Nicor Gas | Energy Efficiency Program

Emerging Technology Program

#1118: Low-E Interior Storm Windows – Public Pilot Project Report

06/15/2022

Technical Contacts

Feibi Yuan
Engineer
fyuan@gti.energy

Hardik Shah
Sr. Engineer | Program Manager
hshah@gti.energy

GTI Energy
1700 South Mount Prospect Road
Des Plaines, IL 60018

Nicor Gas Contact

Mark Szczygiel
Program Manager, Research and Emerging Technology
mszczygi@southernco.com

Nicor Gas Company
1844 Ferry Road
Naperville, IL 60563

Table of Contents

List of Figures

List of Tables

Legal Notice

This information was prepared by GTI Energy for Nicor Gas Company (Nicor Gas).

Neither GTI Energy, the members of GTI Energy, the Sponsor(s), nor any person acting on behalf of any of them:

a) Makes any warranty or representation, express or implied with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately-owned rights. Inasmuch as this project is experimental in nature, the technical information, results, or conclusions cannot be predicted. Conclusions and analysis of results by GTI Energy represent GTI Energy's opinion based on inferences from measurements and empirical relationships, which inferences and assumptions are not infallible, and with respect to which competent specialists may differ.
b) Assumes any liability with respect to the use of, or for any and all damages resulting from the use of, any information, apparatus, method, or process disclosed in this report; any other use of, or reliance on, this report by any third party is at the third party's sole risk.

The results within this report relate only to the items tested.

Executive Summary

Introduction

As part of the Nicor Gas Energy Efficiency Program, the Emerging Technology Program (ETP) assesses new technologies that have the potential to realize natural gas savings for the 2.3 million Nicor Gas customers in northern Illinois. GTI Energy provides program implementation for the Nicor Gas ETP. This report summarizes the findings of field evaluation of removable low-emissivity interior storm windows in the Nicor service territory heating season.

Background

The best-known benefit of energy-efficient double-pane modern windows is the energy savings potential over the course of their 10-20 year lifespan. The average cost of replacing old windows with energy-efficient multi-pane windows is $500-$650, per window.[1,2] A cost-effective alternative is to self-install interior storm windows to improve window insulation, as shown in Figure 1.

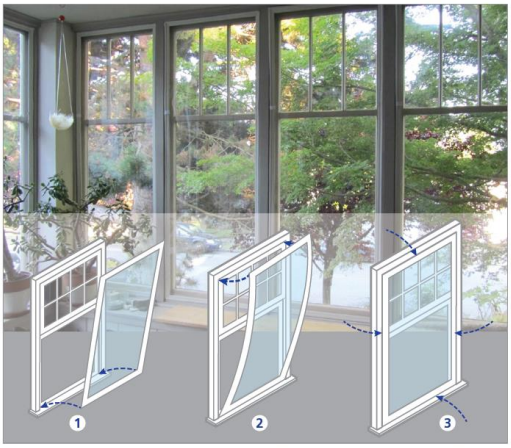

Photo: factory-made interior removable storm windows. Building America Solution Center, Pacific Northwest Laboratory (https://basc.pnnl.gov/images/factory-made-interior-removable-storm-windows)

Figure 1: Removable Interior Storm Window Easy Do-It-Yourself Installation Instructions

Interior storm windows, particularly those treated with low-emissivity or low-e coatings that became economically available in the early 1990s, are an alternative option for comparable savings. The additional insulation prevents moist warm interior air from condensing on the cool window panes in wintertime. Reduced moisture condensation, combined with caulking or outside weatherization (part of many income-eligible housing energy assistance programs) that reduces moisture infiltration, helps extend the useful life

[1] A 2018 Nerdwallet analysis cites the HomeAdvisor average cost of window replacement at the onset of this field pilot. https://www.nerdwallet.com/blog/mortgages/replacement-windows-cost/
[2] An updated 2020 HomeAdvisor estimate shows an average $650 per window cost of replacement. https://www.homeadvisor.com/cost/doors-and-windows/window-replacement/

of the existing window system by reducing corrosion (aluminum) or rot (wood) window frame.[3] Interior Storm Windows are widely available through local hardware stores for do-it-yourselfers and retrofit contractors, easy to install, and do not alter the appearance of the home. To install within existing windows, the retrofit product comes in many standard sizes and attachment methods, including: compression fit, magnetically attached, or Velcro patched. Retailers and manufacturers also offer custom ordering options for odd or non-standard window sizes. These windows purport to create a tight seal with the existing window system to better prevent cold and hot drafts. One additional non-energy benefit of storm windows is the reduced transmission of outside noise into the home. Older and historic single family and multi-family buildings with original single-pane or older double-pane windows are the target market of this technology, as well as light commercial buildings with window characteristics like residential homes.

Common metrics for rating windows are R-Value, U-Value, or Solar Heat Gain Coefficient (SHGC). R-Value is a measure of how well a piece of material insulates, with higher R-Values indicating better insulation. U-Values are the inverse of R-Value, where windows with lower U-Values are better at preventing heat transfer across the window boundary. A Solar Heat Gain Coefficient (SHGC) parameter measures the fraction of incident solar radiation admitted through a window, both directly transmitted and absorbed, and subsequently released inward into the occupied space. SHGC is expressed as a number between 0 and 1. The lower a window's solar heat gain coefficient, the less solar heat it transmits. The total U-Value of a window system with storm windows is on par with double-pane windows, in the range of 0.4 (high performing) to 0.6 (low performing), as documented by manufacturers and prior laboratory studies.

Findings

The technology has potential to deliver energy savings for space heating utilities and end-users. The pilot site for this study showed that 16-29% decreases in heating season heat loss at the windows are possible. During the study, the host site declined in-line modifications to its existing gas and new electric system, which prohibited whole-building system study of mixed utilities.

Interior Low-E insert costs were higher compared to cost estimates cited in prior published studies.[4] There are two reasons for higher costs: 1) non-standard windows sizes required custom (rather than off-the-shelf) Low-E inserts, and 2) the host site's window specifications require tempered glass. The cost of custom-sized windows were $4,393 or $209 per window, which is double the cost of off-the-shelf sizes. The additional safety feature of tempered glass raised costs to $305 per window. Representative return-on-investment information is shown in Table 1.

[3] Condensation and moisture damage as modern windows reach End-of-Life (10-20 years). https://glassdoctor.com/expert-tips/all-about-window-glass/condensation-between-window-panes
[4] The latest publications from the Pacific Northwest National Laboratory, Department of Energy, and Focus on Energy report an average cost of $115 per off-the-shelf sized retrofit interior storm window. https://www.focusonenergy.com/sites/default/files/Focus_on_Energy_2020_TRM.pdf. Last accessed 4/30/2020.

Table 1: Representative Return-on-Investment of Ideal (Baseline) and Pilot (Retrofit) Cases

	Baseline Case (Standard Low-E Windows)	Retrofit Case (Tempered Low-E Windows)	Difference (Qty, %)
# of Windows	10	21	+11 (+110%)
Unitary Cost ($/window)	$94	$209	+$115 (+122%)
Installation Cost	$0	$0	+$0 (+0%)
Subtotal	$940	$4,393	+$3,453 (+367%)
Total Therm Savings Attributed to Windows	179	29.5	-149.5 (-83.5%)
Average Therm Savings per Window	17.9	1.40	-16.5 (-92.2%)
Average Cost Savings per Window ($/window)	$13.43	$1.05	-$12.38 (-92.2%)
Simple Payback Period	70 Years	Over 100 Years	+Over 30 Years Longer