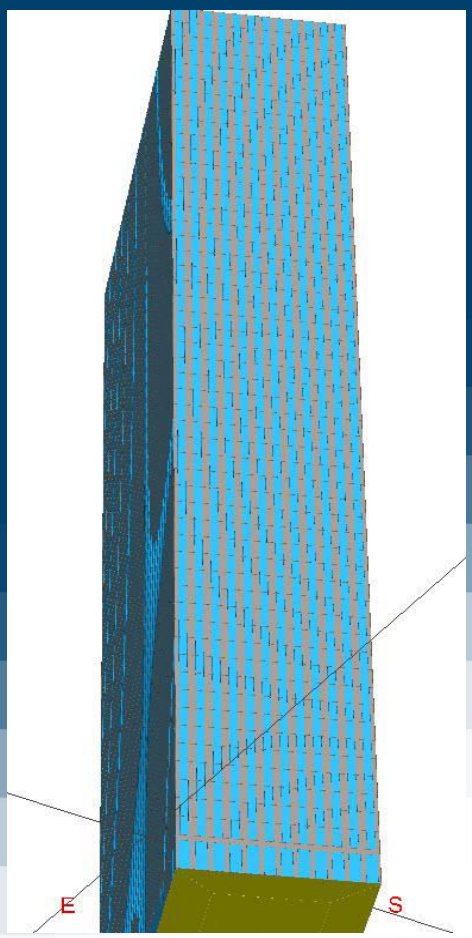
Case Study
Large City Building Modeling

Upgrading Glass from Single to Multiple Pane Using an Interior Window Retrofit



Commercial buildings can save over 20% of their building's energy consumption with retrofit glass technology, in which a secondary glass panel is installed behind existing single glazed glass windows.

To demonstrate the unique opportunity for building owners, city planners, and utility companies to increase the energy efficiency of their commercial buildings through retrofitting glass, Thermolite created a building model study using the available information about the Exxon Building, more commonly known as 1251 Avenue of the Americas, from the City of New York Building Energy Database to show how our RetroWAL™ Silver Series interior retrofit window system would impact energy savings in large city commercial buildings with non-thermally broken, single glazed curtain wall.

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Methodology:

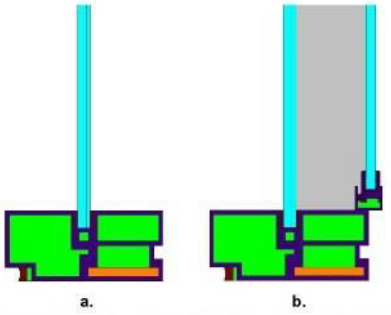
The first step in our analysis calculates the improved thermal performance of the Thermolite retrofit system compared to the existing window. Air infiltration improvement is based on laboratory results.

The model was first run using the following factors approximated by Window 6.3 fenestration software and test data:

- Existing window U Values
- Solar Heat Gain Coefficients (SHGC)
- Air infiltrations

New values using the same software and test data were then placed into the model and rerun to approximate the energy savings of a window retrofit.

In this case -

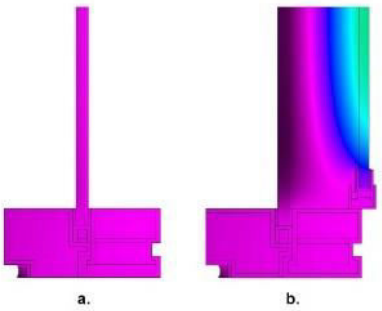


Baseline Single Pane glass in existing curtain wall:

- U-value = 1.16
- SHGC = .77
- Infiltration= .50 cfm/ft^2 of glass (at 25 mph) translates to .32 cfm/ft^2 wall in wizard

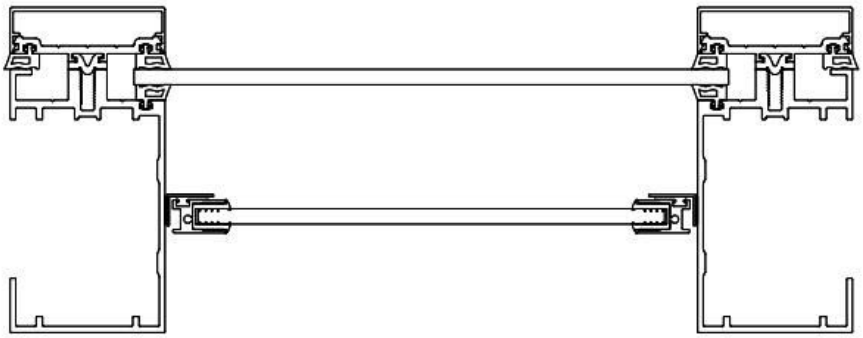
Baseline plus Thermolite Silver Series- single to double:

- U-value= .55
- SHGC= .65
- Infiltration=.04 CFM/ft^2 of glass translates to .026 cfm/ft^2 wall in wizard



The next step in the analysis is to construct a whole building analysis and match the results with the EUI or energy utility index provided to us from the City of New York. A baseline model of the energy consumption and demand was calculated and compared with a new simulation of the improved Thermolite window system.

Thermolite then applied this calibrated building base model to buildings in large cities throughout the US in order to determine what areas of country would benefit the most from our RetroWAL™ Silver Series window retrofit. Weather files using Heating Degree Days (HDD) and Cooling Degree Days (CDD) were placed into the base model and run for a total of 10 metropolitan cities. Local utility energy cost data was also considered as a variable in these different locations. Analysis was performed on the detail of the New York City model building in order to take into account the effects of convection, conduction, and radiation.

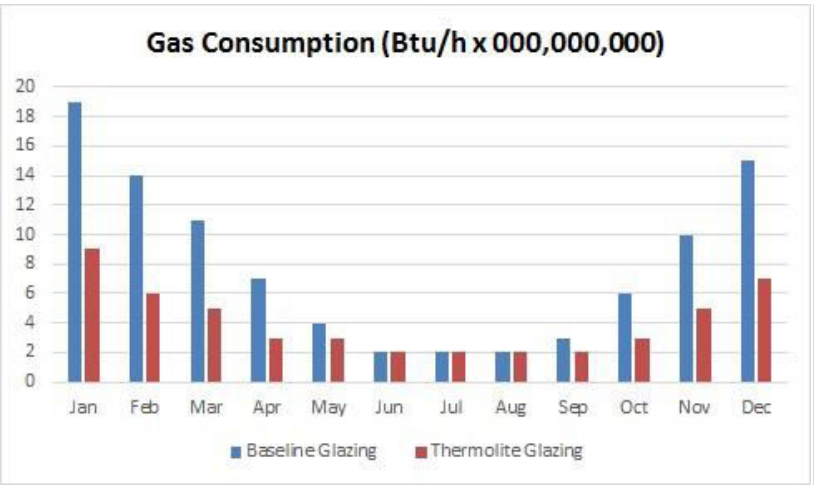


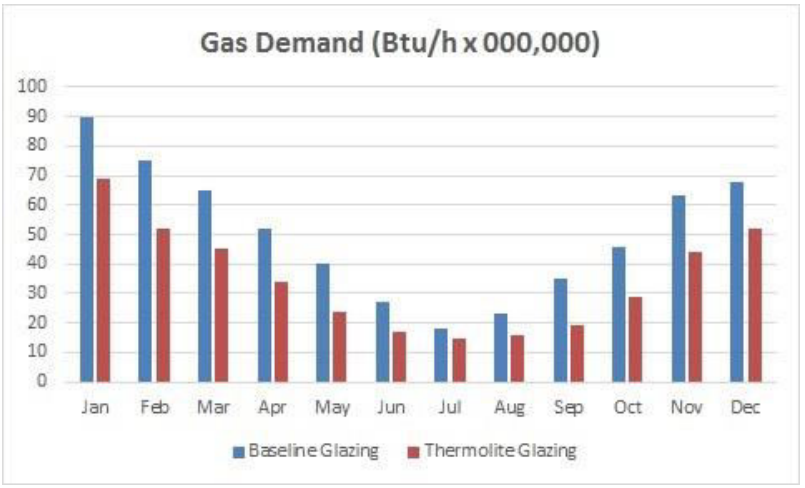
The data indicates that:

- 61.7% of the improvement in energy performance was the result of improved thermal resistance (U value)
- 33.2% of the savings is attributed to air infiltration reduction.
- Just the remaining 5.1% was due to the reduction of solar heat gain.

Results:

A **27.7% energy reduction** was projected by the Energy Utility Index (EUI) of our New York City base model projected





after the installation of Thermolite RetroWAL™ Silver Series behind the building's existing single pane window.

The average reduction in total building energy in the 10 city analysis was 23%; however, there was a distinct difference in performance between warm climates and cold climates.

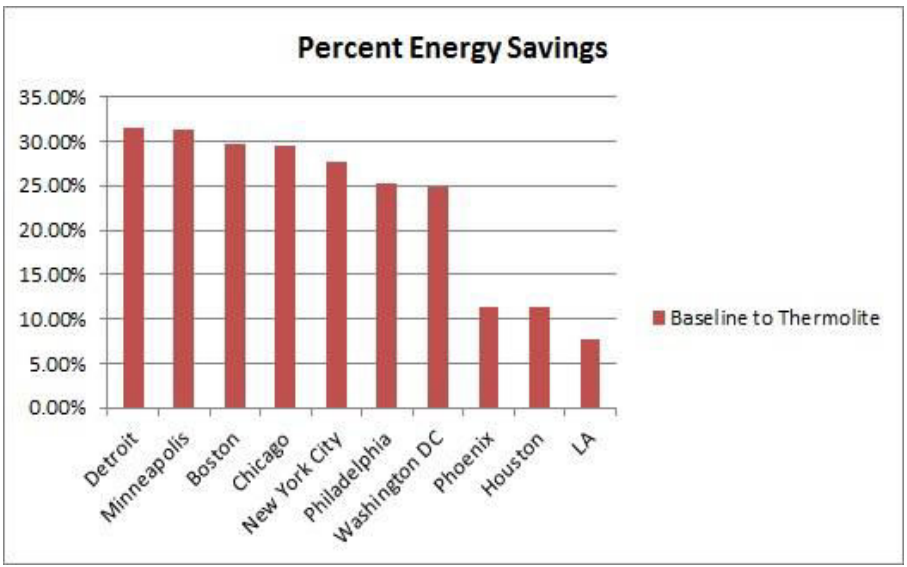
This is consistent with what Thermolite has observed in real world applications in colder climates in which 33% of heating steam is saved, while 8% of electric is saved after the installation of our interior window retrofit glass technology.

Energy savings in cold climate buildings were 28.5% in our simulation, versus 10.1% in the warm climate locations.

This difference in results was expected, as cold climates benefit more from an insulating airspace and the low –e glass coatings of Thermolite's RetroWAL™ Silver Series.

Retrofitting's Return on Investment:

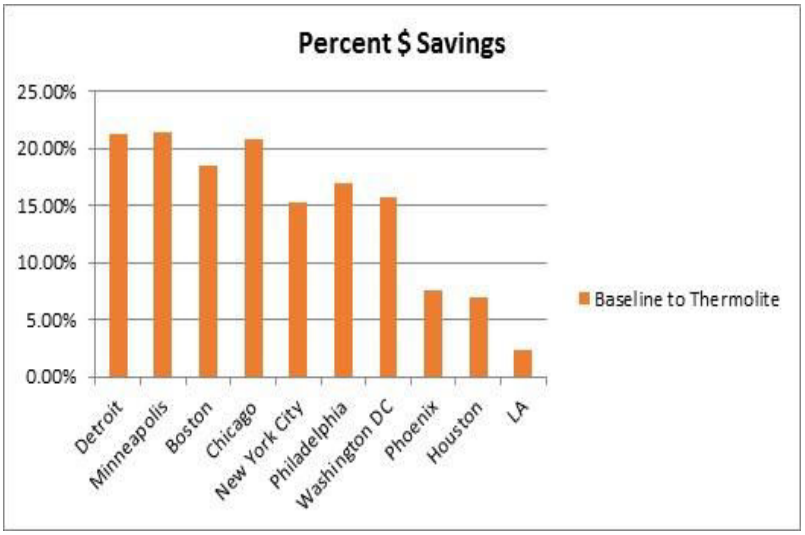
In Thermolite's building model analysis, we take into consideration the ROI and installation costs of the window system, which will vary only slightly between locations depending on the area's labor rates. Energy rates differ from locations and while the efficiency number is important, the total



energy savings will depend on local utility source and site costs.

The average cost for the installed window costs were assumed to be on average $20 per square foot for ROI analysis; however, this cost will vary depending factors, such as existing window type, new glass selection, and installation labor arrangement in each particular market.

Average ROI in cold climates was 6.7 years, which ranged from 5.8 years in Boston to 7.9 years in Philadelphia. Local energy costs and winter temperatures are generally the affecting factors on ROI in cold climates. Warm climates do not benefit nearly as much going from single to double glazing with 28 year ROI on average.



Note: our simulation was carried out to consider baseline single pane glass to triple glazing, which is a 50% higher initial investment. With this figure, the ROI for warm climates decreases significantly to 16.6 years and increasing slightly to 7.4 years for cold climates.

Summary of Findings:

Thermolite's building model study on the effects of installing our RetroWAL™ Silver Series retrofit glass technology behind the existing single pane glass demonstrated improvement in energy usage as well as savings.

The following key findings were observed:

Climate – cold climates, particularly those where energy costs are high, will benefit the most from secondary glazing. ROI is approximately 6 years in cold climates and upwards to 28 years in warmer climates in single to double applications. Single to triple applications significantly decrease the ROI in warm climates to 16 years, while remaining stable for cold climates at 7 years for ROI.

Savings Factors – Improvements in thermal performance and air infiltration levels account for 90% of total savings, with solar heat gain playing a very minor role in total savings.

Heating, Ventilation, and Air Conditioning (HVAC) –Single to triple glazing may be especially cost-effective when HVAC upgrades are needed. Buildings with two pipe heating and cooling systems should consider secondary glazing first in order to properly size new HVAC systems.

Building Factors - Window-to-wall ratio and energy savings increase linearly. Building size will impact the ROI of installing interior window retrofit glass technology, as building size was found to directly correspond with an increase in ROI.

Climate Energy Savings: Baseline Glazing to Thermolite Glazing

COLD CLIMATES

New York City – 27.7%

Chicago- 29.6%

Detroit – 31.4%

Boston- 29.7%

Washington DC – 24.9%

Philadelphia – 25.3%

Minneapolis – 31.3%

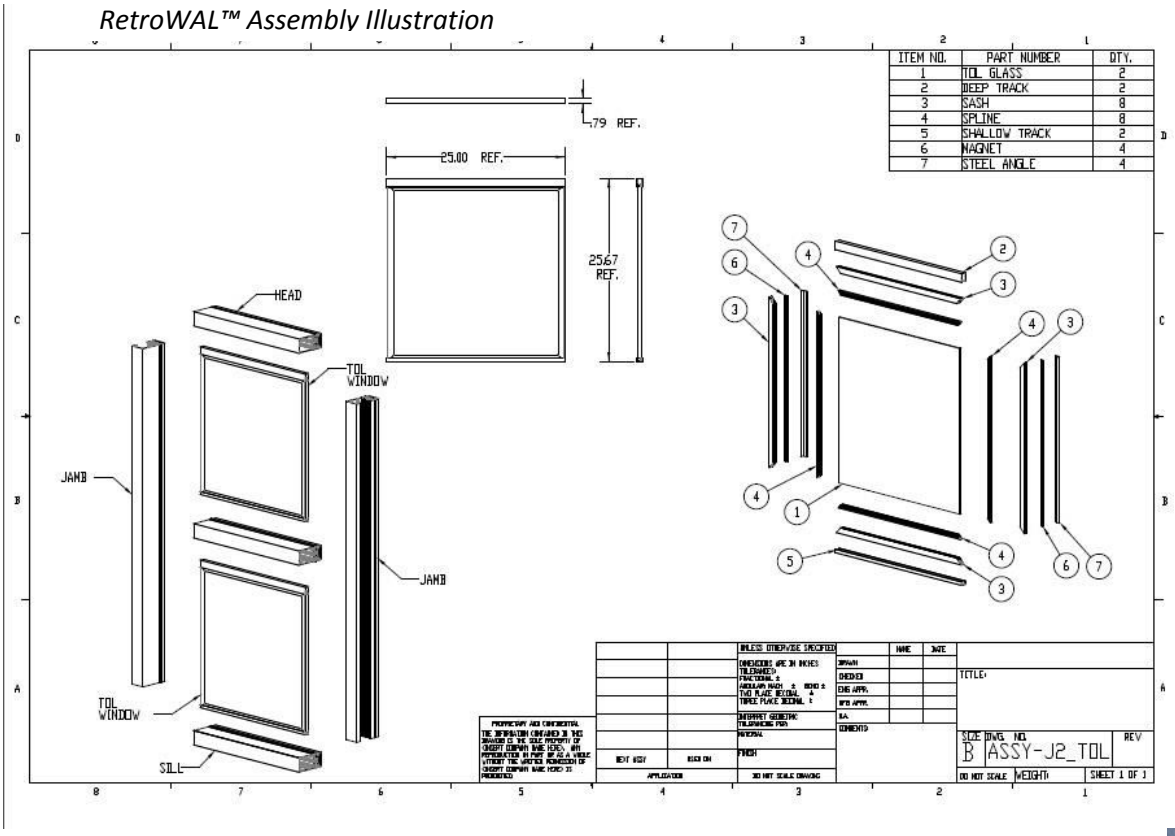
WARM CLIMATES

Los Angeles – 7.7%

Houston – 11.2%

Phoenix – 11.4%

RetroWAL™ Assembly Illustration



Pictured right: Exxon Building, the large building base model

Thermolite used eQuest software to create the building model. Certain assumptions were made about the building in our energy analyses. If you like to learn more about how the analyses were performed, please contact Thermolite.

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