

# **Bird-Safe Windows A Winner For Builders and Birds**

**A Report of the Ornithology Center at  
Muhlenberg College**

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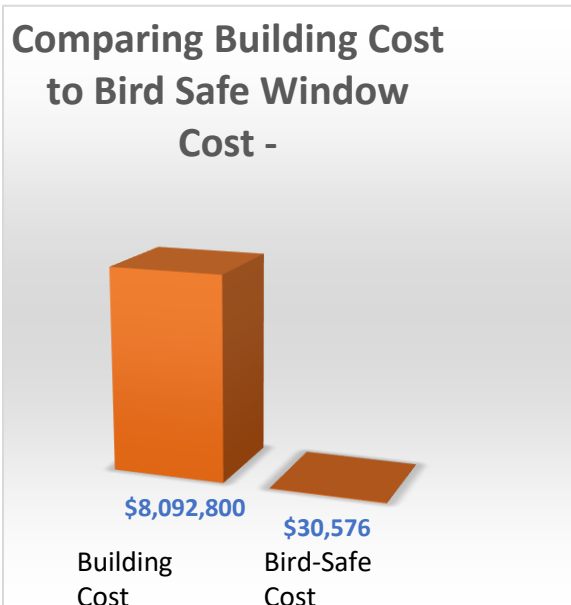
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**Executive Summary**

**Bird Safe Glass - A Win for Builders and Birds**

## Protect Millions of Birds: Very Low Cost

- The cost of bird-safe glass is so low that millions of birds can be saved when it is installed during the construction of new buildings – without a significant effect on the cost or the profitability of the building.
- For example, bird-safe glass can be installed in a new \$8 million 9-story office building for about \$30,000, or four tenths of one per cent (0.38%) of the total cost of the building.
- Installing bird-safe glass in new commercial buildings will save hundreds of millions of birds that die every year hitting commercial building windows.



- Building code reforms requiring bird safe glass in new commercial construction **should face little opposition** because the cost will be minimal. Policy makers can fulfill their responsibility to protect migrating birds and meet the environmental protection objectives of local ordinances without hurting the construction industry.
- The profitability of a new building will not be affected to any significant degree. The monthly debt service on a medium sized office building (\$32,800) will only increase by about \$125 due to the cost of bird-safe glass.

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# Background

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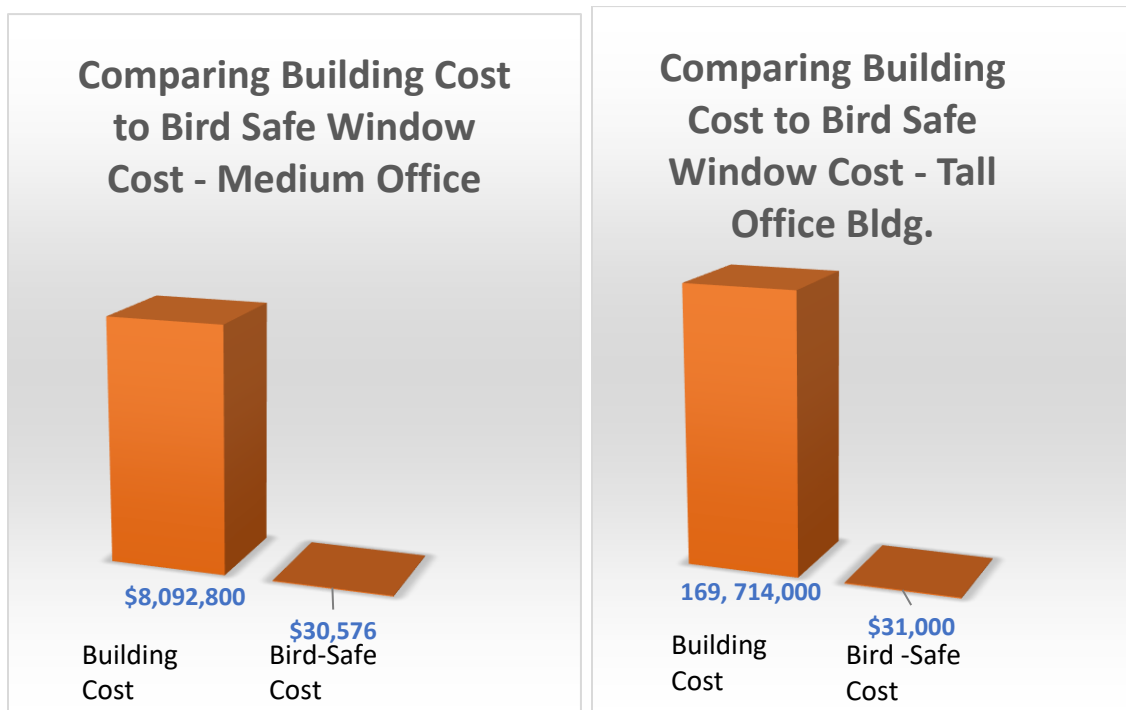
## Why Birds Hit Windows

Birds do not see glass. Instead they typically see a reflection of what is behind them, such as vegetation. What we recognize as glass they see as a safe place that they can fly through. They strike the window glass and most die immediately or later from injuries. There are a few exceptions. Hundreds of millions die this way each year, hitting both residential and commercial windows.

## What is Bird-Safe Glass

There are a number of bird-safe glass options, including frits, UV glass, painted patterns, etched patterns, and photovoltaic glass which have been tested and effectively reduce bird mortality. <https://abcbirds.org/glass-collisions/products-database/> There are also several options that can be applied to the window separately during or after the installation of the windows.

**Summary: Bird-Safe Glass is Affordable In New Construction Because The Cost Of Bird Safe Glass Is Inconsequential In Almost All Instances**



- Bird-safe glass adds less than **4/10ths of one percent** (0.38%) to the cost of a medium or large glass fronted building – even if bird safe glass cost 25% more than standard glass.

- This analysis is based on estimates of the added cost bird-safe window glass – i.e. it assumes that bird-safe glass is 10, 25 and 50% higher than ordinary glass. This method is used because actual cost differences are not available. It will remain valid even as prices change. The range has been confirmed with industry experts. Its soundness is confirmed by a [comparison](#) of the current costs of a building - with and without bird safe glass.

**The Fear of Huge Costs** The phrase “bird safe” windows are 25% more expensive has stymied joint efforts by the development and the bird safety communities to prevent avian deaths in commercial buildings. Developers imagine 100’s of windows that are 25% more expensive. The policy-maker fears that there will be wide opposition from the building community. In reality, when compared to the cost of the building as a whole, the developer’s main concern, the cost of bird safe glass is so low that it is inconsequential in most instances.

### No Major Impact on Building Industry

A bird safe requirement will **not** have a major effect on the building industry. Only about 1/3 of one per cent of buildings are primarily sheathed with glass. Half of new construction is warehouses which will not be affected by the bird-safe glass requirement to any significant degree.

## Why Bird-Safe Glass is so Very, Very Inexpensive

### Limits on the Cost of Bird-Safe Glass

The cost of adding bird safe glass is far lower than feared by the building community for six reasons.

1. **100 foot - Seven Story Cap.** Since 99% of all the bird window collision deaths occur at 100 feet or less, it is only the first 7 floors of a building that will need bird safe glass. This caps the cost for all buildings. The greater the square footage of a building, the less significant is the cost of bird-safe glass. (assumes the story height is 14 feet.)
2. **Only Glass, Not Window, Is More Expensive.** Windows will be installed in the building in any case. **The only extra cost of bird safe glass is the extra cost of the glass itself, not the frame and its fabrication. The cost of an installed bird-safe window is not 25% or more.** Many of the background documents assume that the cost of the glass is about a third of the window, and manufacturing, glazing and installation make up the balance. These are the same, whether bird safe glass is used or not. It may also cost extra to fabricate bird safe glass, so 10% is added in the estimates on which this report is based.

3. **Redesign Option.** This is a worst-case analysis. It assumes that the builder will not modify the design of the first 100 feet to reduce the area of glass. Architects have many options to redesign to reduce window costs. These also save energy and increase the LEED value.

4. **Few Buildings are Dominated by Glass** Bird-safe glass will not broadly affect the building community. According the most recent DOE data, only about 1/3 of 1% of buildings are primarily sheathed with glass. The higher prestige floors will likely have the more expensive glass – and contribute to the added cost for bird safe glass.

## Profitability and Bird-Safe Glass

### Developer's Goal: Net Return: Not Window Costs

A developer's main concern is whether building can produce a net return of 9% (as an example). His goal is not to buy windows. This is the case whether he plans to hold on to the building or find a buyer for it.

### Debt Service and Profitability of the Building

The profitability of a building is determined by comparing its income (usually rental) with its operating costs and debt service. The monthly debt service on a medium sized office building (\$32,900) will only increase by about \$125 due to the cost of bird-safe glass.

## Cost of Bird Safe Glass in Perspective

Major possible changes in the construction cost of a building are factored into the developer's decision to invest in a project These include cost overruns and changes in construction costs. These cost changes far greater than the cost of bird-safe glass.

### Compared to Likely Cost Overruns

About one-third of buildings end up costing more than the original estimates. The average overrun is about 16%. In the two scenarios used in this analysis, 16 per cent of the cost of this building is 30 times and 200 times the added cost of bird safe glass. Change orders are common in construction projects. These change orders can be used to switch to bird-safe glass during construction under certain conditions. In projects following the design/build model, design changes can be made to include bird safe glass since the design is not final.

### Compared to Average Variability In Construction Costs

The cost of basic building materials can change substantially during construction.

Assuming that the price of concrete, steel and lumber are about 50% of the cost of the building, the annual variation in the cost of those basic materials is 9% -- using historical data, not current prices. This change in costs is between 12 and 100 times the cost of bird safe glass for the two buildings used as examples.

## Cost of Bird Safe Glass Will Fall

The market for bird safe glass is thin at present. As more communities develop bird safe glass ordinances, the demand will increase and the costs will decline. This is demonstrated by the large drop in solar panel prices and the cost of water saving toilets.

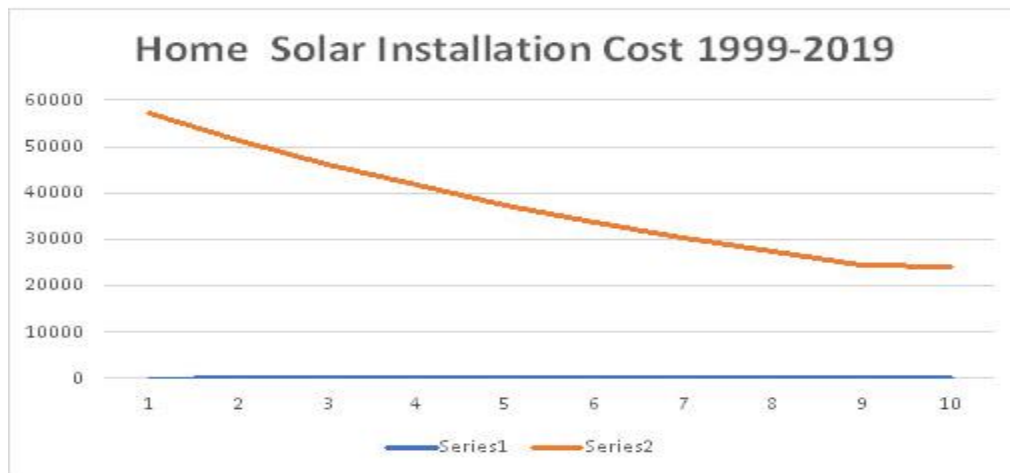
### More Ordinances Increase Market Size

Twenty communities now have bird-safe building standards or are in the process of developing them. These include large cities such as New York, San Francisco and Toronto. These bird safe ordinances will increase demand and push down the price of bird safe options.

<https://abcbirds.org/glass-collisions/existing-ordinances/> There is also a LEED standard.

### Cost Reductions as Demand Increases

The price of another glass product, solar panels, illustrates how the price may decline over time as demand increases. Under [Swanson's Law](#), drops by 20% for every doubling of shipped product. The cost of solar panels has generally been following [Swanson's Law](#). Home solar installation costs have fallen from \$57,000 to \$24,000 in 10 years – about in half.



The price of solar equipment has dropped by 89% since 2010.

### Competition Will Lower the Cost of Bird-Safe Glass

Because there are over 20 suppliers of bird safe glass, competition will lower the cost. The suppliers offer variety of types of bird safe glass which will give developers and architects many options.

## The Architect is Free to Do His/her Job

When bird safety advocates have asked for bird-safe windows, they are usually referred to architect who already has a budget for windows and does not want to add to the project's cost. When bird safe design is required by the building code, its cost is included in the overall cost of the building and the architect or builder then chooses which option works best for the particular building. This reduces uncertainty and lowers management costs.

## Special Consideration of Code Writers

### Standards For Bird-Safe Glass

The building code writer does not need to develop a standard for bird safe glass. A group of ornithologists and architects have developed a system for rating the effectiveness of bird safe glass options. <https://abcbirds.org/glass-collisions/threat-factor-rating/>

### Uncertain Costs Not a Barrier to Bird Safe Building Code.

As discussed below, policy makers often have to make decisions in the face of uncertainties. In such cases the use of scenarios which bracket possible outcomes gives the policy maker the information he needs to assess whether the new building code will be acceptable to the community. The scenarios – between 10% and 50% -- were recommended by industry sources.

### Lowering the Cost By Reducing the 100 foot cap – A Bad Choice.

Lowering the safe-bird height from 100 feet to some lower level is a bad choice because the savings to the developer are miniscule, but the increase in bird deaths is very large.

For example, lowering the bird-safe height to 50 feet only saves 0.07% of the cost of the building but increases the bird deaths substantially.

## Process of Analyzing the Added Cost of Bird-Safe Glass

This section describes how the conclusions stated above were developed in a spreadsheet.

To assess the economic acceptability of the cost of bird safe glass a spreadsheet was developed which includes ten (10) variables: These include (1) the building height, width and depth, (2) the construction costs per square foot, (3) the size of the windows, (4) the number of



windows per floor and (5) the cost of standard glass.

<https://ornithologycenter.com/background-information-for-safe-building-codes/>

## Why Scenarios and Not Actual Costs

The actual added cost of bird-safe glass depends on a number of factors. There are many types of glass. The added cost of all of these glass types is not available from the manufacturers, except to architects pricing a particular project. In order to assess the affordability of bird safe glass it is not necessary to know the exact added costs of bird-safe glass. Instead, one can begin with a cost of standard commercial glass and multiply it by 10, 25 and 50% to ascertain the range of added cost. This range was approved by industry experts. The use of scenarios in this way is a standard procedure used in policy development when exact costs are not known.

The costs and results of these scenarios were compared to the estimated cost of [a library with bird-safe glass and one without using current price quotes](#). Using actual costs, the added cost of bird-safe glass is 0.17% and using the scenario approach it is 0.15%.

**Medium Building Scenario** The first scenario is a [medium sized building](#) 125 ft high by 60 feet wide and deep. It was assumed that either the entire front or 4 all sides were entirely covered with windows. This scenario assumes that standard commercial glass cost \$25 per square foot. (This price is frequently appears in advertising.) (Columns 1 and 2 in the spreadsheet) The construction cost was assumed to be \$562/sq. ft. which is typical of a mid-rise building. [https://www.levelset.com/blog/commercial-construction-cost-per-square-foot/#Commercial\\_office\\_space](https://www.levelset.com/blog/commercial-construction-cost-per-square-foot/#Commercial_office_space)


























**Large Building Scenario** In the second set of scenario is a building twice the size of the midrise - 250 feet high and 18 stories, by 120 wide and 120 deep. In this instance unsafe glass was assumed to cost \$50 sq. ft. The building cost is \$660 per square foot - typical cost for high rises.

The added cost of the bird-safe glass for the floors needing bird safe glass was computed and compared to (1) the overall cost of the building, (2) the expected cost overruns, and (3) the expected variability in construction costs.

A wider range of typical per square foot cost follow. They vary widely based on the type of building.

# CONSTRUCTION COST PER SQUARE FOOT (PSF)

## AVERAGE COST PER SQUARE FOOT IN THE UNITED STATES

Commercial Office Space	Hospitality	Warehouse & Manufacturing Facilities	Healthcare	Schools	Universities	Public & Community Facilities	Parking Structures
 Single story \$313 psf	 3-star hotel \$478 psf	 Regional distribution center \$214 psf	 Medical office \$498 psf	 Elementary - \$295 psf Middle school - \$325 psf High school - \$359 psf	 Dormitory \$322 psf	 Gymnasium \$403 psf	 Above-ground /multi-level parking \$71 psf
 Mid-rise \$562 psf	 5-star hotel \$691 psf	 Light industrial warehouse \$238 psf	 Specialty clinic \$619 psf	 Primary/Secondary \$327 psf	 Standard classroom building \$580 psf	 Police station \$580 psf	 Below-ground /multi-level parking \$143 psf
 High-rise \$660 psf	 5-star hotel \$691 psf	 Tech lab factory \$635 psf	 Acute care facility \$888 psf	 Primary/Secondary \$327 psf	 Admin building \$596 psf	 Government admin building \$591 psf	 Museum/Performing arts center \$892 psf
					 Laboratory \$756 psf		

LEVELSET

Source: [https://www.levelset.com/blog/commercial-construction-cost-per-square-foot/#Commercial\\_office\\_space](https://www.levelset.com/blog/commercial-construction-cost-per-square-foot/#Commercial_office_space)

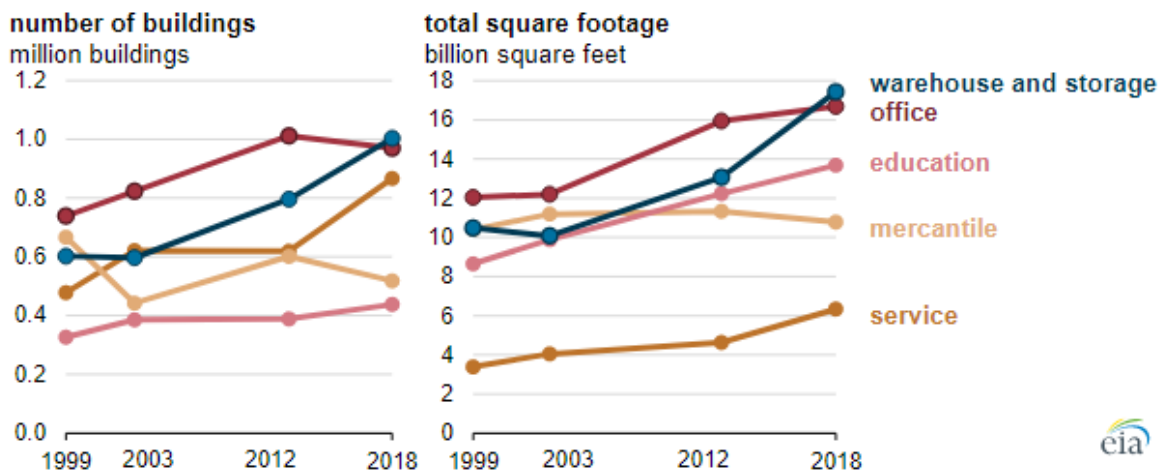
**Estimated Costs vs. Negotiated Costs.** Of course, the estimated costs are designed to provide an overall assessment of the acceptability of bird safe glass are different than the costs negotiated between the window supplier and the contractor for an installed window. As noted this tool produces results very close to actual comparisons of the cost of bird safe vs. unsafe windows.

## Commercial Building Types

NOVEMBER 30, 2021

### Warehouses were the most common U.S. commercial building type as of 2018

Number of buildings and total square footage, selected commercial building types (1999–2018)



Source: U.S. Energy Information Administration, *Commercial Buildings Energy Consumption Survey (CBECS)*

As of 2018, warehouse and storage buildings were the most common type of commercial building in the country, according to our most recent *Commercial Buildings Energy Consumption Survey (CBECS)*. Our most recent CBECS was released in September 2021 and was based on buildings characteristics as of 2018. We estimate that the United States had just over 1 million warehouse and storage buildings as of 2018 and a total floorspace of 17.4 billion square feet. This survey marks the first time since CBECS was released in 1979 that warehouse and storage buildings were the most common building type, ranked by both number of buildings and by total square footage.

## Case Study - Comparing Actual Costs

The soundness of this approach has been confirmed by architects who utilize bird-safe glass in projects. An example is below. An architect priced the cost of a new library with and without bird safe glass. In the yellow highlighted cell in L (recomputed at K) is the increased cost of bird safe glass as a percentage of the overall building cost. Below H2 is the percentage computed using the scenario spreadsheet. There is a difference of only 0.02%. This building is about the size of the medium office building in the analysis.

Library Case Study: Glass with Frit or UV Coating												
A	B	C	D	E	F	G	H2	I2	J2	K2	L	
Building Type	Site	Zoning	Area	# Floors	Total Façade Area (S.F.)	Glass Window Area (SF)	Windows: Total Cost (Labor & Material)	Windows: Material Cost (60% of H2)	Glass : Material Cost (21.5 % of I2)	Cost Increase (J x 1.5)	Increased Cost for Protected Glass (K2/K1)	
Public Library	Urban	Attached	12,625 SF	2	11,705	3084	\$447,260	\$268,356	\$57,780	\$19,260	0.18 %	
<b>Scenario approach found 0.15%</b>										0.17%		
							\$1,816,000	time average				
expected cost overruns							00	94	overruns			

The scenario assumed UV glass, priced at 50% above standard glass.

**Spreadsheet** The spreadsheet underlying these estimates can be downloaded at <https://ornithologycenter.com/background-information-for-safe-building-codes/> It is recommended that before using the spreadsheet you contact Jim Cubie at 843-991-1059 or jimcubie1@gmail.com