

## OPPORTUNITY

How much window energy use could higher performing windows save?

UP TO **75%**

OF THE ENERGY LOST THROUGH WINDOWS COULD BE REDUCED WITH HIGHER PERFORMING WINDOWS<sup>1</sup>

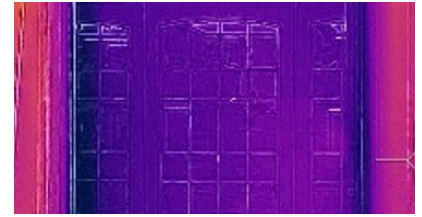
## TECHNOLOGY

How do lightweight secondary windows work?

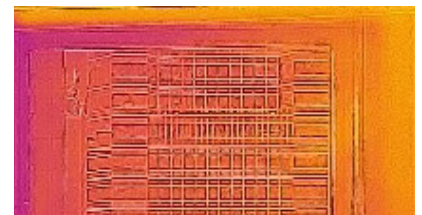
### THIN GLASS IN INSULATED FIBERGLASS FRAME

#### PRE-MANUFACTURED LIKE STORM WINDOWS

Single- & double-pane configurations  
2 to 3 times lighter than inserts  
manufactured with standard glass



Outside temperature 27°  
Single-pane interior glass 42°



Outside temperature 27°  
Single pane with insert 64°

## M&V

Where did Measurement and Verification occur?

**NATIONAL RENEWABLE ENERGY LABORATORY** assessed the impact of lightweight secondary windows provided by Alpen High Performance Products in a two-story office building at the Denver Federal Center.

## RESULTS

How did lightweight secondary windows perform in M&V?

**15%**  
**AVERAGE WHOLE-BUILDING ENERGY SAVINGS**<sup>2</sup>

Savings for double-pane insert with a baseline single-pane window

**EASY INSTALLATION**

< 10 MINUTES FOR 1 PERSON

NO DRILLED HOLES OR PERMANENT DEVICES<sup>3</sup>

**COMFORT INCREASED**

20° WARMER INTERIOR GLASS<sup>4</sup>

73% REDUCTION IN CONDENSATION<sup>5</sup>

97% LESS AIR LEAKAGE<sup>6</sup>

## Cost-Effective Across Climate Zones<sup>7</sup>

Positive return on investment at average GSA utility rates, \$0.11/kWh and \$7.43/mmBtu

Location		Savings with Double-Pane Insert (Single-Pane Window Baseline)					
CLIMATE ZONE	CITY	WHOLE BUILDING ENERGY SAVINGS kBtu/ft <sup>2</sup> /yr	ENERGY COST SAVINGS \$/ft <sup>2</sup> /yr	ANNUAL SAVINGS \$/yr	SAVINGS %	PAYBACK* YRS	SIR positive ROI if >1
1A	Miami, FL	8.1	\$0.27	\$14,480	11%	11.2	1.59
2A	Houston, TX	9.1	\$0.30	\$16,088	12%	10.1	1.76
2B	Phoenix, AZ	10.7	\$0.35	\$18,770	14%	8.7	2.05
3A	Atlanta, GA	10.3	\$0.35	\$18,770	14%	8.7	2.05
3B	Las Vegas, NV	10.8	\$0.36	\$19,306	15%	8.4	2.11
3C	San Francisco, CA	8.3	\$0.28	\$15,016	13%	10.8	1.64
4A	Baltimore, MD	12.6	\$0.43	\$23,060	16%	7.1	2.52
5A	Chicago, IL	13.5	\$0.46	\$24,669	17%	6.6	2.70
5B	Boulder, CO	13.9	\$0.47	\$25,205	18%	6.5	2.76
6A	Minneapolis, MN	15.6	\$0.54	\$28,959	17%	5.6	3.17
<b>AVERAGE SAVINGS</b>		<b>11.3</b>	<b>\$0.38</b>	<b>\$20,432</b>	<b>15%</b>	<b>8.4</b>	<b>2.2</b>

\*Modeling for high SHGC-0.42 in a medium-sized office building. A low SHGC-0.20 is more cost-effective in warm climates, with estimated payback < 10 years. Does not include savings from reduced air infiltration. Double-pane insert \$22/ft<sup>2</sup> Single-pane insert \$17/ft<sup>2</sup> Installation \$1.15/ft<sup>2</sup>

## DEPLOYMENT

Where does M&V recommend deploying lightweight secondary windows?

### RETROFIT SINGLE-PANE WINDOWS

In cold climates, double-pane secondary windows will be more cost-effective. In warm climates, the single-pane configuration may offer a better return on investment.

This retrofit technology is particularly well suited for historic structures where changes to the facade are not allowed.

<sup>1</sup>Highly Insulating Window Panel Attachment Retrofit. Charlie Curcija, Howdy Goudey, Robin Mitchell, Erin Dickerhoff (LBNL), December 2013, p.3

<sup>2</sup>Demonstration and Evaluation of Lightweight High-Performance Secondary Windows. Kosol Kiatreungwattana, Lin Simpson (NREL), November 2021, p.66 <sup>3</sup>Ibid, p.30 <sup>4</sup>Ibid, p.28, 9° warmer with single-pane insert <sup>5</sup>Ibid, p.22 <sup>6</sup>Ibid, p.28 <sup>7</sup>Ibid, p.66