	10.71	-14.4%	2.78	-7.2%	28.76	-5.2%	10.48	-15.8%	2.69	-10.2%
Spectrally Selective Film	28.77	-0.6%	10.50	-1.6%	2.33	6.2%	27.82	-0.7%	9.55	-2.0%	2.56	1.3%	27.59	-1.0%	9.32	-3.0%	2.48	-1.2%
Low-e Film	29.06	-1.6%	10.79	-4.4%	2.39	4.1%	28.50	-3.1%	10.23	-9.3%	2.60	-0.5%	28.61	-4.7%	10.34	-14.2%	2.62	-7.3%
Spectrally Selective + Low-e Film	28.35	0.9%	10.08	2.5%	2.40	3.9%	28.08	-1.6%	9.80	-4.7%	2.52	2.6%	28.60	-4.7%	10.33	-14.1%	2.58	-5.5%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	30.05	--	11.78	--	2.52	--	28.33	--	10.06	--	2.61	--	27.77	--	9.49	--	2.54	--
Traditional Tint Film	31.36	-4.3%	13.08	-11.1%	2.59	-2.9%	29.86	-5.4%	11.59	-15.2%	2.88	-10.1%	29.26	-5.4%	10.99	-15.7%	2.87	-13.2%
Spectrally Selective Film	30.20	-0.5%	11.92	-1.2%	2.44	3.3%	28.66	-1.1%	10.38	-3.2%	2.65	-1.3%	28.10	-1.2%	9.82	-3.4%	2.63	-3.5%
Low-e Film	30.14	-0.3%	11.87	-0.7%	2.52	-0.2%	29.35	-3.6%	11.08	-10.1%	2.70	-3.2%	29.02	-4.5%	10.74	-13.1%	2.75	-8.4%
Spectrally Selective + Low-e Film	29.27	2.6%	10.99	6.7%	2.51	0.3%	28.89	-2.0%	10.61	-5.5%	2.63	-0.8%	28.71	-3.4%	10.44	-9.9%	2.65	-4.3%

Climate Zone 2

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.58	--	17.31	--	3.66	--	34.10	--	15.82	--	3.87	--	32.20	--	13.93	--	3.43	--
Traditional Tint Film	34.38	3.4%	16.11	6.9%	3.29	10.1%	33.53	1.7%	15.25	3.6%	3.71	4.1%	32.15	0.1%	13.88	0.3%	3.38	1.5%
Spectrally Selective Film	34.61	2.7%	16.33	5.6%	3.75	-2.4%	33.65	1.3%	15.38	2.8%	3.75	3.1%	32.15	0.1%	13.88	0.3%	3.40	1.1%
Low-e Film	33.03	7.2%	14.76	14.8%	3.45	5.6%	32.79	3.8%	14.52	8.2%	3.55	8.4%	31.98	0.7%	13.71	1.5%	3.27	4.8%
Spectrally Selective + Low-e Film	32.59	8.4%	14.32	17.3%	3.47	5.3%	32.66	4.2%	14.38	9.1%	3.49	10.0%	31.95	0.8%	13.67	1.8%	3.22	6.0%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.74	--	18.47	--	4.07	--	34.16	--	15.88	--	3.85	--	32.82	--	14.55	--	3.62	--
Traditional Tint Film	36.06	1.9%	17.79	3.7%	3.82	6.3%	33.82	1.0%	15.54	2.1%	3.73	3.1%	32.70	0.4%	14.42	0.9%	3.57	1.6%
Spectrally Selective Film	36.14	1.7%	17.86	3.3%	3.88	4.7%	33.91	0.7%	15.64	1.5%	3.77	2.1%	32.76	0.2%	14.49	0.4%	3.60	0.8%
Low-e Film	34.49	6.1%	16.21	12.2%	3.64	10.7%	33.24	2.7%	14.96	5.8%	3.59	6.7%	32.40	1.3%	14.13	2.9%	3.41	5.8%
Spectrally Selective + Low-e Film	33.60	8.6%	15.33	17.0%	3.58	12.1%	32.99	3.4%	14.72	7.3%	3.53	8.4%	32.38	1.4%	14.11	3.0%	3.38	6.8%

Climate Zone 2

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.66	--	15.39	--	3.56	--	32.80	--	14.53	--	3.57	--	31.90	--	13.62	--	3.24	--
Traditional Tint Film	33.28	1.1%	15.01	2.5%	3.37	5.3%	32.74	0.2%	14.47	0.4%	3.53	0.9%	31.91	-0.1%	13.64	-0.1%	3.25	-0.1%
Spectrally Selective Film	33.37	0.9%	15.10	1.9%	3.46	2.7%	32.79	0.0%	14.51	0.1%	3.55	0.4%	31.90	-0.0%	13.63	-0.0%	3.24	0.0%
Low-e Film	32.44	3.6%	14.16	8.0%	3.16	11.3%	32.14	2.0%	13.87	4.6%	4.01	-12.5%	31.76	0.4%	13.49	1.0%	3.16	2.4%
Spectrally Selective + Low-e Film	32.08	4.7%	13.81	10.3%	3.14	11.9%	31.96	2.6%	13.69	5.8%	3.20	10.2%	31.69	0.6%	13.42	1.5%	3.12	3.8%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.93	--	16.66	--	3.65	--	33.09	--	14.82	--	3.58	--	32.28	--	14.01	--	3.39	--
Traditional Tint Film	34.61	0.9%	16.33	1.9%	3.48	4.7%	33.03	0.2%	14.76	0.4%	3.52	1.5%	32.34	-0.2%	14.06	-0.4%	3.39	-0.2%
Spectrally Selective Film	34.64	0.8%	16.37	1.7%	3.54	2.9%	33.07	0.1%	14.80	0.1%	3.56	0.6%	32.33	-0.2%	14.05	-0.3%	3.39	-0.3%
Low-e Film	33.32	4.6%	15.05	9.7%	3.34	8.4%	32.49	1.8%	14.22	4.0%	3.36	6.2%	32.07	0.6%	13.80	1.5%	3.25	4.0%
Spectrally Selective + Low-e Film	32.58	6.7%	14.31	14.1%	3.22	11.8%	32.19	2.7%	13.92	6.0%	3.22	9.9%	31.96	1.0%	13.69	2.3%	3.19	5.7%

Climate Zone 2

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	31.08	--	12.81	--	3.12	--	30.16	--	11.89	--	3.12	--	29.59	--	11.32	--	2.82	--
Traditional Tint Film	31.93	-2.7%	13.66	-6.7%	3.14	-0.8%	31.44	-4.2%	13.16	-10.7%	3.29	-5.5%	31.04	-4.9%	12.77	-12.8%	3.09	-9.5%
Spectrally Selective Film	31.05	0.1%	12.78	0.2%	3.03	2.8%	30.32	-0.5%	12.05	-1.3%	3.10	0.6%	29.86	-0.9%	11.59	-2.4%	2.87	-1.7%
Low-e Film	31.18	-0.3%	12.91	-0.8%	2.90	6.8%	30.83	-2.2%	12.55	-5.6%	3.03	2.8%	30.82	-4.2%	12.55	-10.9%	2.98	-5.9%
Spectrally Selective + Low-e Film	30.51	1.8%	12.24	4.5%	2.83	9.3%	30.39	-0.8%	12.12	-2.0%	2.92	6.5%	30.76	-3.9%	12.48	-10.3%	2.93	-4.0%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.64	--	14.37	--	3.27	--	30.92	--	12.65	--	3.20	--	30.24	--	11.97	--	3.01	--
Traditional Tint Film	33.75	-3.4%	15.47	-7.7%	3.32	-1.6%	32.36	-4.7%	14.09	-11.4%	3.41	-6.6%	31.71	-4.8%	13.43	-12.2%	3.29	-9.3%
Spectrally Selective Film	32.66	-0.0%	14.38	-0.1%	3.20	2.4%	31.21	-0.9%	12.94	-2.3%	3.24	-1.1%	30.57	-1.1%	12.30	-2.8%	3.06	-1.8%
Low-e Film	32.40	0.7%	14.13	1.7%	3.16	3.4%	31.70	-2.5%	13.43	-6.2%	3.19	0.3%	31.32	-3.6%	13.05	-9.0%	3.11	-3.5%
Spectrally Selective + Low-e Film	31.48	3.6%	13.21	8.1%	2.99	8.6%	31.19	-0.9%	12.92	-2.1%	3.06	4.5%	30.99	-2.5%	12.72	-6.2%	3.02	-0.6%

Climate Zone 3

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.63	--	15.35	--	3.69	--	32.78	--	14.50	--	3.61	--	31.10	--	12.82	--	3.16	--
Traditional Tint Film	32.25	4.1%	13.97	9.0%	3.18	13.9%	32.14	1.9%	13.87	4.3%	3.36	6.9%	31.03	0.2%	12.76	0.5%	3.13	1.0%
Spectrally Selective Film	32.54	3.2%	14.26	7.1%	3.35	9.2%	32.29	1.5%	14.02	3.3%	3.43	5.1%	31.04	0.2%	12.76	0.5%	3.13	0.9%
Low-e Film	31.25	7.1%	12.98	15.5%	2.98	19.1%	31.47	4.0%	13.20	9.0%	3.19	11.6%	30.86	0.7%	12.59	1.8%	3.04	3.8%
Spectrally Selective + Low-e Film	31.10	7.5%	12.83	16.4%	3.08	16.5%	31.42	4.1%	13.15	9.3%	3.15	12.6%	30.84	0.8%	12.57	2.0%	3.01	4.6%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.26	--	15.98	--	3.65	--	32.56	--	14.29	--	3.49	--	31.59	--	13.32	--	3.31	--
Traditional Tint Film	33.45	2.3%	15.18	5.0%	3.24	11.3%	32.19	1.1%	13.91	2.6%	3.34	4.4%	31.44	0.5%	13.17	1.1%	3.23	2.5%
Spectrally Selective Film	33.60	1.9%	15.33	4.1%	3.34	8.6%	32.30	0.8%	14.02	1.8%	3.39	3.1%	31.52	0.2%	13.24	0.6%	3.28	1.1%
Low-e Film	32.36	5.5%	14.08	11.9%	3.09	15.3%	31.70	2.6%	13.43	6.0%	3.11	10.9%	31.17	1.3%	12.90	3.2%	3.10	6.4%
Spectrally Selective + Low-e Film	31.83	7.1%	13.56	15.2%	3.08	15.7%	31.58	3.0%	13.30	6.9%	3.12	10.8%	31.19	1.3%	12.91	3.1%	3.06	7.5%

Climate Zone 3

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	31.87	--	13.60	--	3.19	--	31.53	--	13.26	--	3.24	--	30.77	--	12.50	--	3.07	--
Traditional Tint Film	31.36	1.6%	13.09	3.7%	2.93	8.3%	31.43	0.3%	13.15	0.8%	3.19	1.6%	30.80	-0.1%	12.52	-0.2%	3.04	1.1%
Spectrally Selective Film	31.50	1.2%	13.23	2.7%	2.98	6.7%	31.49	0.1%	13.22	0.3%	3.21	1.0%	30.79	-0.0%	12.51	-0.1%	3.03	1.2%
Low-e Film	30.82	3.3%	12.54	7.7%	2.86	10.3%	30.91	2.0%	12.63	4.7%	3.03	6.4%	30.62	0.5%	12.35	1.2%	3.03	1.3%
Spectrally Selective + Low-e Film	30.69	3.7%	12.41	8.7%	2.92	8.6%	30.78	2.4%	12.51	5.7%	3.02	6.8%	30.54	0.8%	12.27	1.9%	3.00	2.2%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.65	--	14.38	--	3.11	--	31.58	--	13.31	--	3.17	--	31.04	--	12.77	--	3.14	--
Traditional Tint Film	32.26	1.2%	13.99	2.7%	2.98	4.4%	31.50	0.3%	13.23	0.6%	3.07	3.3%	31.11	-0.2%	12.83	-0.5%	3.10	1.3%
Spectrally Selective Film	32.35	0.9%	14.07	2.1%	3.02	2.9%	31.56	0.1%	13.28	0.2%	3.12	1.6%	31.10	-0.2%	12.83	-0.5%	3.11	1.1%
Low-e Film	31.43	3.7%	13.16	8.5%	2.92	6.1%	31.06	1.7%	12.78	4.0%	3.00	5.4%	30.84	0.7%	12.57	1.6%	3.06	2.6%
Spectrally Selective + Low-e Film	31.00	5.1%	12.73	11.5%	2.93	5.8%	30.86	2.3%	12.58	5.5%	2.97	6.3%	30.75	1.0%	12.47	2.3%	3.03	3.5%

Climate Zone 3

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	29.11	--	10.83	--	2.73	--	28.73	--	10.45	--	2.82	--	28.28	--	10.01	--	2.67	--
Traditional Tint Film	29.95	-2.9%	11.68	-7.8%	2.74	-0.3%	30.10	-4.8%	11.83	-13.2%	2.99	-6.1%	29.86	-5.6%	11.59	-15.8%	2.90	-8.8%
Spectrally Selective Film	28.97	0.5%	10.69	1.3%	2.58	5.5%	28.88	-0.5%	10.60	-1.5%	2.80	0.9%	28.56	-1.0%	10.29	-2.8%	2.70	-1.2%
Low-e Film	29.39	-1.0%	11.12	-2.6%	2.65	2.9%	29.48	-2.6%	11.21	-7.2%	2.82	-0.1%	29.56	-4.5%	11.29	-12.8%	2.81	-5.6%
Spectrally Selective + Low-e Film	28.93	0.6%	10.66	1.7%	2.62	4.0%	29.06	-1.2%	10.79	-3.2%	2.76	2.3%	29.46	-4.2%	11.19	-11.8%	2.78	-4.4%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	30.27	--	12.00	--	2.78	--	29.31	--	11.04	--	2.82	--	28.85	--	10.57	--	2.78	--
Traditional Tint Film	31.40	-3.7%	13.12	-9.3%	2.85	-2.6%	30.83	-5.2%	12.56	-13.8%	2.98	-5.6%	30.45	-5.6%	12.18	-15.2%	3.01	-8.3%
Spectrally Selective Film	30.29	-0.0%	12.01	-0.1%	2.72	2.2%	29.61	-1.0%	11.33	-2.7%	2.82	-0.2%	29.20	-1.2%	10.93	-3.3%	2.82	-1.7%
Low-e Film	30.46	-0.6%	12.18	-1.5%	2.79	-0.4%	30.23	-3.1%	11.96	-8.3%	2.87	-1.9%	30.04	-4.1%	11.77	-11.3%	2.91	-4.7%
Spectrally Selective + Low-e Film	29.77	1.7%	11.50	4.2%	2.74	1.5%	29.77	-1.5%	11.49	-4.1%	2.82	-0.2%	29.68	-2.9%	11.41	-7.9%	2.84	-2.3%

Climate Zone 4

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.41	--	18.13	--	3.88	--	35.31	--	17.04	--	3.74	--	33.11	--	14.84	--	3.41	--
Traditional Tint Film	34.57	5.1%	16.29	10.1%	3.55	8.5%	34.46	2.4%	16.19	5.0%	3.60	3.8%	33.00	0.3%	14.73	0.7%	3.39	0.6%
Spectrally Selective Film	34.97	3.9%	16.70	7.9%	3.63	6.3%	34.67	1.8%	16.39	3.8%	3.64	2.9%	33.01	0.3%	14.74	0.7%	3.39	0.5%
Low-e Film	33.29	8.6%	15.02	17.2%	3.37	13.1%	33.56	5.0%	15.28	10.3%	3.46	7.6%	32.76	1.1%	14.48	2.4%	3.34	1.9%
Spectrally Selective + Low-e Film	33.13	9.0%	14.85	18.1%	3.39	12.6%	33.47	5.2%	15.19	10.8%	3.46	7.7%	32.70	1.3%	14.42	2.8%	3.31	2.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.07	--	18.79	--	3.94	--	35.00	--	16.72	--	3.73	--	33.78	--	15.51	--	3.53	--
Traditional Tint Film	35.96	3.0%	17.69	5.9%	3.70	6.2%	34.48	1.5%	16.20	3.1%	3.62	2.9%	33.54	0.7%	15.27	1.5%	3.49	1.2%
Spectrally Selective Film	36.19	2.4%	17.92	4.7%	3.76	4.6%	34.64	1.0%	16.36	2.2%	3.66	1.9%	33.66	0.4%	15.38	0.8%	3.51	0.6%
Low-e Film	34.60	6.7%	16.32	13.1%	3.53	10.3%	33.83	3.3%	15.56	7.0%	3.50	6.0%	33.17	1.8%	14.90	3.9%	3.42	3.1%
Spectrally Selective + Low-e Film	33.99	8.3%	15.72	16.4%	3.50	11.3%	33.65	3.8%	15.38	8.0%	3.49	6.5%	33.15	1.9%	14.88	4.0%	3.41	3.3%

Climate Zone 4

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.05	--	15.77	--	3.46	--	33.64	--	15.36	--	3.47	--	32.66	--	14.39	--	3.32	--
Traditional Tint Film	33.35	2.1%	15.07	4.4%	3.32	4.2%	33.47	0.5%	15.20	1.1%	3.45	0.7%	32.68	-0.0%	14.40	-0.1%	3.32	-0.0%
Spectrally Selective Film	33.55	1.5%	15.28	3.1%	3.37	2.7%	33.57	0.2%	15.29	0.5%	3.46	0.3%	32.66	-0.0%	14.39	-0.0%	3.31	0.1%
Low-e Film	32.66	4.1%	14.38	8.8%	3.21	7.3%	32.81	2.5%	14.53	5.4%	3.34	3.9%	32.45	0.6%	14.18	1.5%	3.24	2.3%
Spectrally Selective + Low-e Film	32.49	4.6%	14.22	9.9%	3.20	7.5%	32.64	3.0%	14.37	6.5%	3.28	5.6%	32.33	1.0%	14.05	2.3%	3.20	3.6%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.95	--	16.68	--	3.54	--	33.69	--	15.41	--	3.49	--	33.03	--	14.75	--	3.39	--
Traditional Tint Film	34.41	1.6%	16.13	3.3%	3.40	4.0%	33.56	0.4%	15.28	0.8%	3.45	1.0%	33.08	-0.2%	14.81	-0.4%	3.40	-0.3%
Spectrally Selective Film	34.54	1.2%	16.26	2.5%	3.44	2.6%	33.63	0.2%	15.36	0.3%	3.47	0.4%	33.08	-0.2%	14.81	-0.4%	3.40	-0.3%
Low-e Film	33.41	4.4%	15.14	9.2%	3.30	6.6%	33.01	2.0%	14.73	4.4%	3.35	3.9%	32.74	0.9%	14.47	1.9%	3.30	2.6%
Spectrally Selective + Low-e Film	32.90	5.9%	14.62	12.3%	3.26	7.8%	32.74	2.8%	14.47	6.1%	3.28	5.9%	32.61	1.3%	14.33	2.9%	3.25	4.0%

Climate Zone 4

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	31.18	--	12.91	--	3.03	--	30.72	--	12.45	--	3.05	--	30.08	--	11.80	--	2.91	--
Traditional Tint Film	31.85	-2.1%	13.57	-5.1%	3.10	-2.5%	32.04	-4.3%	13.77	-10.6%	3.28	-7.6%	31.67	-5.3%	13.40	-13.5%	3.15	-8.3%
Spectrally Selective Film	30.92	0.8%	12.65	2.0%	2.95	2.3%	30.83	-0.3%	12.55	-0.8%	3.08	-0.8%	30.35	-0.9%	12.07	-2.3%	2.94	-0.9%
Low-e Film	31.15	0.1%	12.87	0.3%	2.96	2.2%	31.29	-1.9%	13.02	-4.6%	3.11	-2.0%	31.31	-4.1%	13.03	-10.4%	3.07	-5.3%
Spectrally Selective + Low-e Film	30.65	1.7%	12.37	4.2%	2.90	4.1%	30.84	-0.4%	12.56	-1.0%	2.99	1.8%	31.16	-3.6%	12.88	-9.2%	3.01	-3.5%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.45	--	14.17	--	3.18	--	31.30	--	13.02	--	3.15	--	30.72	--	12.45	--	3.05	--
Traditional Tint Film	33.48	-3.2%	15.21	-7.3%	3.26	-2.5%	32.84	-4.9%	14.57	-11.8%	3.35	-6.4%	32.38	-5.4%	14.11	-13.3%	3.30	-8.2%
Spectrally Selective Film	32.37	0.2%	14.10	0.5%	3.12	1.6%	31.57	-0.9%	13.30	-2.1%	3.19	-1.3%	31.08	-1.2%	12.80	-2.8%	3.10	-1.8%
Low-e Film	32.37	0.2%	14.09	0.6%	3.15	0.9%	32.12	-2.6%	13.84	-6.3%	3.21	-1.9%	31.88	-3.8%	13.61	-9.3%	3.17	-4.1%
Spectrally Selective + Low-e Film	31.59	2.6%	13.32	6.0%	3.03	4.5%	31.58	-0.9%	13.30	-2.1%	3.11	1.4%	31.47	-2.4%	13.19	-6.0%	3.09	-1.3%

Climate Zone 5

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.97	--	15.69	--	3.42	--	33.27	--	14.99	--	3.34	--	31.59	--	13.31	--	3.03	--
Traditional Tint Film	32.47	4.4%	14.19	9.6%	3.01	11.9%	32.58	2.1%	14.30	4.6%	3.18	5.0%	31.52	0.2%	13.24	0.5%	3.00	0.9%
Spectrally Selective Film	32.79	3.5%	14.51	7.5%	3.13	8.5%	32.74	1.6%	14.47	3.5%	3.22	3.8%	31.52	0.2%	13.25	0.5%	3.00	0.8%
Low-e Film	31.48	7.3%	13.21	15.8%	2.86	16.3%	31.88	4.2%	13.61	9.2%	3.04	9.3%	31.34	0.8%	13.07	1.8%	2.94	2.8%
Spectrally Selective + Low-e Film	31.45	7.4%	13.17	16.0%	2.93	14.2%	31.87	4.2%	13.59	9.4%	3.04	9.2%	31.33	0.8%	13.05	2.0%	2.90	4.0%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.54	--	16.26	--	3.38	--	32.97	--	14.70	--	3.26	--	32.07	--	13.80	--	3.12	--
Traditional Tint Film	33.65	2.6%	15.37	5.5%	3.05	9.8%	32.57	1.2%	14.29	2.8%	3.13	3.9%	31.90	0.5%	13.63	1.2%	3.06	1.8%
Spectrally Selective Film	33.83	2.0%	15.55	4.3%	3.15	7.0%	32.69	0.8%	14.42	1.9%	3.17	2.6%	31.99	0.3%	13.71	0.6%	3.09	0.8%
Low-e Film	32.61	5.6%	14.34	11.8%	2.84	15.6%	32.08	2.7%	13.81	6.0%	3.00	7.8%	31.64	1.4%	13.36	3.2%	2.97	4.6%
Spectrally Selective + Low-e Film	32.18	6.8%	13.91	14.5%	2.93	13.1%	32.00	2.9%	13.73	6.6%	2.97	8.8%	31.67	1.3%	13.40	2.9%	2.97	4.6%

Climate Zone 5

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.10	--	13.82	--	3.00	--	31.93	--	13.66	--	3.07	--	31.23	--	12.96	--	2.93	--
Traditional Tint Film	31.56	1.7%	13.28	3.9%	2.73	8.7%	31.81	0.4%	13.53	0.9%	3.02	1.6%	31.26	-0.1%	12.98	-0.2%	2.93	0.2%
Spectrally Selective Film	31.71	1.2%	13.43	2.8%	2.85	4.9%	31.88	0.2%	13.60	0.4%	3.04	1.0%	31.24	-0.0%	12.97	-0.1%	2.93	0.2%
Low-e Film	31.03	3.3%	12.76	7.7%	2.73	9.0%	31.31	1.9%	13.04	4.5%	2.93	4.7%	31.08	0.5%	12.80	1.2%	2.88	1.9%
Spectrally Selective + Low-e Film	30.99	3.5%	12.71	8.0%	2.80	6.7%	31.22	2.2%	12.95	5.2%	2.90	5.5%	31.00	0.8%	12.72	1.8%	2.82	3.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.86	--	14.58	--	2.95	--	31.94	--	13.67	--	3.01	--	31.48	--	13.21	--	2.98	--
Traditional Tint Film	32.44	1.3%	14.17	2.8%	2.72	7.5%	31.86	0.3%	13.58	0.6%	2.95	2.0%	31.55	-0.2%	13.28	-0.5%	2.98	-0.2%
Spectrally Selective Film	32.54	1.0%	14.26	2.2%	2.77	5.9%	31.91	0.1%	13.64	0.2%	2.97	1.3%	31.55	-0.2%	13.27	-0.5%	2.99	-0.3%
Low-e Film	31.67	3.6%	13.39	8.2%	2.72	7.7%	31.42	1.6%	13.15	3.8%	2.89	4.1%	31.28	0.6%	13.01	1.5%	2.92	2.0%
Spectrally Selective + Low-e Film	31.30	4.8%	13.02	10.7%	2.82	4.5%	31.26	2.1%	12.98	5.0%	2.87	4.8%	31.20	0.9%	12.93	2.1%	2.88	3.3%

Climate Zone 5

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	29.25	--	10.98	--	2.55	--	29.07	--	10.79	--	2.63	--	28.70	--	10.43	--	2.50	--
Traditional Tint Film	30.10	-2.9%	11.83	-7.8%	2.49	1.9%	30.47	-4.8%	12.19	-13.0%	2.83	-7.6%	30.29	-5.5%	12.02	-15.3%	2.77	-10.5%
Spectrally Selective Film	29.08	0.6%	10.80	1.6%	2.38	6.5%	29.20	-0.5%	10.92	-1.2%	2.64	-0.4%	28.98	-1.0%	10.71	-2.7%	2.55	-1.7%
Low-e Film	29.55	-1.0%	11.27	-2.7%	2.45	3.4%	29.85	-2.7%	11.58	-7.3%	2.67	-1.8%	29.96	-4.4%	11.68	-12.0%	2.68	-7.0%
Spectrally Selective + Low-e Film	29.20	0.2%	10.92	0.5%	2.51	1.4%	29.46	-1.3%	11.18	-3.6%	2.59	1.3%	29.83	-3.9%	11.56	-10.8%	2.64	-5.6%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	30.46	--	12.18	--	2.56	--	29.63	--	11.36	--	2.66	--	29.25	--	10.97	--	2.62	--
Traditional Tint Film	31.55	-3.6%	13.27	-8.9%	2.57	-1.1%	31.16	-5.1%	12.88	-13.4%	2.85	-7.1%	30.87	-5.5%	12.59	-14.8%	2.86	-9.5%
Spectrally Selective Film	30.46	0.0%	12.18	0.0%	2.44	4.1%	29.92	-1.0%	11.65	-2.5%	2.66	0.0%	29.60	-1.2%	11.32	-3.2%	2.68	-2.3%
Low-e Film	30.64	-0.6%	12.37	-1.5%	2.57	-0.6%	30.55	-3.1%	12.28	-8.1%	2.76	-3.9%	30.43	-4.1%	12.16	-10.8%	2.76	-5.6%
Spectrally Selective + Low-e Film	29.98	1.6%	11.70	3.9%	2.55	0.0%	30.11	-1.6%	11.84	-4.2%	2.69	-1.3%	30.08	-2.8%	11.80	-7.6%	2.70	-3.1%

Climate Zone 6

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.29	--	17.01	--	3.66	--	34.76	--	16.48	--	3.57	--	32.67	--	14.39	--	3.23	--
Traditional Tint Film	33.17	6.0%	14.89	12.4%	3.32	9.3%	33.80	2.7%	15.52	5.8%	3.41	4.7%	32.55	0.4%	14.27	0.9%	3.20	0.9%
Spectrally Selective Film	33.68	4.6%	15.40	9.5%	3.41	6.9%	34.04	2.1%	15.76	4.3%	3.44	3.7%	32.56	0.3%	14.28	0.8%	3.20	0.8%
Low-e Film	32.17	8.8%	13.89	18.3%	3.15	14.0%	32.91	5.3%	14.63	11.2%	3.26	8.8%	32.29	1.2%	14.01	2.7%	3.13	2.9%
Spectrally Selective + Low-e Film	32.32	8.4%	14.04	17.5%	3.17	13.3%	32.90	5.4%	14.62	11.3%	3.26	8.8%	32.24	1.3%	13.96	3.0%	3.11	3.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.44	--	17.16	--	3.68	--	34.23	--	15.95	--	3.52	--	33.28	--	15.00	--	3.33	--
Traditional Tint Film	34.13	3.7%	15.85	7.7%	3.41	7.6%	33.62	1.8%	15.34	3.8%	3.40	3.5%	33.01	0.8%	14.73	1.8%	3.29	1.4%
Spectrally Selective Film	34.45	2.8%	16.17	5.8%	3.48	5.5%	33.82	1.2%	15.53	2.6%	3.43	2.6%	33.14	0.4%	14.86	0.9%	3.31	0.8%
Low-e Film	33.17	6.4%	14.89	13.2%	3.25	11.9%	33.03	3.5%	14.75	7.5%	3.29	6.5%	32.63	2.0%	14.35	4.4%	3.23	3.1%
Spectrally Selective + Low-e Film	32.94	7.1%	14.66	14.6%	3.22	12.5%	32.95	3.7%	14.67	8.0%	3.27	7.2%	32.65	1.9%	14.37	4.2%	3.20	4.0%

Climate Zone 6

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.91	--	14.63	--	3.26	--	33.04	--	14.76	--	3.28	--	32.16	--	13.88	--	3.12	--
Traditional Tint Film	32.07	2.6%	13.79	5.8%	3.09	5.2%	32.84	0.6%	14.56	1.4%	3.25	1.0%	32.18	-0.1%	13.90	-0.2%	3.12	0.0%
Spectrally Selective Film	32.34	1.8%	14.06	3.9%	3.15	3.4%	32.94	0.3%	14.66	0.7%	3.27	0.4%	32.16	-0.0%	13.88	-0.0%	3.11	0.1%
Low-e Film	31.55	4.1%	13.27	9.3%	3.03	7.2%	32.21	2.5%	13.93	5.7%	3.14	4.5%	31.91	0.8%	13.63	1.8%	3.06	1.8%
Spectrally Selective + Low-e Film	31.64	3.9%	13.36	8.7%	3.03	7.1%	32.08	2.9%	13.80	6.5%	3.09	5.9%	31.76	1.2%	13.48	2.9%	3.03	2.8%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.38	--	15.10	--	3.29	--	32.90	--	14.62	--	3.28	--	32.46	--	14.18	--	3.19	--
Traditional Tint Film	32.74	1.9%	14.46	4.3%	3.15	4.2%	32.74	0.5%	14.46	1.1%	3.22	1.9%	32.52	-0.2%	14.24	-0.5%	3.20	-0.3%
Spectrally Selective Film	32.93	1.4%	14.65	3.0%	3.19	3.0%	32.83	0.2%	14.55	0.5%	3.26	0.8%	32.52	-0.2%	14.24	-0.5%	3.20	-0.3%
Low-e Film	32.10	3.8%	13.82	8.5%	3.08	6.3%	32.22	2.1%	13.94	4.6%	3.14	4.5%	32.15	0.9%	13.87	2.2%	3.11	2.4%
Spectrally Selective + Low-e Film	31.87	4.5%	13.59	10.0%	3.06	7.1%	32.03	2.7%	13.75	6.0%	3.09	5.8%	32.01	1.4%	13.73	3.1%	3.09	3.3%

Climate Zone 6

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	29.82	--	11.54	--	2.83	--	29.94	--	11.66	--	2.86	--	29.32	--	11.04	--	2.71	--
Traditional Tint Film	30.42	-2.0%	12.14	-5.2%	2.87	-1.4%	31.37	-4.8%	13.09	-12.3%	3.07	-7.3%	31.09	-6.0%	12.81	-16.0%	2.96	-9.3%
Spectrally Selective Film	29.42	1.4%	11.14	3.5%	2.74	3.2%	30.02	-0.3%	11.74	-0.7%	2.87	-0.5%	29.62	-1.0%	11.34	-2.7%	2.77	-2.1%
Low-e Film	29.80	0.1%	11.52	0.2%	2.72	3.8%	30.54	-2.0%	12.26	-5.1%	2.91	-1.9%	30.63	-4.5%	12.35	-11.9%	2.90	-7.0%
Spectrally Selective + Low-e Film	29.50	1.1%	11.22	2.8%	2.67	5.7%	30.03	-0.3%	11.75	-0.8%	2.79	2.3%	30.42	-3.7%	12.14	-9.9%	2.83	-4.4%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	30.74	--	12.46	--	2.92	--	30.34	--	12.06	--	2.93	--	29.93	--	11.65	--	2.84	--
Traditional Tint Film	31.75	-3.3%	13.47	-8.1%	3.02	-3.4%	31.99	-5.4%	13.70	-13.7%	3.12	-6.6%	31.78	-6.2%	13.50	-15.9%	3.09	-8.9%
Spectrally Selective Film	30.59	0.5%	12.31	1.2%	2.85	2.4%	30.62	-0.9%	12.34	-2.4%	2.96	-1.2%	30.33	-1.4%	12.05	-3.5%	2.91	-2.5%
Low-e Film	30.94	-0.6%	12.66	-1.6%	2.92	-0.2%	31.26	-3.0%	12.98	-7.7%	3.01	-2.7%	31.20	-4.3%	12.92	-11.0%	2.99	-5.5%
Spectrally Selective + Low-e Film	30.37	1.2%	12.09	3.0%	2.81	3.7%	30.73	-1.3%	12.45	-3.3%	2.94	-0.4%	30.73	-2.7%	12.45	-6.9%	2.93	-3.2%

Climate Zone 7

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.13	--	17.84	--	3.74	--	35.58	--	17.30	--	3.63	--	33.42	--	15.14	--	3.31	--
Traditional Tint Film	33.91	6.1%	15.63	12.4%	3.43	8.2%	34.58	2.8%	16.29	5.8%	3.50	3.7%	33.28	0.4%	14.99	1.0%	3.29	0.7%
Spectrally Selective Film	34.45	4.6%	16.17	9.4%	3.51	6.1%	34.83	2.1%	16.55	4.3%	3.53	2.8%	33.29	0.4%	15.01	0.9%	3.30	0.6%
Low-e Film	32.88	9.0%	14.60	18.2%	3.27	12.6%	33.64	5.4%	15.36	11.2%	3.36	7.6%	32.99	1.3%	14.71	2.8%	3.25	2.0%
Spectrally Selective + Low-e Film	33.05	8.5%	14.77	17.2%	3.29	12.0%	33.62	5.5%	15.34	11.3%	3.35	7.8%	32.93	1.5%	14.65	3.2%	3.24	2.1%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.26	--	17.97	--	3.79	--	35.03	--	16.74	--	3.62	--	34.06	--	15.78	--	3.44	--
Traditional Tint Film	34.86	3.9%	16.58	7.8%	3.57	5.7%	34.38	1.8%	16.10	3.9%	3.51	3.1%	33.76	0.9%	15.48	1.9%	3.39	1.2%
Spectrally Selective Film	35.21	2.9%	16.92	5.8%	3.63	4.1%	34.59	1.3%	16.30	2.6%	3.55	2.1%	33.90	0.5%	15.62	1.0%	3.42	0.6%
Low-e Film	33.88	6.6%	15.59	13.2%	3.42	9.6%	33.76	3.6%	15.47	7.6%	3.40	6.1%	33.35	2.1%	15.07	4.5%	3.32	3.3%
Spectrally Selective + Low-e Film	33.66	7.1%	15.38	14.4%	3.39	10.5%	33.66	3.9%	15.38	8.1%	3.38	6.8%	33.36	2.1%	15.07	4.5%	3.32	3.4%

Climate Zone 7

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.62	--	15.34	--	3.36	--	33.79	--	15.51	--	3.38	--	32.87	--	14.59	--	3.23	--
Traditional Tint Film	32.73	2.6%	14.45	5.8%	3.24	3.5%	33.56	0.7%	15.28	1.5%	3.35	1.0%	32.88	-0.0%	14.60	-0.1%	3.23	-0.1%
Spectrally Selective Film	33.01	1.8%	14.73	4.0%	3.28	2.3%	33.67	0.4%	15.39	0.8%	3.37	0.3%	32.87	0.0%	14.59	0.0%	3.23	-0.1%
Low-e Film	32.19	4.2%	13.91	9.3%	3.16	5.9%	32.91	2.6%	14.63	5.7%	3.25	4.0%	32.61	0.8%	14.33	1.8%	3.20	1.0%
Spectrally Selective + Low-e Film	32.30	3.9%	14.02	8.6%	3.17	5.5%	32.77	3.0%	14.49	6.6%	3.23	4.6%	32.44	1.3%	14.16	3.0%	3.18	1.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.06	--	15.78	--	3.44	--	33.63	--	15.35	--	3.39	--	33.18	--	14.90	--	3.31	--
Traditional Tint Film	33.37	2.0%	15.09	4.4%	3.28	4.9%	33.45	0.5%	15.17	1.2%	3.36	0.9%	33.24	-0.2%	14.96	-0.3%	3.31	-0.1%
Spectrally Selective Film	33.58	1.4%	15.30	3.1%	3.37	2.2%	33.55	0.2%	15.26	0.5%	3.37	0.4%	33.24	-0.2%	14.96	-0.4%	3.31	-0.1%
Low-e Film	32.74	3.9%	14.46	8.4%	3.24	5.8%	32.92	2.1%	14.64	4.6%	3.28	3.3%	32.85	1.0%	14.57	2.2%	3.26	1.6%
Spectrally Selective + Low-e Film	32.53	4.5%	14.24	9.7%	3.22	6.4%	32.72	2.7%	14.43	5.9%	3.24	4.3%	32.70	1.5%	14.42	3.2%	3.23	2.4%

Climate Zone 7

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	30.48	--	12.20	--	2.93	--	30.64	--	12.36	--	2.95	--	29.99	--	11.71	--	2.84	--
Traditional Tint Film	31.06	-1.9%	12.78	-4.7%	2.94	-0.4%	32.08	-4.7%	13.80	-11.6%	3.18	-7.5%	31.79	-6.0%	13.51	-15.4%	3.13	-10.0%
Spectrally Selective Film	30.05	1.4%	11.77	3.6%	2.80	4.3%	30.70	-0.2%	12.42	-0.5%	2.97	-0.4%	30.27	-0.9%	11.99	-2.4%	2.90	-1.8%
Low-e Film	30.41	0.2%	12.13	0.6%	2.90	1.2%	31.22	-1.9%	12.94	-4.7%	3.06	-3.5%	31.32	-4.4%	13.03	-11.3%	3.06	-7.6%
Spectrally Selective + Low-e Film	30.12	1.2%	11.84	3.0%	2.85	2.7%	30.68	-0.1%	12.40	-0.3%	2.98	-0.8%	31.09	-3.6%	12.80	-9.3%	3.03	-6.5%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	31.38	--	13.10	--	3.03	--	31.03	--	12.74	--	3.05	--	30.61	--	12.33	--	2.98	--
Traditional Tint Film	32.38	-3.2%	14.10	-7.7%	3.10	-2.4%	32.70	-5.4%	14.42	-13.1%	3.27	-7.2%	32.50	-6.2%	14.22	-15.4%	3.23	-8.4%
Spectrally Selective Film	31.20	0.6%	12.92	1.4%	2.95	2.6%	31.30	-0.9%	13.02	-2.2%	3.09	-1.5%	31.02	-1.3%	12.74	-3.3%	3.05	-2.3%
Low-e Film	31.57	-0.6%	13.29	-1.5%	3.06	-1.0%	31.96	-3.0%	13.67	-7.3%	3.16	-3.9%	31.91	-4.2%	13.63	-10.5%	3.15	-5.8%
Spectrally Selective + Low-e Film	31.01	1.2%	12.72	2.8%	3.00	0.8%	31.41	-1.2%	13.12	-3.0%	3.10	-1.7%	31.41	-2.6%	13.13	-6.5%	3.09	-3.6%

Climate Zone 8

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.81	--	18.53	--	3.90	--	36.13	--	17.85	--	3.78	--	33.84	--	15.55	--	3.45	--
Traditional Tint Film	34.57	6.1%	16.29	12.1%	3.59	8.0%	35.12	2.8%	16.84	5.6%	3.65	3.6%	33.69	0.4%	15.41	0.9%	3.42	0.8%
Spectrally Selective Film	35.11	4.6%	16.83	9.2%	3.68	5.8%	35.37	2.1%	17.09	4.2%	3.68	2.6%	33.71	0.4%	15.43	0.8%	3.43	0.6%
Low-e Film	33.44	9.2%	15.15	18.2%	3.42	12.4%	34.14	5.5%	15.85	11.2%	3.50	7.4%	33.41	1.3%	15.12	2.8%	3.36	2.5%
Spectrally Selective + Low-e Film	33.54	8.9%	15.26	17.7%	3.44	11.9%	34.10	5.6%	15.81	11.4%	3.49	7.8%	33.35	1.4%	15.06	3.2%	3.34	3.2%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.05	--	18.77	--	3.96	--	35.63	--	17.35	--	3.77	--	34.53	--	16.25	--	3.57	--
Traditional Tint Film	35.64	3.8%	17.36	7.5%	3.73	5.8%	34.98	1.8%	16.69	3.8%	3.66	3.1%	34.23	0.9%	15.95	1.8%	3.52	1.4%
Spectrally Selective Film	35.99	2.9%	17.71	5.7%	3.79	4.2%	35.19	1.2%	16.91	2.5%	3.70	2.0%	34.38	0.4%	16.09	0.9%	3.54	0.7%
Low-e Film	34.55	6.8%	16.27	13.3%	3.57	9.8%	34.31	3.7%	16.03	7.6%	3.54	6.1%	33.81	2.1%	15.53	4.4%	3.44	3.6%
Spectrally Selective + Low-e Film	34.26	7.5%	15.98	14.9%	3.53	10.8%	34.19	4.0%	15.91	8.3%	3.51	6.9%	33.81	2.1%	15.53	4.4%	3.42	4.1%

Climate Zone 8

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.16	--	15.88	--	3.51	--	34.25	--	15.97	--	3.52	--	33.26	--	14.98	--	3.34	--
Traditional Tint Film	33.28	2.6%	14.99	5.6%	3.39	3.7%	34.03	0.6%	15.75	1.4%	3.49	0.8%	33.28	-0.1%	15.00	-0.1%	3.35	-0.0%
Spectrally Selective Film	33.56	1.8%	15.28	3.8%	3.43	2.4%	34.14	0.3%	15.86	0.7%	3.50	0.4%	33.26	-0.0%	14.98	-0.0%	3.34	0.0%
Low-e Film	32.68	4.3%	14.40	9.3%	3.27	7.1%	33.34	2.7%	15.05	5.7%	3.37	4.2%	32.99	0.8%	14.70	1.8%	3.29	1.7%
Spectrally Selective + Low-e Film	32.72	4.2%	14.44	9.1%	3.25	7.4%	33.17	3.1%	14.89	6.8%	3.33	5.4%	32.81	1.4%	14.52	3.0%	3.24	3.2%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.72	--	16.44	--	3.59	--	34.14	--	15.86	--	3.53	--	33.61	--	15.33	--	3.42	--
Traditional Tint Film	34.03	2.0%	15.75	4.2%	3.47	3.4%	33.96	0.5%	15.68	1.1%	3.49	1.0%	33.68	-0.2%	15.40	-0.4%	3.42	-0.1%
Spectrally Selective Film	34.24	1.4%	15.95	3.0%	3.51	2.3%	34.07	0.2%	15.78	0.5%	3.51	0.6%	33.68	-0.2%	15.40	-0.4%	3.42	-0.1%
Low-e Film	33.32	4.0%	15.04	8.5%	3.36	6.4%	33.40	2.2%	15.11	4.7%	3.39	4.0%	33.27	1.0%	14.99	2.3%	3.34	2.3%
Spectrally Selective + Low-e Film	33.02	4.9%	14.74	10.4%	3.30	8.0%	33.15	2.9%	14.87	6.2%	3.32	5.9%	33.10	1.5%	14.82	3.3%	3.29	3.8%

Climate Zone 8

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	31.05	--	12.76	--	3.08	--	31.12	--	12.84	--	3.09	--	30.42	--	12.14	--	2.93	--
Traditional Tint Film	31.61	-1.8%	13.33	-4.4%	3.14	-1.9%	32.53	-4.5%	14.25	-11.0%	3.29	-6.5%	32.17	-5.8%	13.89	-14.4%	3.19	-8.9%
Spectrally Selective Film	30.62	1.4%	12.34	3.3%	3.00	2.6%	31.19	-0.2%	12.91	-0.6%	3.09	-0.2%	30.71	-0.9%	12.43	-2.4%	2.95	-0.7%
Low-e Film	30.92	0.4%	12.63	1.0%	2.99	2.7%	31.65	-1.7%	13.37	-4.1%	3.13	-1.3%	31.68	-4.1%	13.40	-10.4%	3.09	-5.5%
Spectrally Selective + Low-e Film	30.58	1.5%	12.30	3.7%	2.92	5.1%	31.11	0.0%	12.83	0.1%	2.98	3.4%	31.44	-3.4%	13.16	-8.4%	3.00	-2.3%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.05	--	13.77	--	3.21	--	31.55	--	13.27	--	3.16	--	31.07	--	12.79	--	3.05	--
Traditional Tint Film	33.02	-3.0%	14.74	-7.0%	3.33	-3.5%	33.19	-5.2%	14.91	-12.3%	3.39	-7.3%	32.92	-6.0%	14.64	-14.5%	3.32	-8.6%
Spectrally Selective Film	31.87	0.6%	13.59	1.3%	3.17	1.5%	31.83	-0.9%	13.54	-2.0%	3.19	-0.9%	31.47	-1.3%	13.19	-3.1%	3.10	-1.7%
Low-e Film	32.14	-0.3%	13.85	-0.6%	3.20	0.6%	32.40	-2.7%	14.12	-6.4%	3.25	-2.8%	32.30	-4.0%	14.01	-9.6%	3.20	-4.6%
Spectrally Selective + Low-e Film	31.49	1.7%	13.21	4.1%	3.07	4.5%	31.83	-0.9%	13.55	-2.1%	3.12	1.2%	31.80	-2.3%	13.52	-5.7%	3.08	-0.8%

Climate Zone 9

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.25	--	18.97	--	4.01	--	36.42	--	18.14	--	3.89	--	34.07	--	15.79	--	3.48	--
Traditional Tint Film	35.02	6.0%	16.74	11.8%	3.63	9.7%	35.41	2.8%	17.13	5.6%	3.69	5.3%	33.92	0.4%	15.64	0.9%	3.45	0.6%
Spectrally Selective Film	35.56	4.5%	17.28	8.9%	3.72	7.3%	35.66	2.1%	17.38	4.2%	3.75	3.8%	33.94	0.4%	15.66	0.8%	3.46	0.6%
Low-e Film	33.82	9.2%	15.54	18.1%	3.44	14.5%	34.41	5.5%	16.12	11.1%	3.53	9.3%	33.63	1.3%	15.35	2.8%	3.41	1.9%
Spectrally Selective + Low-e Film	33.86	9.1%	15.58	17.9%	3.46	14.0%	34.35	5.7%	16.06	11.4%	3.52	9.5%	33.56	1.5%	15.28	3.2%	3.40	2.2%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.61	--	19.32	--	4.04	--	35.97	--	17.69	--	3.82	--	34.78	--	16.50	--	3.62	--
Traditional Tint Film	36.17	3.8%	17.89	7.4%	3.78	6.5%	35.31	1.8%	17.03	3.8%	3.71	3.0%	34.48	0.9%	16.20	1.8%	3.57	1.4%
Spectrally Selective Film	36.52	2.9%	18.24	5.6%	3.85	4.7%	35.52	1.3%	17.24	2.6%	3.75	2.0%	34.63	0.4%	16.35	0.9%	3.59	0.7%
Low-e Film	34.99	7.0%	16.71	13.5%	3.61	10.8%	34.62	3.8%	16.34	7.7%	3.58	6.4%	34.05	2.1%	15.77	4.4%	3.50	3.3%
Spectrally Selective + Low-e Film	34.62	7.9%	16.34	15.5%	3.57	11.9%	34.47	4.2%	16.19	8.5%	3.56	6.9%	34.05	2.1%	15.77	4.5%	3.49	3.5%

Climate Zone 9

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.50	--	16.22	--	3.53	--	34.51	--	16.23	--	3.55	--	33.49	--	15.21	--	3.39	--
Traditional Tint Film	33.64	2.5%	15.36	5.3%	3.39	4.0%	34.29	0.6%	16.00	1.4%	3.52	0.9%	33.50	-0.0%	15.22	-0.1%	3.39	-0.1%
Spectrally Selective Film	33.91	1.7%	15.63	3.6%	3.44	2.6%	34.40	0.3%	16.11	0.7%	3.54	0.4%	33.49	0.0%	15.21	0.0%	3.39	-0.0%
Low-e Film	32.99	4.4%	14.71	9.3%	3.31	6.3%	33.58	2.7%	15.30	5.7%	3.41	4.0%	33.22	0.8%	14.93	1.8%	3.35	1.3%
Spectrally Selective + Low-e Film	32.99	4.4%	14.71	9.3%	3.32	6.1%	33.41	3.2%	15.12	6.8%	3.38	4.8%	33.04	1.4%	14.75	3.0%	3.32	2.2%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.12	--	16.84	--	3.62	--	34.44	--	16.16	--	3.57	--	33.86	--	15.58	--	3.47	--
Traditional Tint Film	34.43	2.0%	16.15	4.1%	3.50	3.5%	34.26	0.5%	15.98	1.1%	3.53	0.9%	33.92	-0.2%	15.64	-0.4%	3.48	-0.2%
Spectrally Selective Film	34.63	1.4%	16.35	2.9%	3.54	2.4%	34.36	0.2%	16.08	0.5%	3.55	0.4%	33.92	-0.2%	15.64	-0.4%	3.48	-0.2%
Low-e Film	33.66	4.1%	15.38	8.7%	3.40	6.2%	33.68	2.2%	15.40	4.7%	3.44	3.5%	33.51	1.0%	15.23	2.2%	3.42	1.6%
Spectrally Selective + Low-e Film	33.32	5.1%	15.04	10.7%	3.38	6.9%	33.42	3.0%	15.13	6.3%	3.40	4.6%	33.34	1.6%	15.06	3.4%	3.37	2.9%

Climate Zone 9

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	31.42	--	13.14	--	3.09	--	31.41	--	13.13	--	3.11	--	30.69	--	12.41	--	2.97	--
Traditional Tint Film	32.03	-1.9%	13.74	-4.6%	3.16	-2.2%	32.83	-4.5%	14.55	-10.8%	3.32	-6.7%	32.44	-5.7%	14.16	-14.1%	3.24	-9.2%
Spectrally Selective Film	31.01	1.3%	12.73	3.1%	3.01	2.8%	31.49	-0.3%	13.21	-0.6%	3.11	0.0%	30.98	-0.9%	12.70	-2.3%	3.02	-1.7%
Low-e Film	31.29	0.4%	13.01	1.0%	3.05	1.5%	31.96	-1.7%	13.68	-4.2%	3.18	-2.0%	31.96	-4.2%	13.68	-10.3%	3.15	-6.2%
Spectrally Selective + Low-e Film	30.91	1.6%	12.63	3.9%	2.99	3.3%	31.39	0.1%	13.11	0.2%	3.08	1.1%	31.72	-3.4%	13.44	-8.3%	3.11	-4.8%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.50	--	14.22	--	3.23	--	31.91	--	13.63	--	3.20	--	31.37	--	13.09	--	3.11	--
Traditional Tint Film	33.44	-2.9%	15.15	-6.6%	3.35	-3.7%	33.50	-5.0%	15.22	-11.7%	3.42	-7.2%	33.17	-5.7%	14.89	-13.7%	3.37	-8.4%
Spectrally Selective Film	32.31	0.6%	14.03	1.3%	3.18	1.5%	32.18	-0.8%	13.90	-2.0%	3.24	-1.4%	31.77	-1.3%	13.49	-3.1%	3.18	-2.2%
Low-e Film	32.51	-0.0%	14.23	-0.1%	3.23	-0.0%	32.71	-2.5%	14.43	-5.9%	3.30	-3.3%	32.57	-3.8%	14.29	-9.1%	3.27	-5.3%
Spectrally Selective + Low-e Film	31.84	2.0%	13.55	4.7%	3.16	2.3%	32.14	-0.7%	13.86	-1.7%	3.21	-0.5%	32.08	-2.2%	13.80	-5.4%	3.19	-2.6%

Climate Zone 10

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

Window Film	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.72	--	19.44	--	4.14	--	36.78	--	18.50	--	3.99	--	34.37	--	16.08	--	3.53	--
Traditional Tint Film	35.53	5.8%	17.25	11.3%	3.77	8.8%	35.76	2.8%	17.48	5.5%	3.83	4.1%	34.22	0.4%	15.94	0.9%	3.50	0.7%
Spectrally Selective Film	36.05	4.4%	17.77	8.6%	3.87	6.5%	36.02	2.1%	17.74	4.1%	3.87	3.1%	34.24	0.4%	15.96	0.8%	3.51	0.6%
Low-e Film	34.27	9.2%	15.98	17.8%	3.55	14.2%	34.73	5.6%	16.45	11.1%	3.62	9.5%	33.93	1.3%	15.65	2.7%	3.44	2.6%
Spectrally Selective + Low-e Film	34.23	9.3%	15.95	18.0%	3.56	14.0%	34.65	5.8%	16.37	11.5%	3.58	10.4%	33.85	1.5%	15.56	3.2%	3.38	4.4%

Window Film	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.19	--	19.91	--	4.21	--	36.40	--	18.12	--	3.98	--	35.12	--	16.84	--	3.74	--
Traditional Tint Film	36.79	3.7%	18.51	7.1%	3.94	6.4%	35.74	1.8%	17.46	3.7%	3.85	3.1%	34.82	0.9%	16.54	1.8%	3.63	2.9%
Spectrally Selective Film	37.12	2.8%	18.84	5.4%	4.02	4.7%	35.95	1.2%	17.67	2.5%	3.89	2.1%	34.97	0.4%	16.68	0.9%	3.66	2.1%
Low-e Film	35.52	7.0%	17.24	13.4%	3.76	10.8%	35.02	3.8%	16.74	7.6%	3.70	7.1%	34.39	2.1%	16.11	4.4%	3.54	5.2%
Spectrally Selective + Low-e Film	35.07	8.2%	16.79	15.7%	3.66	13.2%	34.84	4.3%	16.56	8.6%	3.59	9.7%	34.37	2.2%	16.08	4.5%	3.50	6.5%

Climate Zone 10

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.92	--	16.64	--	3.66	--	34.83	--	16.54	--	3.64	--	33.79	--	15.51	--	3.40	--
Traditional Tint Film	34.12	2.3%	15.84	4.8%	3.50	4.5%	34.62	0.6%	16.33	1.3%	3.58	1.6%	33.80	-0.0%	15.52	-0.1%	3.41	-0.1%
Spectrally Selective Film	34.37	1.6%	16.09	3.3%	3.56	2.9%	34.72	0.3%	16.44	0.6%	3.62	0.6%	33.79	0.0%	15.50	0.0%	3.40	0.0%
Low-e Film	33.43	4.3%	15.14	9.0%	3.33	9.1%	33.91	2.6%	15.63	5.5%	3.45	5.1%	33.51	0.8%	15.23	1.8%	3.32	2.5%
Spectrally Selective + Low-e Film	33.35	4.5%	15.07	9.4%	3.31	9.8%	33.71	3.2%	15.43	6.7%	3.39	7.1%	33.33	1.4%	15.05	2.9%	3.25	4.4%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.69	--	17.41	--	3.75	--	34.85	--	16.56	--	3.67	--	34.20	--	15.92	--	3.50	--
Traditional Tint Film	35.04	1.8%	16.75	3.7%	3.59	4.5%	34.67	0.5%	16.39	1.1%	3.62	1.4%	34.25	-0.2%	15.97	-0.3%	3.52	-0.4%
Spectrally Selective Film	35.22	1.3%	16.94	2.7%	3.64	3.0%	34.77	0.2%	16.49	0.5%	3.64	0.9%	34.26	-0.2%	15.98	-0.4%	3.53	-0.9%
Low-e Film	34.18	4.2%	15.90	8.7%	3.46	7.9%	34.07	2.2%	15.79	4.7%	3.47	5.6%	33.85	1.0%	15.56	2.2%	3.41	2.6%
Spectrally Selective + Low-e Film	33.75	5.4%	15.47	11.1%	3.38	10.0%	33.78	3.1%	15.50	6.4%	3.39	7.6%	33.66	1.6%	15.38	3.4%	3.32	5.1%

Climate Zone 10

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	31.87	--	13.59	--	3.23	--	31.77	--	13.49	--	3.22	--	31.03	--	12.75	--	3.01	--
Traditional Tint Film	32.49	-1.9%	14.21	-4.5%	3.24	-0.2%	33.13	-4.3%	14.85	-10.1%	3.39	-5.5%	32.71	-5.4%	14.43	-13.2%	3.23	-7.3%
Spectrally Selective Film	31.50	1.2%	13.22	2.7%	3.12	3.3%	31.84	-0.2%	13.56	-0.5%	3.19	0.9%	31.30	-0.9%	13.02	-2.1%	3.03	-0.5%
Low-e Film	31.73	0.5%	13.44	1.1%	3.09	4.4%	32.28	-1.6%	13.99	-3.7%	3.21	0.2%	32.25	-3.9%	13.96	-9.5%	3.12	-3.6%
Spectrally Selective + Low-e Film	31.29	1.8%	13.01	4.3%	2.98	7.8%	31.71	0.2%	13.42	0.5%	3.05	5.3%	32.01	-3.1%	13.73	-7.6%	3.04	-0.9%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.07	--	14.79	--	3.37	--	32.32	--	14.04	--	3.30	--	31.73	--	13.44	--	3.16	--
Traditional Tint Film	34.02	-2.9%	15.74	-6.4%	3.44	-2.0%	33.88	-4.8%	15.60	-11.2%	3.50	-5.9%	33.48	-5.5%	15.20	-13.0%	3.41	-8.0%
Spectrally Selective Film	32.90	0.5%	14.62	1.2%	3.29	2.3%	32.57	-0.8%	14.29	-1.8%	3.31	-0.4%	32.10	-1.2%	13.82	-2.8%	3.21	-1.8%
Low-e Film	33.00	0.2%	14.72	0.5%	3.30	2.2%	33.08	-2.4%	14.80	-5.4%	3.34	-1.1%	32.87	-3.6%	14.59	-8.5%	3.29	-4.0%
Spectrally Selective + Low-e Film	32.25	2.5%	13.97	5.5%	3.16	6.3%	32.48	-0.5%	14.19	-1.1%	3.20	3.0%	32.38	-2.0%	14.09	-4.8%	3.13	0.9%

Climate Zone 11

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.94	--	20.66	--	4.15	--	36.83	--	18.55	--	4.00	--	34.14	--	15.86	--	3.59	--
Traditional Tint Film	37.16	4.6%	18.88	8.6%	3.78	8.7%	36.05	2.1%	17.77	4.2%	3.84	4.0%	34.07	0.2%	15.79	0.5%	3.57	0.6%
Spectrally Selective Film	37.52	3.6%	19.24	6.9%	3.88	6.5%	36.23	1.6%	17.95	3.3%	3.88	3.0%	34.07	0.2%	15.79	0.5%	3.57	0.5%
Low-e Film	35.36	9.2%	17.08	17.3%	3.57	13.9%	35.02	4.9%	16.74	9.8%	3.67	8.3%	33.79	1.0%	15.52	2.2%	3.51	2.4%
Spectrally Selective + Low-e Film	34.79	10.7%	16.51	20.1%	3.58	13.6%	34.76	5.6%	16.48	11.2%	3.66	8.5%	33.69	1.3%	15.41	2.9%	3.49	2.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	40.31	--	22.03	--	4.21	--	36.91	--	18.63	--	3.98	--	35.06	--	16.78	--	3.75	--
Traditional Tint Film	39.19	2.8%	20.91	5.1%	3.95	6.3%	36.40	1.4%	18.13	2.7%	3.86	3.0%	34.88	0.5%	16.60	1.1%	3.70	1.5%
Spectrally Selective Film	39.38	2.3%	21.10	4.2%	4.02	4.6%	36.55	1.0%	18.27	1.9%	3.90	2.1%	34.96	0.3%	16.68	0.6%	3.73	0.7%
Low-e Film	37.11	7.9%	18.83	14.5%	3.76	10.7%	35.55	3.7%	17.27	7.3%	3.72	6.5%	34.42	1.8%	16.14	3.8%	3.61	3.8%
Spectrally Selective + Low-e Film	35.95	10.8%	17.67	19.8%	3.71	11.9%	35.16	4.7%	16.88	9.4%	3.69	7.3%	34.31	2.1%	16.03	4.5%	3.60	4.1%

Climate Zone 11

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.30	--	18.02	--	3.69	--	35.08	--	16.80	--	3.69	--	33.65	--	15.37	--	3.48	--
Traditional Tint Film	35.64	1.8%	17.36	3.6%	3.52	4.5%	34.96	0.3%	16.68	0.7%	3.66	0.8%	33.68	-0.1%	15.41	-0.2%	3.49	-0.1%
Spectrally Selective Film	35.81	1.3%	17.53	2.7%	3.59	2.8%	35.04	0.1%	16.76	0.3%	3.68	0.4%	33.67	-0.1%	15.39	-0.1%	3.49	-0.1%
Low-e Film	34.44	5.1%	16.16	10.3%	3.40	7.9%	34.09	2.8%	15.81	5.9%	3.52	4.8%	33.39	0.8%	15.12	1.6%	3.43	1.4%
Spectrally Selective + Low-e Film	33.92	6.6%	15.64	13.2%	3.40	7.8%	33.73	3.9%	15.45	8.0%	3.47	6.0%	33.22	1.3%	14.94	2.8%	3.37	3.3%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.82	--	19.54	--	3.78	--	35.44	--	17.16	--	3.71	--	34.24	--	15.96	--	3.59	--
Traditional Tint Film	37.27	1.4%	19.00	2.8%	3.63	3.9%	35.32	0.3%	17.04	0.7%	3.66	1.3%	34.31	-0.2%	16.03	-0.5%	3.60	-0.4%
Spectrally Selective Film	37.38	1.2%	19.10	2.3%	3.68	2.7%	35.38	0.2%	17.11	0.3%	3.69	0.5%	34.30	-0.2%	16.02	-0.4%	3.60	-0.4%
Low-e Film	35.58	5.9%	17.30	11.5%	3.52	7.1%	34.50	2.6%	16.22	5.5%	3.56	4.1%	33.88	1.0%	15.60	2.2%	3.51	2.3%
Spectrally Selective + Low-e Film	34.55	8.6%	16.27	16.7%	3.45	8.7%	34.03	4.0%	15.75	8.2%	3.49	5.8%	33.64	1.7%	15.36	3.7%	3.45	3.9%

Climate Zone 11

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.67	--	15.39	--	3.23	--	32.42	--	14.15	--	3.25	--	31.33	--	13.05	--	3.08	--
Traditional Tint Film	34.19	-1.6%	15.91	-3.4%	3.31	-2.2%	33.59	-3.6%	15.31	-8.2%	3.47	-6.7%	32.71	-4.4%	14.43	-10.6%	3.35	-8.6%
Spectrally Selective Film	33.44	0.7%	15.16	1.5%	3.16	2.2%	32.54	-0.4%	14.27	-0.8%	3.28	-0.7%	31.61	-0.9%	13.33	-2.1%	3.14	-1.8%
Low-e Film	33.07	1.8%	14.79	3.9%	3.15	2.5%	32.66	-0.7%	14.38	-1.6%	3.30	-1.3%	32.36	-3.3%	14.09	-8.0%	3.25	-5.3%
Spectrally Selective + Low-e Film	32.23	4.3%	13.95	9.3%	3.09	4.6%	32.05	1.1%	13.78	2.6%	3.18	2.3%	32.20	-2.8%	13.92	-6.7%	3.19	-3.5%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.48	--	17.20	--	3.41	--	33.16	--	14.88	--	3.35	--	32.12	--	13.84	--	3.24	--
Traditional Tint Film	36.33	-2.4%	18.05	-5.0%	3.50	-2.6%	34.58	-4.3%	16.30	-9.6%	3.56	-6.3%	33.61	-4.7%	15.33	-10.8%	3.49	-7.8%
Spectrally Selective Film	35.28	0.6%	17.00	1.2%	3.35	1.9%	33.41	-0.8%	15.13	-1.7%	3.39	-1.2%	32.46	-1.1%	14.18	-2.5%	3.30	-2.0%
Low-e Film	34.58	2.5%	16.30	5.2%	3.37	1.4%	33.65	-1.5%	15.37	-3.3%	3.41	-1.9%	33.06	-3.0%	14.78	-6.9%	3.37	-4.0%
Spectrally Selective + Low-e Film	33.37	5.9%	15.09	12.3%	3.25	4.7%	32.93	0.7%	14.65	1.5%	3.30	1.6%	32.58	-1.4%	14.30	-3.4%	3.27	-1.1%

Climate Zone 12

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.70	--	19.42	--	4.09	--	36.13	--	17.85	--	3.95	--	33.64	--	15.36	--	3.58	--
Traditional Tint Film	35.89	4.8%	17.61	9.3%	3.73	8.6%	35.33	2.2%	17.05	4.5%	3.79	4.0%	33.56	0.2%	15.28	0.5%	3.56	0.5%
Spectrally Selective Film	36.28	3.8%	18.00	7.3%	3.83	6.4%	35.51	1.7%	17.23	3.4%	3.83	3.0%	33.56	0.2%	15.28	0.5%	3.56	0.5%
Low-e Film	34.41	8.7%	16.13	17.0%	3.54	13.4%	34.35	4.9%	16.07	9.9%	3.63	8.0%	33.30	1.0%	15.02	2.2%	3.51	2.0%
Spectrally Selective + Low-e Film	34.02	9.8%	15.74	18.9%	3.56	13.0%	34.17	5.4%	15.89	11.0%	3.63	8.1%	33.22	1.2%	14.94	2.7%	3.47	3.1%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.72	--	20.44	--	4.15	--	36.07	--	17.79	--	3.93	--	34.48	--	16.20	--	3.71	--
Traditional Tint Film	37.59	2.9%	19.31	5.5%	3.89	6.2%	35.55	1.4%	17.28	2.9%	3.82	3.0%	34.27	0.6%	15.99	1.3%	3.67	1.3%
Spectrally Selective Film	37.81	2.3%	19.53	4.4%	3.96	4.5%	35.70	1.0%	17.42	2.1%	3.85	2.0%	34.37	0.3%	16.09	0.7%	3.69	0.7%
Low-e Film	35.94	7.2%	17.66	13.6%	3.72	10.4%	34.80	3.5%	16.52	7.2%	3.69	6.3%	33.84	1.8%	15.56	3.9%	3.60	3.0%
Spectrally Selective + Low-e Film	35.07	9.4%	16.79	17.8%	3.68	11.4%	34.49	4.4%	16.21	8.9%	3.67	6.8%	33.78	2.0%	15.50	4.3%	3.60	3.2%

Climate Zone 12

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.16	--	16.89	--	3.65	--	34.40	--	16.12	--	3.65	--	33.19	--	14.91	--	3.50	--
Traditional Tint Film	34.51	1.9%	16.23	3.9%	3.51	3.8%	34.27	0.4%	15.99	0.8%	3.63	0.7%	33.21	-0.1%	14.93	-0.2%	3.49	0.2%
Spectrally Selective Film	34.69	1.4%	16.41	2.8%	3.55	2.5%	34.35	0.2%	16.07	0.3%	3.64	0.3%	33.20	-0.0%	14.92	-0.1%	3.49	0.3%
Low-e Film	33.63	4.4%	15.36	9.1%	3.42	6.3%	33.49	2.7%	15.21	5.7%	3.52	3.7%	32.97	0.7%	14.69	1.5%	3.40	2.8%
Spectrally Selective + Low-e Film	33.29	5.3%	15.01	11.1%	3.37	7.5%	33.24	3.4%	14.96	7.2%	3.45	5.6%	32.83	1.1%	14.55	2.4%	3.36	4.0%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.38	--	18.10	--	3.74	--	34.65	--	16.37	--	3.67	--	33.70	--	15.42	--	3.58	--
Traditional Tint Film	35.84	1.5%	17.56	3.0%	3.61	3.4%	34.52	0.4%	16.24	0.8%	3.64	0.9%	33.76	-0.2%	15.48	-0.4%	3.59	-0.4%
Spectrally Selective Film	35.96	1.2%	17.68	2.3%	3.65	2.3%	34.59	0.2%	16.31	0.3%	3.66	0.4%	33.76	-0.2%	15.48	-0.4%	3.59	-0.4%
Low-e Film	34.57	5.0%	16.29	10.0%	3.51	6.2%	33.85	2.3%	15.57	4.8%	3.55	3.4%	33.38	0.9%	15.10	2.0%	3.49	2.4%
Spectrally Selective + Low-e Film	33.83	7.0%	15.55	14.1%	3.46	7.5%	33.47	3.4%	15.19	7.2%	3.47	5.7%	33.20	1.5%	14.92	3.2%	3.44	4.0%

Climate Zone 12

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	32.48	--	14.20	--	3.20	--	31.67	--	13.39	--	3.22	--	30.80	--	12.52	--	3.12	--
Traditional Tint Film	33.05	-1.8%	14.77	-4.0%	3.29	-3.0%	32.87	-3.8%	14.59	-8.9%	3.46	-7.5%	32.25	-4.7%	13.97	-11.6%	3.33	-6.8%
Spectrally Selective Film	32.26	0.7%	13.98	1.6%	3.13	2.2%	31.79	-0.4%	13.51	-0.9%	3.26	-1.2%	31.06	-0.9%	12.78	-2.1%	3.14	-0.8%
Low-e Film	32.27	0.7%	13.99	1.5%	3.16	1.1%	32.07	-1.2%	13.79	-2.9%	3.30	-2.6%	31.92	-3.7%	13.64	-9.0%	3.23	-3.7%
Spectrally Selective + Low-e Film	31.60	2.7%	13.32	6.2%	3.08	3.6%	31.54	0.4%	13.27	1.0%	3.18	1.3%	31.80	-3.3%	13.52	-8.0%	3.19	-2.4%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.98	--	15.70	--	3.38	--	32.37	--	14.09	--	3.34	--	31.56	--	13.28	--	3.24	--
Traditional Tint Film	34.89	-2.7%	16.61	-5.8%	3.49	-3.2%	33.78	-4.4%	15.50	-10.0%	3.54	-6.0%	33.06	-4.7%	14.78	-11.3%	3.48	-7.3%
Spectrally Selective Film	33.85	0.4%	15.57	0.8%	3.33	1.4%	32.63	-0.8%	14.35	-1.8%	3.37	-1.0%	31.90	-1.1%	13.62	-2.6%	3.30	-1.8%
Low-e Film	33.57	1.2%	15.29	2.6%	3.36	0.5%	32.98	-1.9%	14.70	-4.3%	3.42	-2.6%	32.54	-3.1%	14.26	-7.4%	3.36	-3.6%
Spectrally Selective + Low-e Film	32.62	4.0%	14.34	8.6%	3.24	4.0%	32.37	-0.0%	14.09	-0.0%	3.30	1.2%	32.13	-1.8%	13.86	-4.3%	3.27	-0.8%

Climate Zone 13

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	39.96	--	21.68	--	4.16	--	38.32	--	20.04	--	4.02	--	35.43	--	17.15	--	3.65	--
Traditional Tint Film	37.68	5.7%	19.40	10.5%	3.80	8.7%	37.31	2.6%	19.03	5.1%	3.86	4.0%	35.28	0.4%	17.00	0.8%	3.63	0.5%
Spectrally Selective Film	38.21	4.4%	19.93	8.1%	3.89	6.4%	37.55	2.0%	19.27	3.8%	3.90	3.0%	35.30	0.4%	17.02	0.8%	3.63	0.5%
Low-e Film	36.01	9.9%	17.73	18.2%	3.59	13.5%	36.12	5.7%	17.84	11.0%	3.70	7.9%	34.95	1.4%	16.67	2.8%	3.59	1.6%
Spectrally Selective + Low-e Film	35.69	10.7%	17.41	19.7%	3.62	12.9%	35.90	6.3%	17.62	12.1%	3.70	7.9%	34.82	1.7%	16.54	3.6%	3.58	1.8%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	40.86	--	22.58	--	4.23	--	38.18	--	19.90	--	4.01	--	36.41	--	18.13	--	3.78	--
Traditional Tint Film	39.38	3.6%	21.10	6.6%	3.96	6.3%	37.51	1.8%	19.23	3.4%	3.88	3.1%	36.11	0.8%	17.83	1.7%	3.74	1.2%
Spectrally Selective Film	39.71	2.8%	21.43	5.1%	4.03	4.6%	37.72	1.2%	19.44	2.3%	3.92	2.1%	36.25	0.4%	17.97	0.9%	3.76	0.6%
Low-e Film	37.62	7.9%	19.34	14.3%	3.78	10.5%	36.59	4.2%	18.31	8.0%	3.75	6.3%	35.59	2.2%	17.31	4.5%	3.67	2.9%
Spectrally Selective + Low-e Film	36.78	10.0%	18.50	18.1%	3.74	11.5%	36.22	5.1%	17.94	9.8%	3.74	6.7%	35.47	2.6%	17.19	5.2%	3.68	2.8%

Climate Zone 13

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.88	--	18.60	--	3.71	--	36.22	--	17.94	--	3.72	--	34.84	--	16.56	--	3.56	--
Traditional Tint Film	36.01	2.4%	17.73	4.7%	3.56	3.8%	36.03	0.5%	17.75	1.0%	3.69	0.7%	34.85	-0.0%	16.57	-0.1%	3.57	-0.1%
Spectrally Selective Film	36.27	1.7%	17.99	3.3%	3.61	2.5%	36.13	0.3%	17.85	0.5%	3.71	0.3%	34.84	0.0%	16.56	0.0%	3.57	-0.1%
Low-e Film	35.08	4.9%	16.80	9.7%	3.48	6.2%	35.15	2.9%	16.87	5.9%	3.58	3.7%	34.53	0.9%	16.25	1.8%	3.52	1.1%
Spectrally Selective + Low-e Film	34.74	5.8%	16.46	11.5%	3.49	5.8%	34.83	3.8%	16.55	7.8%	3.56	4.4%	34.33	1.5%	16.05	3.1%	3.50	1.9%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.03	--	19.74	--	3.81	--	36.46	--	18.18	--	3.74	--	35.44	--	17.16	--	3.65	--
Traditional Tint Film	37.30	1.9%	19.01	3.7%	3.68	3.4%	36.29	0.5%	18.01	1.0%	3.71	0.9%	35.50	-0.2%	17.22	-0.3%	3.66	-0.4%
Spectrally Selective Film	37.48	1.4%	19.20	2.8%	3.72	2.3%	36.38	0.2%	18.10	0.4%	3.72	0.4%	35.51	-0.2%	17.23	-0.4%	3.66	-0.4%
Low-e Film	36.07	5.1%	17.79	9.9%	3.57	6.2%	35.52	2.6%	17.24	5.2%	3.62	3.3%	35.02	1.2%	16.74	2.5%	3.59	1.4%
Spectrally Selective + Low-e Film	35.33	7.1%	17.05	13.6%	3.55	6.6%	35.06	3.8%	16.78	7.7%	3.58	4.2%	34.76	1.9%	16.48	4.0%	3.57	2.1%

Climate Zone 13

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.00	--	15.72	--	3.25	--	33.31	--	15.03	--	3.28	--	32.27	--	13.99	--	3.17	--
Traditional Tint Film	34.48	-1.4%	16.20	-3.1%	3.37	-3.7%	34.57	-3.8%	16.29	-8.4%	3.54	-7.7%	33.82	-4.8%	15.54	-11.1%	3.45	-8.8%
Spectrally Selective Film	33.60	1.2%	15.32	2.5%	3.19	1.9%	33.39	-0.2%	15.11	-0.5%	3.32	-1.0%	32.54	-0.8%	14.26	-1.9%	3.23	-2.0%
Low-e Film	33.54	1.3%	15.26	2.9%	3.26	-0.2%	33.62	-0.9%	15.34	-2.0%	3.40	-3.4%	33.34	-3.3%	15.06	-7.6%	3.38	-6.7%
Spectrally Selective + Low-e Film	32.88	3.3%	14.60	7.1%	3.21	1.0%	32.99	1.0%	14.71	2.1%	3.30	-0.5%	33.12	-2.6%	14.83	-6.0%	3.34	-5.4%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.50	--	17.22	--	3.44	--	34.08	--	15.80	--	3.41	--	33.15	--	14.87	--	3.33	--
Traditional Tint Film	36.32	-2.3%	18.04	-4.8%	3.56	-3.5%	35.52	-4.2%	17.24	-9.1%	3.61	-5.9%	34.75	-4.8%	16.47	-10.7%	3.57	-7.3%
Spectrally Selective Film	35.28	0.6%	16.99	1.3%	3.40	1.1%	34.31	-0.7%	16.03	-1.4%	3.45	-1.1%	33.49	-1.0%	15.20	-2.2%	3.39	-1.9%
Low-e Film	34.98	1.5%	16.70	3.0%	3.43	0.2%	34.58	-1.4%	16.30	-3.1%	3.51	-2.8%	34.11	-2.9%	15.83	-6.5%	3.48	-4.7%
Spectrally Selective + Low-e Film	33.97	4.3%	15.69	8.9%	3.38	1.8%	33.86	0.7%	15.58	1.4%	3.43	-0.7%	33.59	-1.3%	15.31	-3.0%	3.42	-2.8%

Climate Zone 14

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	38.41	--	20.12	--	4.30	--	36.85	--	18.57	--	4.16	--	34.39	--	16.11	--	3.71	--
Traditional Tint Film	36.68	4.5%	18.40	8.6%	3.92	8.9%	36.02	2.2%	17.74	4.5%	3.99	4.1%	34.30	0.3%	16.02	0.6%	3.68	0.9%
Spectrally Selective Film	37.04	3.6%	18.76	6.8%	4.02	6.6%	36.21	1.7%	17.93	3.4%	4.03	3.1%	34.31	0.2%	16.03	0.5%	3.68	0.8%
Low-e Film	35.25	8.2%	16.97	15.7%	3.70	14.1%	35.05	4.9%	16.76	9.7%	3.79	8.9%	34.05	1.0%	15.76	2.1%	3.58	3.6%
Spectrally Selective + Low-e Film	34.81	9.4%	16.53	17.9%	3.70	14.0%	34.84	5.4%	16.56	10.8%	3.77	9.3%	33.94	1.3%	15.66	2.8%	3.54	4.6%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	39.59	--	21.31	--	4.38	--	36.85	--	18.57	--	4.14	--	35.26	--	16.98	--	3.87	--
Traditional Tint Film	38.57	2.6%	20.29	4.8%	4.10	6.4%	36.35	1.4%	18.06	2.7%	4.02	3.1%	35.04	0.6%	16.76	1.3%	3.82	1.4%
Spectrally Selective Film	38.76	2.1%	20.47	3.9%	4.18	4.7%	36.49	1.0%	18.21	1.9%	4.06	2.0%	35.14	0.3%	16.86	0.7%	3.84	0.7%
Low-e Film	36.91	6.8%	18.63	12.6%	3.91	10.7%	35.59	3.4%	17.31	6.8%	3.86	6.9%	34.63	1.8%	16.35	3.7%	3.73	3.6%
Spectrally Selective + Low-e Film	35.96	9.2%	17.68	17.1%	3.84	12.3%	35.25	4.4%	16.96	8.7%	3.81	8.0%	34.53	2.1%	16.25	4.3%	3.68	4.8%

Climate Zone 14

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	35.97	--	17.69	--	3.82	--	35.12	--	16.83	--	3.81	--	33.97	--	15.69	--	3.58	--
Traditional Tint Film	35.42	1.5%	17.13	3.1%	3.66	4.2%	34.98	0.4%	16.70	0.8%	3.77	1.1%	33.99	-0.1%	15.71	-0.1%	3.58	-0.1%
Spectrally Selective Film	35.54	1.2%	17.26	2.4%	3.71	2.9%	35.05	0.2%	16.77	0.4%	3.79	0.6%	33.98	-0.0%	15.70	-0.0%	3.58	-0.0%
Low-e Film	34.57	3.9%	16.29	7.9%	3.53	7.4%	34.29	2.3%	16.01	4.9%	3.63	4.8%	33.74	0.7%	15.46	1.5%	3.49	2.3%
Spectrally Selective + Low-e Film	34.15	5.1%	15.87	10.3%	3.47	9.1%	34.02	3.1%	15.74	6.5%	3.54	7.3%	33.60	1.1%	15.31	2.4%	3.41	4.7%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.39	--	19.11	--	3.94	--	35.50	--	17.22	--	3.84	--	34.53	--	16.25	--	3.70	--
Traditional Tint Film	36.94	1.2%	18.66	2.4%	3.78	3.8%	35.38	0.3%	17.10	0.7%	3.79	1.3%	34.58	-0.2%	16.30	-0.3%	3.71	-0.3%
Spectrally Selective Film	37.01	1.0%	18.72	2.0%	3.83	2.6%	35.45	0.1%	17.17	0.3%	3.82	0.5%	34.58	-0.2%	16.30	-0.3%	3.71	-0.4%
Low-e Film	35.68	4.6%	17.40	9.0%	3.64	7.4%	34.73	2.2%	16.45	4.4%	3.68	4.0%	34.20	0.9%	15.92	2.0%	3.60	2.6%
Spectrally Selective + Low-e Film	34.81	6.9%	16.53	13.5%	3.59	8.9%	34.33	3.3%	16.05	6.8%	3.58	6.7%	33.99	1.6%	15.71	3.3%	3.50	5.3%

Climate Zone 14

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	33.18	--	14.90	--	3.37	--	32.31	--	14.02	--	3.38	--	31.54	--	13.26	--	3.18	--
Traditional Tint Film	33.94	-2.3%	15.66	-5.1%	3.46	-2.8%	33.56	-3.9%	15.27	-8.9%	3.61	-6.8%	32.97	-4.5%	14.69	-10.8%	3.45	-8.5%
Spectrally Selective Film	32.98	0.6%	14.70	1.3%	3.30	2.1%	32.40	-0.3%	14.12	-0.7%	3.39	-0.2%	31.80	-0.8%	13.51	-1.9%	3.23	-1.6%
Low-e Film	33.11	0.2%	14.83	0.5%	3.30	2.0%	32.80	-1.5%	14.52	-3.5%	3.41	-0.9%	32.57	-3.3%	14.29	-7.8%	3.33	-4.7%
Spectrally Selective + Low-e Film	32.42	2.3%	14.14	5.1%	3.19	5.4%	32.29	0.1%	14.01	0.1%	3.27	3.2%	32.39	-2.7%	14.11	-6.4%	3.24	-1.8%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.99	--	16.71	--	3.57	--	33.21	--	14.93	--	3.49	--	32.33	--	14.05	--	3.37	--
Traditional Tint Film	35.99	-2.8%	17.71	-6.0%	3.65	-2.4%	34.62	-4.2%	16.33	-9.4%	3.69	-5.6%	33.82	-4.6%	15.54	-10.6%	3.62	-7.3%
Spectrally Selective Film	34.95	0.1%	16.66	0.3%	3.52	1.4%	33.44	-0.7%	15.16	-1.6%	3.53	-1.0%	32.64	-0.9%	14.35	-2.2%	3.43	-1.7%
Low-e Film	34.62	1.1%	16.34	2.2%	3.50	1.8%	33.80	-1.8%	15.51	-3.9%	3.56	-1.9%	33.28	-2.9%	15.00	-6.8%	3.49	-3.5%
Spectrally Selective + Low-e Film	33.48	4.3%	15.19	9.1%	3.39	4.9%	33.15	0.2%	14.87	0.4%	3.42	2.3%	32.83	-1.5%	14.55	-3.5%	3.34	0.9%

Climate Zone 15

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	43.83	--	25.55	--	4.31	--	42.30	--	24.01	--	4.17	--	38.83	--	20.55	--	3.79	--
Traditional Tint Film	40.81	6.9%	22.53	11.8%	3.93	8.8%	40.93	3.2%	22.64	5.7%	4.00	4.0%	38.61	0.6%	20.33	1.1%	3.76	0.5%
Spectrally Selective Film	41.56	5.2%	23.27	8.9%	4.03	6.5%	41.27	2.4%	22.99	4.3%	4.04	3.0%	38.64	0.5%	20.36	0.9%	3.77	0.5%
Low-e Film	39.02	11.0%	20.73	18.9%	3.73	13.5%	39.46	6.7%	21.18	11.8%	3.85	7.8%	38.15	1.8%	19.86	3.3%	3.72	1.7%
Spectrally Selective + Low-e Film	38.85	11.4%	20.57	19.5%	3.76	12.8%	39.22	7.3%	20.94	12.8%	3.84	7.8%	37.96	2.2%	19.67	4.2%	3.71	1.9%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	44.40	--	26.11	--	4.39	--	41.95	--	23.67	--	4.16	--	39.99	--	21.71	--	3.93	--
Traditional Tint Film	42.37	4.6%	24.09	7.8%	4.11	6.4%	41.02	2.2%	22.74	3.9%	4.03	3.1%	39.56	1.1%	21.28	2.0%	3.88	1.2%
Spectrally Selective Film	42.88	3.4%	24.60	5.8%	4.19	4.7%	41.31	1.5%	23.03	2.7%	4.07	2.1%	39.77	0.6%	21.49	1.0%	3.91	0.6%
Low-e Film	40.63	8.5%	22.34	14.4%	3.92	10.7%	39.92	4.8%	21.64	8.6%	3.89	6.4%	38.88	2.8%	20.60	5.1%	3.81	3.0%
Spectrally Selective + Low-e Film	39.92	10.1%	21.64	17.1%	3.88	11.7%	39.51	5.8%	21.23	10.3%	3.88	6.7%	38.73	3.2%	20.44	5.8%	3.82	2.9%

Climate Zone 15

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	39.88	--	21.60	--	3.84	--	39.62	--	21.33	--	3.87	--	37.98	--	19.70	--	3.70	--
Traditional Tint Film	38.73	2.9%	20.44	5.4%	3.69	3.7%	39.31	0.8%	21.03	1.4%	3.84	0.8%	37.98	-0.0%	19.70	-0.0%	3.70	-0.1%
Spectrally Selective Film	39.10	2.0%	20.82	3.6%	3.74	2.4%	39.45	0.4%	21.17	0.8%	3.86	0.3%	37.97	0.0%	19.68	0.1%	3.70	-0.1%
Low-e Film	37.68	5.5%	19.40	10.2%	3.61	6.0%	38.26	3.4%	19.98	6.3%	3.72	3.8%	37.53	1.2%	19.25	2.3%	3.66	1.1%
Spectrally Selective + Low-e Film	37.44	6.1%	19.16	11.3%	3.62	5.6%	37.86	4.4%	19.58	8.2%	3.69	4.5%	37.19	2.1%	18.91	4.0%	3.63	2.0%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	40.81	--	22.53	--	3.95	--	39.74	--	21.45	--	3.88	--	38.66	--	20.38	--	3.79	--
Traditional Tint Film	39.85	2.4%	21.57	4.3%	3.81	3.5%	39.46	0.7%	21.18	1.3%	3.85	0.9%	38.71	-0.1%	20.43	-0.2%	3.80	-0.4%
Spectrally Selective Film	40.13	1.7%	21.85	3.0%	3.86	2.4%	39.60	0.4%	21.31	0.7%	3.87	0.4%	38.72	-0.2%	20.44	-0.3%	3.80	-0.4%
Low-e Film	38.71	5.2%	20.42	9.3%	3.70	6.2%	38.55	3.0%	20.27	5.5%	3.76	3.3%	38.07	1.5%	19.79	2.9%	3.73	1.5%
Spectrally Selective + Low-e Film	38.02	6.8%	19.73	12.4%	3.69	6.6%	38.00	4.4%	19.71	8.1%	3.72	4.2%	37.70	2.5%	19.41	4.7%	3.70	2.2%

Climate Zone 15

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.60	--	18.32	--	3.38	--	36.35	--	18.07	--	3.42	--	35.00	--	16.71	--	3.29	--
Traditional Tint Film	36.94	-0.9%	18.66	-1.9%	3.49	-3.3%	37.72	-3.8%	19.43	-7.5%	3.67	-7.3%	36.80	-5.1%	18.51	-10.8%	3.57	-8.7%
Spectrally Selective Film	35.98	1.7%	17.69	3.4%	3.31	2.1%	36.37	-0.0%	18.08	-0.1%	3.44	-0.6%	35.27	-0.8%	16.99	-1.6%	3.34	-1.7%
Low-e Film	35.78	2.2%	17.50	4.5%	3.37	0.1%	36.47	-0.3%	18.19	-0.7%	3.52	-2.8%	36.14	-3.2%	17.85	-6.8%	3.50	-6.7%
Spectrally Selective + Low-e Film	35.15	4.0%	16.86	8.0%	3.33	1.3%	35.67	1.9%	17.38	3.8%	3.43	-0.4%	35.74	-2.1%	17.45	-4.4%	3.47	-5.5%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.97	--	19.69	--	3.57	--	37.01	--	18.72	--	3.54	--	35.97	--	17.69	--	3.46	--
Traditional Tint Film	38.76	-2.1%	20.47	-4.0%	3.69	-3.4%	38.62	-4.4%	20.34	-8.6%	3.75	-5.8%	37.88	-5.3%	19.59	-10.8%	3.71	-7.2%
Spectrally Selective Film	37.60	1.0%	19.31	1.9%	3.54	1.0%	37.23	-0.6%	18.95	-1.2%	3.58	-1.0%	36.38	-1.1%	18.10	-2.3%	3.52	-1.8%
Low-e Film	37.42	1.5%	19.13	2.8%	3.56	0.2%	37.48	-1.3%	19.20	-2.5%	3.64	-2.7%	37.02	-2.9%	18.74	-5.9%	3.62	-4.7%
Spectrally Selective + Low-e Film	36.38	4.2%	18.09	8.1%	3.50	1.8%	36.58	1.2%	18.30	2.3%	3.56	-0.3%	36.30	-0.9%	18.02	-1.9%	3.54	-2.5%

Climate Zone 16

Daylighting Off
Window Shades No
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.98	--	19.70	--	3.87	--	35.11	--	16.83	--	3.67	--	33.18	--	14.90	--	3.15	--
Traditional Tint Film	37.81	0.5%	19.53	0.9%	3.34	13.7%	34.92	0.5%	16.64	1.1%	3.43	6.5%	33.23	-0.2%	14.95	-0.3%	3.11	1.3%
Spectrally Selective Film	37.66	0.8%	19.38	1.6%	3.47	10.3%	34.93	0.5%	16.65	1.1%	3.49	4.9%	33.21	-0.1%	14.93	-0.2%	3.12	1.1%
Low-e Film	36.02	5.2%	17.74	9.9%	3.10	19.8%	34.30	2.3%	16.02	4.8%	3.22	12.4%	33.12	0.2%	14.84	0.4%	3.04	3.5%
Spectrally Selective + Low-e Film	34.72	8.6%	16.44	16.5%	3.13	19.2%	33.92	3.4%	15.64	7.1%	3.18	13.3%	33.02	0.5%	14.74	1.1%	3.01	4.4%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	40.61	--	22.33	--	3.85	--	35.87	--	17.59	--	3.57	--	33.93	--	15.65	--	3.32	--
Traditional Tint Film	40.77	-0.4%	22.49	-0.7%	3.49	9.3%	35.86	0.0%	17.58	0.1%	3.41	4.5%	33.95	-0.1%	15.68	-0.2%	3.24	2.3%
Spectrally Selective Film	40.55	0.2%	22.27	0.3%	3.59	6.8%	35.81	0.2%	17.53	0.3%	3.47	3.0%	33.93	-0.0%	15.65	-0.0%	3.28	1.2%
Low-e Film	38.22	5.9%	19.94	10.7%	3.27	15.1%	35.15	2.0%	16.87	4.1%	3.25	9.1%	33.69	0.7%	15.41	1.5%	3.13	5.6%
Spectrally Selective + Low-e Film	36.17	10.9%	17.89	19.9%	3.22	16.3%	34.55	3.7%	16.27	7.5%	3.20	10.5%	33.52	1.2%	15.24	2.6%	3.11	6.2%

Climate Zone 16

Daylighting Off
Window Shades Yes (30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio 33% (Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	36.81	--	18.53	--	3.23	--	34.32	--	16.04	--	3.26	--	33.02	--	14.74	--	3.02	--
Traditional Tint Film	36.91	-0.3%	18.63	-0.6%	3.03	6.4%	34.39	-0.2%	16.11	-0.5%	3.20	1.8%	33.08	-0.2%	14.80	-0.4%	3.02	0.1%
Spectrally Selective Film	36.79	0.1%	18.51	0.1%	3.09	4.4%	34.38	-0.2%	16.10	-0.4%	3.23	1.0%	33.07	-0.1%	14.79	-0.3%	3.02	0.1%
Low-e Film	35.46	3.7%	17.18	7.3%	2.92	9.6%	33.75	1.7%	15.47	3.5%	3.04	6.6%	32.91	0.3%	14.63	0.8%	2.96	2.1%
Spectrally Selective + Low-e Film	34.35	6.7%	16.07	13.2%	2.92	9.5%	33.32	2.9%	15.04	6.3%	3.00	8.0%	32.83	0.6%	14.55	1.3%	2.92	3.5%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	39.43	--	21.15	--	3.29	--	35.24	--	16.96	--	3.24	--	33.59	--	15.31	--	3.11	--
Traditional Tint Film	39.52	-0.2%	21.24	-0.4%	3.12	5.1%	35.29	-0.1%	17.01	-0.3%	3.19	1.6%	33.68	-0.3%	15.40	-0.6%	3.12	-0.2%
Spectrally Selective Film	39.35	0.2%	21.07	0.4%	3.18	3.5%	35.25	-0.0%	16.97	-0.1%	3.21	0.8%	33.64	-0.1%	15.36	-0.3%	3.12	-0.3%
Low-e Film	37.12	5.8%	18.84	10.9%	3.02	8.3%	34.47	2.2%	16.19	4.6%	3.07	5.4%	33.40	0.6%	15.12	1.3%	3.03	2.8%
Spectrally Selective + Low-e Film	35.34	10.4%	17.06	19.3%	2.98	9.5%	33.87	3.9%	15.59	8.1%	3.01	7.2%	33.20	1.2%	14.92	2.5%	2.98	4.2%

Climate Zone 16

Daylighting	On	(30 fc setpoint, Primay + Secondary Zones, 3 Levels+Off Ctrls)
Window Shades	Yes	(30% Visible, 30% Solar Transmissive Roller Shades, operated by 50 W/m2 solar trigger on window surface)
Window-to-Wall Ratio	33%	(Gross WWR, considering plenum wall area)

	Single Pane Clear Window						Double Pane Clear Window						Double Pane Low-e Clear Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	34.71	--	16.43	--	2.82	--	32.13	--	13.85	--	2.86	--	31.24	--	12.96	--	2.65	--
Traditional Tint Film	35.73	-2.9%	17.45	-6.2%	2.83	0.0%	33.19	-3.3%	14.91	-7.7%	3.02	-5.6%	32.27	-3.3%	13.99	-7.9%	2.88	-9.0%
Spectrally Selective Film	35.01	-0.9%	16.73	-1.8%	2.70	4.3%	32.31	-0.6%	14.03	-1.3%	2.85	0.4%	31.49	-0.8%	13.21	-1.9%	2.69	-1.8%
Low-e Film	34.47	0.7%	16.19	1.5%	2.69	4.8%	32.55	-1.3%	14.27	-3.0%	2.83	1.1%	32.13	-2.8%	13.85	-6.8%	2.80	-5.8%
Spectrally Selective + Low-e Film	33.13	4.5%	14.85	9.6%	2.64	6.5%	31.99	0.4%	13.71	1.0%	2.73	4.6%	32.10	-2.7%	13.82	-6.6%	2.75	-3.9%

	Single Pane Tinted Window						Double Pane Tinted Window						Double Pane Low-e Tinted Window					
Window Film	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings	Whole Bldg Energy Use (kBtu/sf)	% Whole Bldg Energy Savings	HVAC Energy Use (kBtu/sf)	% HVAC Energy Use	Peak Electric Demand (W/sf)	% Demand Savings
No Film (Base case)	37.48	--	19.20	--	2.95	--	33.28	--	15.00	--	2.92	--	31.86	--	13.58	--	2.79	--
Traditional Tint Film	38.74	-3.4%	20.46	-6.6%	2.99	-1.5%	34.66	-4.2%	16.38	-9.2%	3.09	-5.8%	33.07	-3.8%	14.79	-8.9%	3.02	-8.3%
Spectrally Selective Film	37.62	-0.4%	19.34	-0.7%	2.87	2.6%	33.55	-0.8%	15.27	-1.8%	2.94	-0.6%	32.10	-0.8%	13.82	-1.8%	2.85	-2.1%
Low-e Film	36.33	3.1%	18.05	6.0%	2.87	2.7%	33.78	-1.5%	15.50	-3.3%	2.94	-0.5%	32.76	-2.8%	14.48	-6.7%	2.90	-4.0%
Spectrally Selective + Low-e Film	34.50	7.9%	16.22	15.5%	2.78	5.6%	33.03	0.8%	14.75	1.7%	2.84	2.8%	32.37	-1.6%	14.10	-3.8%	2.82	-0.9%

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