

A Parametric Study of the Savings Associated with Selected Serious Materials Glazing Products

July 6, 2009

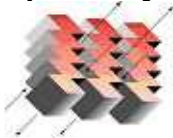
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Preface

Architectural Energy Corporation (AEC), an energy and environmental research, development, and design consulting firm located in Boulder, Colorado, prepared this document for Serious Materials. The AEC Project Manager is Rob Salcido and the authors of this report are Rob Salcido and Robert Slowinski.

Acknowledgements

The assistance of Robert Clarke, Judy DePuy, and Kevin Surace is most gratefully acknowledged.

0.0 Executive Summary

Architectural Energy Corporation was commissioned by Serious Materials, Inc to ascertain and analyze the energy savings associated with several Serious Materials and competitors' products, in a variety of building types and locations. Annual percent savings, simple payback period, and 30-year savings were among the metrics considered to evaluate each product's performance.

The results of the building simulations are highly dependent upon utility rates and structures, building internal loads, Window-Wall-Ratio, and climate. However, the results of the study follow a logical pattern. The selection of window glazing type produces the most profound differences in the office and hotel buildings, as these buildings have the highest Window-Wall-Ratios and lowest internal loads. Conversely, in the middle school and hospital—two building types with lower Window-Wall-Ratios and relatively high internal gains—the energy savings associated with fenestration is lower across-the-board, regardless of climate zone.

Several conclusions can be drawn from these results:

- Serious Materials products yielded higher annual and 30-year savings than selected competitor's products in most cases examined. SG-8 and SG-12 packages generally produced the highest 30-year savings of all glazings studied, in some cases up to \$24M when compared to single clear glazing and \$17M when compared to double clear glazing. Annual percent savings reached as high as 36% compared to single clear glazing and 28% when compared to double clear glazing.
- In the Atlanta and Phoenix climates, particularly in the Office and Hotel cases, Competitor B showed the highest annual and 30-year savings. This is due to a lower Solar Heat Gain Coefficient, which more effectively blocks unwanted summer solar heat gain.
- While the SG-5, SG-6, and SG-8 packages outperform Competitor A in all cases, the simple payback periods of these glazing packages are similar, and in some cases slightly lower than that of Competitor A. The simple payback periods for SG-5, SG-6, and SG-8 are all significantly shorter than the simple payback period of Competitor B.
- While projected energy savings in the Hospital building is lower than that of the other building types, the simple payback periods of Serious Materials products are most attractive (relative to the competitor's products) in the Hospital application..

1.0 Introduction

Drawing upon 28 years of worldwide leadership at the forefront of *super* insulating glass technology, Serious Materials in 2009 introduced a new family of Suspended Coated Film (SCF) architectural glazing offering high daylight transmission, directionally-tuned solar heat transmission/rejection, 99%+ UV blockage, and U-values 25 to 50% lower than the insulating values of the nearest competitor. This report presents the energy and cost savings of several high performance Serious Materials glazings in four different building types and six different climate zones. Studies indicate that, in many cases, Serious Materials products may yield significantly greater 30-year savings than comparable competitors' products, and may provide a savings of up to \$24M over the life of the product when compared to single clear glazing.

2.0 Energy Analysis, Assumptions, and Inputs

2.1 Description of Energy Analysis

In order to establish the performance of Serious Materials glazings in a wide spectrum of buildings, four different building types were modeled: a typical high-rise office building, middle school, hotel, and hospital.

Energy simulations were performed using DOE-2.2 building energy analysis software (Version 45n). An Excel-based DOE-2 Run Manager program was used to facilitate the analysis of many different parameters and the compilation of data, such that multiple runs could be performed with different glazing types and in different climate zones in rapid succession.

Atlanta, Chicago, New York, Phoenix, Seattle, and Washington DC were chosen for comparison, in order to include a variety of different climate types. Atlanta is a hot and humid climate, while Phoenix is hot and dry. Chicago is very cold in the winter, while Seattle is relatively mild year-round.

2.1.1 Envelope

The majority of the characteristics and inputs for each building type were taken from the 1991 Lawrence Berkeley Laboratory study to compile a database of the existing building stock within the United States. This study produced 481 prototypical commercial buildings for 20 urban market areas. The four prototypical buildings used were upgraded to ASHRAE Standard 90.1-2004 minimum standards.

Table 2 in Appendix B summarizes the building envelope characteristics for each modeled building type.

2.1.2 Internal Loads and Schedules

Lighting and equipment power densities are shown in Table 3 of Appendix B. Lighting power densities are 80% of the ASHRAE 90.1-2004 standard. Equipment power densities were taken from California Title 24 Alternative Calculation Method (ACM) and specified by whole-building.

2.1.3 Mechanical System

The HVAC system details for the ASHRAE Baseline and Proposed Design are outlined in Table 4 in Appendix B.

2.1.4 Window Types

Eight different combinations of window glazings were selected for analysis in each building type and in each climate. Glazing packages included generic single and double clear glazings to provide savings baselines, as well as two selections from PPG and four from Serious Materials. The details of each glazing package can be found in Table 1.

Table 1: Selected glazing packages and specifications

Package Name	Single Clear	Double Clear	Glazing A	Glazing B	SG-5	SG-6	SG-8	SG-12*
Manufacturer	generic	generic	PPG	PPG	Serious Materials	Serious Materials	Serious Materials	Serious Materials
Product	-	-	SB60	SG70XL	SG-5	SG-6	SG-8	SG-12
Outer Light	Clear	Clear	PPG SB60	PPG 70XL	C272	C272	C272	SB60
Interspaces and Thickness	n/a	1 @ 1/2"	1 @ 1/2"	1 @ 1/2"	2 @ 1/4"	2 @ 1/4"	2 @ 1/2"	3 @ 11/32"
Suspended Coated Film (s)	n/a	None	None	None	HM88F	SMIONE	SMIONE	2 HM88F
Gas Fill	n/a	Air	Air	Air	Argon	Argon	Argon	Krypton
Inner Light	n/a	Clear	Clear	Clear	Clear	C272(F)	C272(F)	Clear
PERFORMANCE								
U-value (Thermal Conductivity)	1.03	0.47	0.29	0.29	0.20	0.18	0.12	0.08
R-value (Insulation Level)	0.98	2.11	3.45	3.45	5.00	5.55	8.30	12.30
SHGC (Solar Heat Gain Coefficient)	0.82	0.70	0.38	0.28	0.35	0.34	0.33	0.31
Tvis (Visible Light Transmission)	0.89	0.79	0.70	0.63	0.62	0.56	0.55	0.56
LSG Light/Solar Gain Ratio (Tvis/SHGC)	1.09	1.13	1.84	2.25	1.80	1.65	1.70	1.80
"Winter" NFRC (70 in/ 0 out) Glass Temp	16	44	54	54	59	59	63	65
"Summer" NFRC (75 in/ 90 out) Glass Temp	93	97	88	86	89	94	93	87
Overall Thickness	1/4"	1"	1"	1"	1"	1"	1.5"	1.5"
Ultraviolet Blockage	34%	50.1%	81%	95%	99.4%	99.5%	99.8%	99.9%
Cost Per Square Foot	\$2.00	\$3.50	\$6.00	\$8.00	\$6.70	\$6.54	\$6.80	\$15.96
All Results are Center of Glass - Based On LBL "Window" 5.2 Software							*3/16" glass	

Note: glazing cost estimates provided by Serious Materials

Due to the fact that Serious Materials glazing products maintain higher interior surface temperatures during periods of cold weather, a decrease in the winter heating setpoint of 3°F was applied for these simulations.

2.1.5 Utility Rates

Electricity and natural gas rates were obtained for each city, based on the local Utility's current rate structures. Specific details of the consumption, demand, and monthly fixed charges for electricity and natural gas can be found in Appendix A.

3.0 Energy Cost Savings and Payback

Three performance metrics quantified energy cost savings for each glazing type. In addition, both single clear and double clear glazing were used as a baseline for comparing the savings for the four Serious Materials and two competitor's glazings.

Annual Energy Cost Savings

The annual reduction in building energy costs were calculated for each building type and location. This metric does not account for first-costs associated with improved glazings.

Simple Payback

Simple payback is the number of years before the annual energy savings equals the first-costs associated with a particular glazing type. This metric is occasionally referred to as the "break-even period".

30-Year Savings

The 30-year savings metric incorporates the annual energy cost savings, as well as the first-costs associated with each glazing, throughout a projected 30-year period of operation. There is an assumed electricity and natural gas escalation rate of 5% per year, and a financial discount rate of 0%.

The results for each of the four building types in each of the six locations can be seen in Figure 1 through Figure 24. Numerical results for each of the simulations can be found in Appendix C.

3.1 Office Building Savings

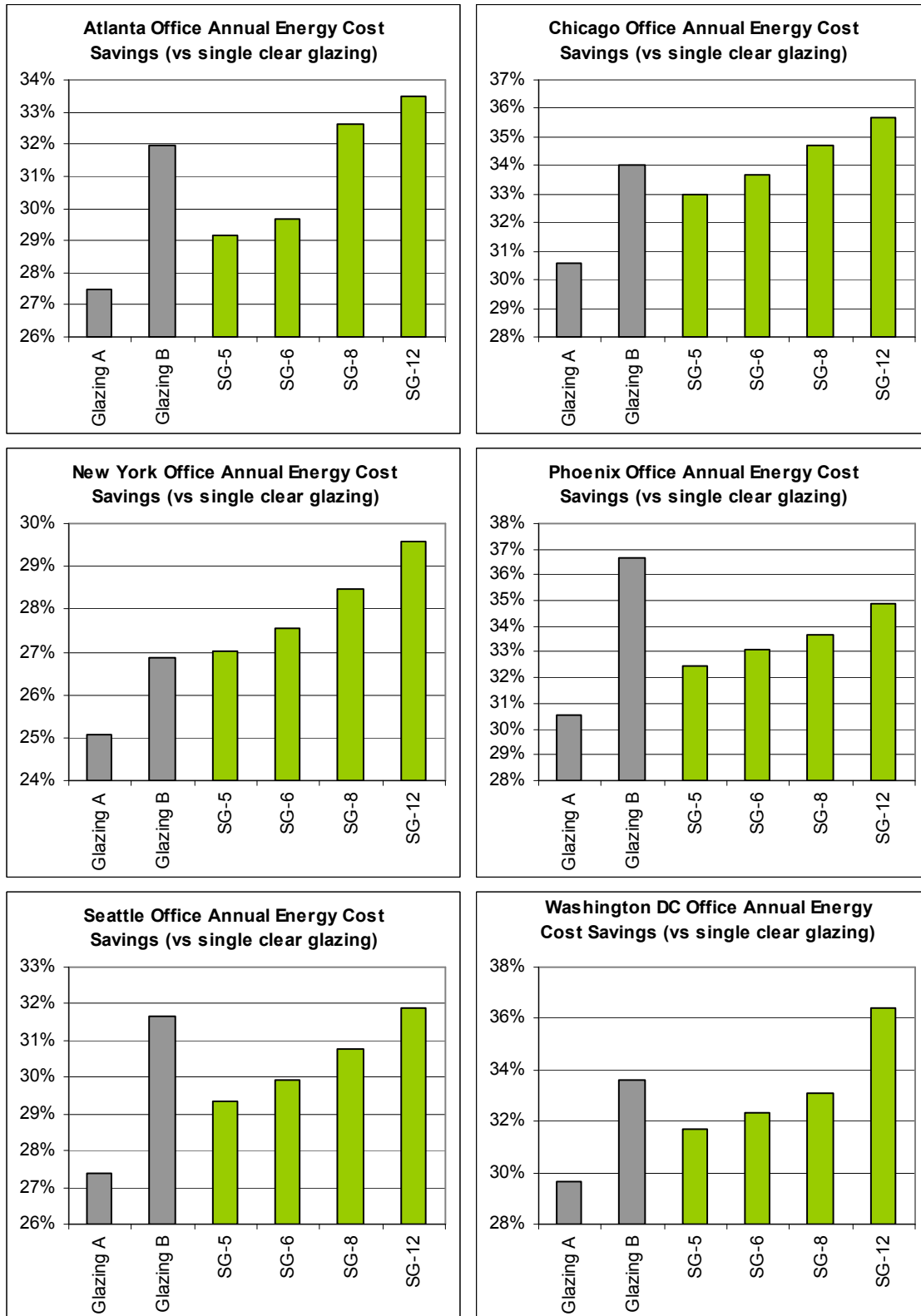


Figure 1: Annual office energy savings compared to single clear glazing, by city

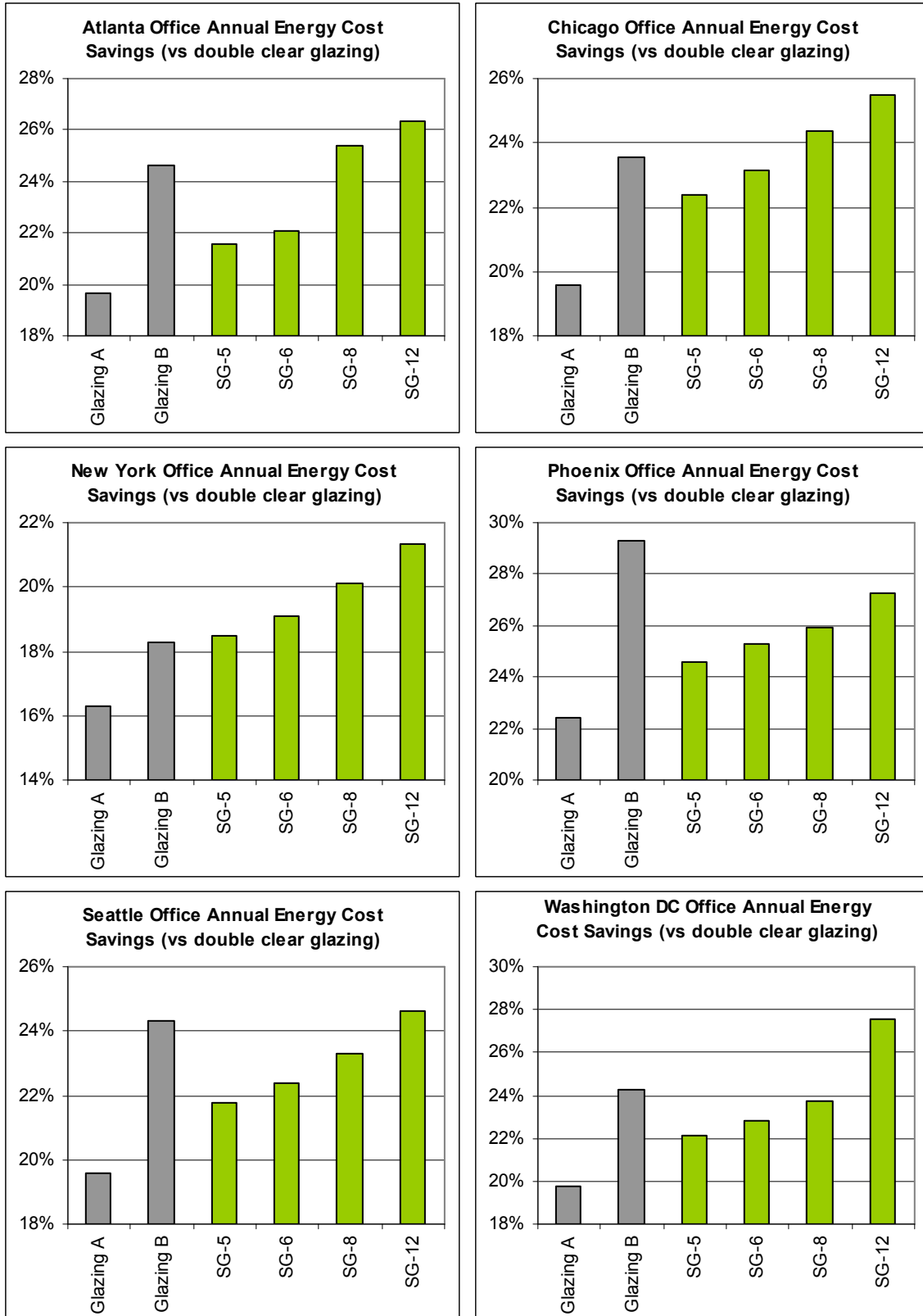


Figure 2: Annual office energy savings compared to double clear glazing, by city

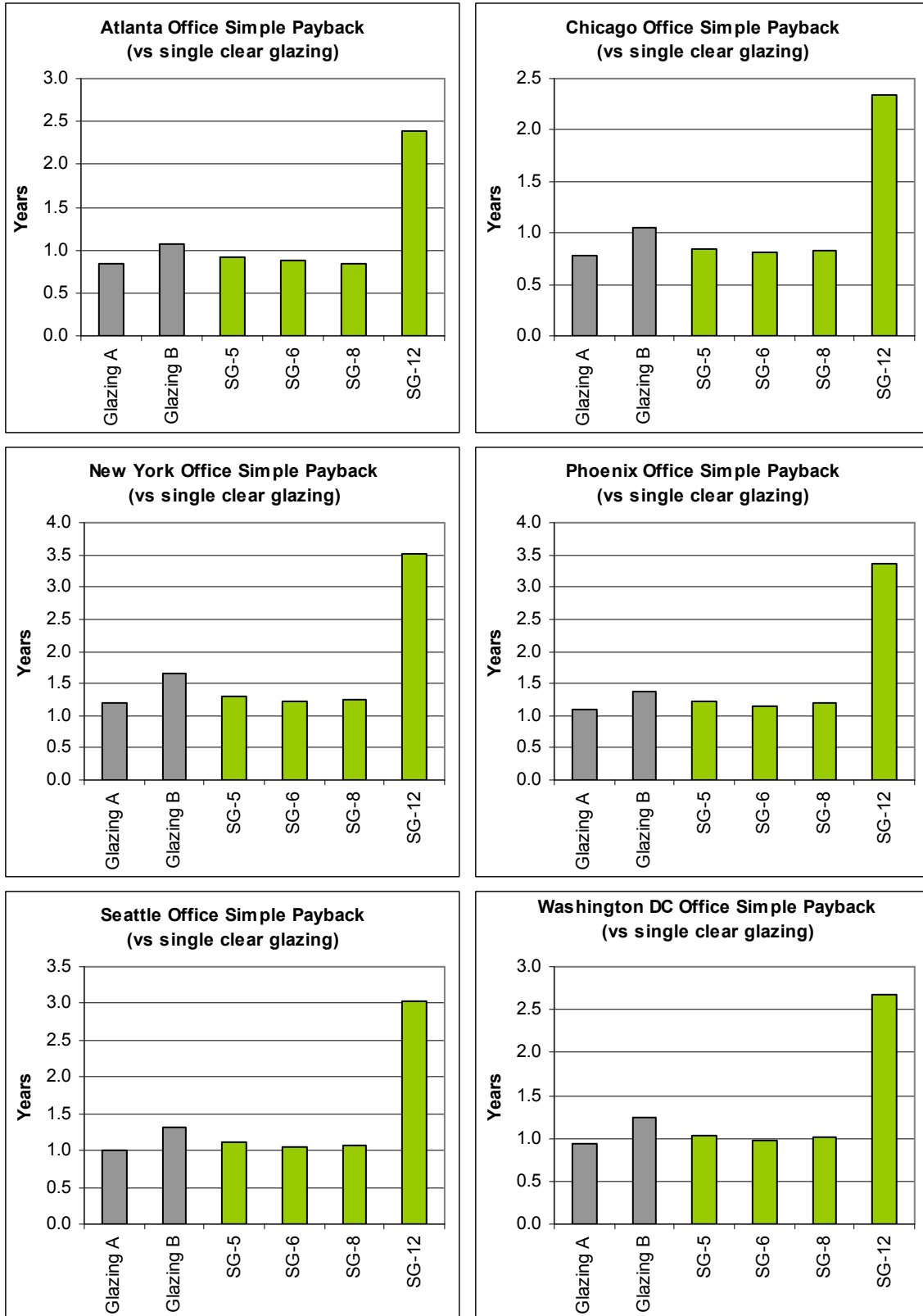


Figure 3: Office simple payback period compared to single clear glazing, by city

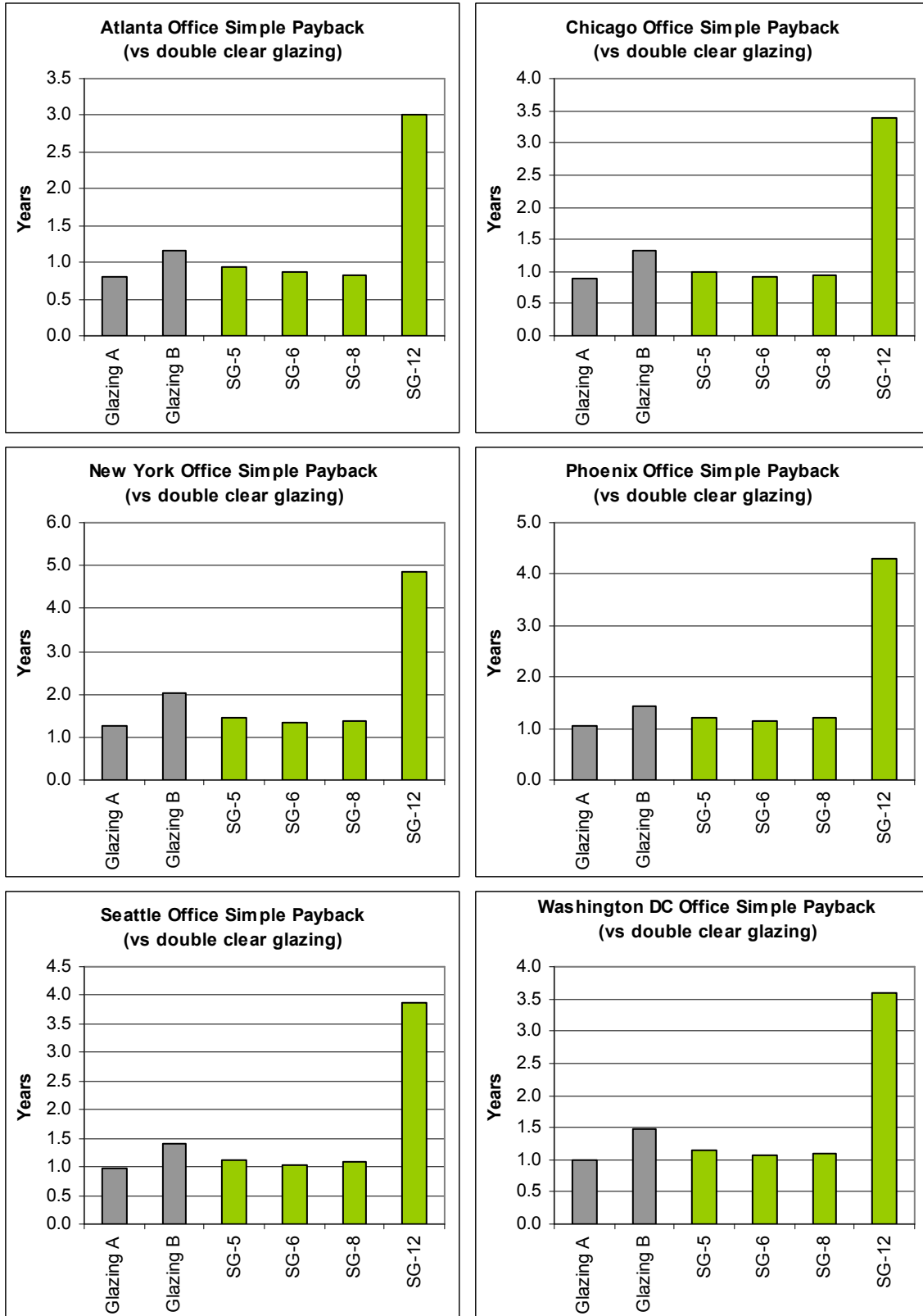


Figure 4: Office simple payback period compared to double clear glazing, by city

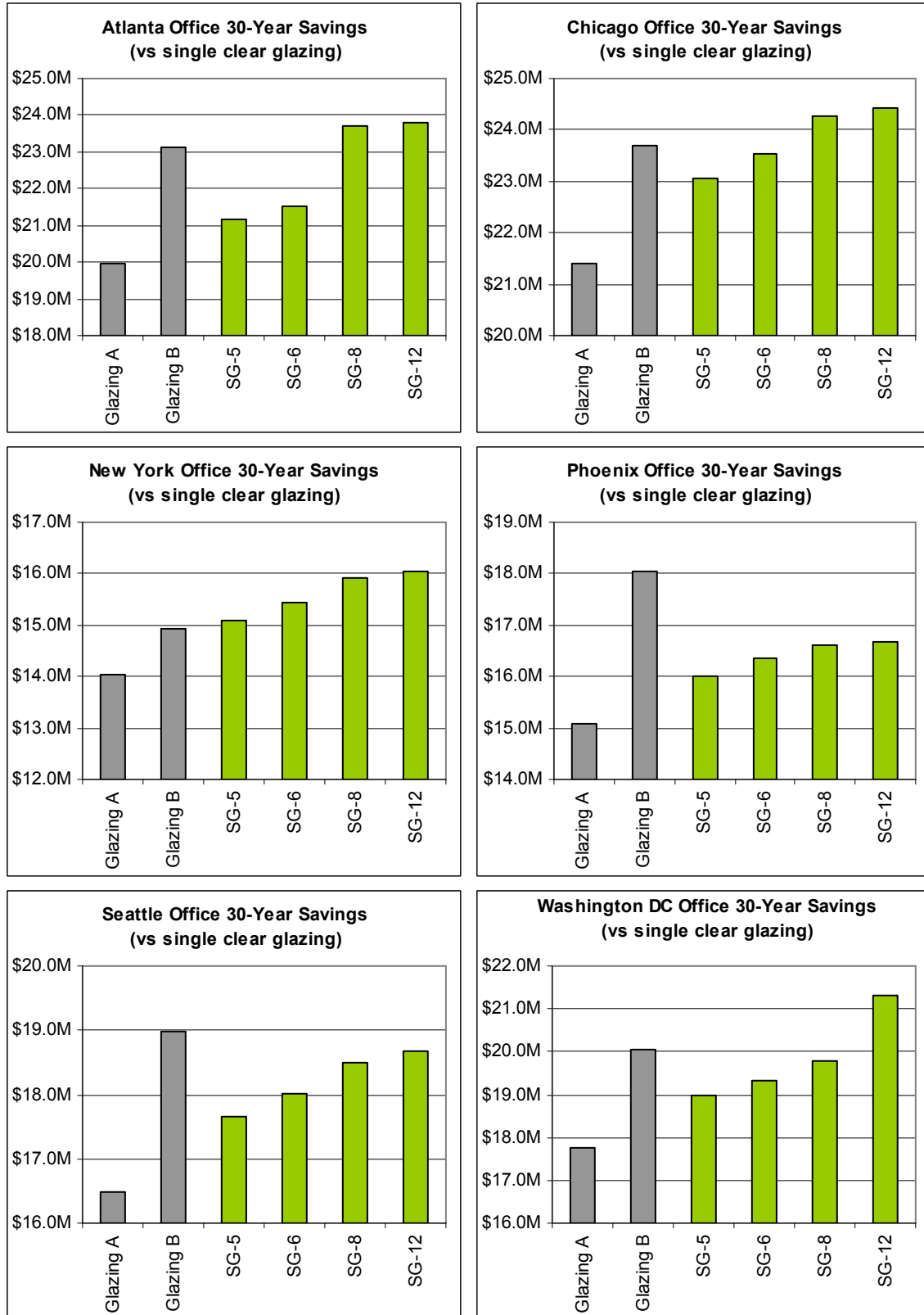


Figure 5: Office 30-year savings compared to single clear glazing, by city (including a 5% energy escalation rate)

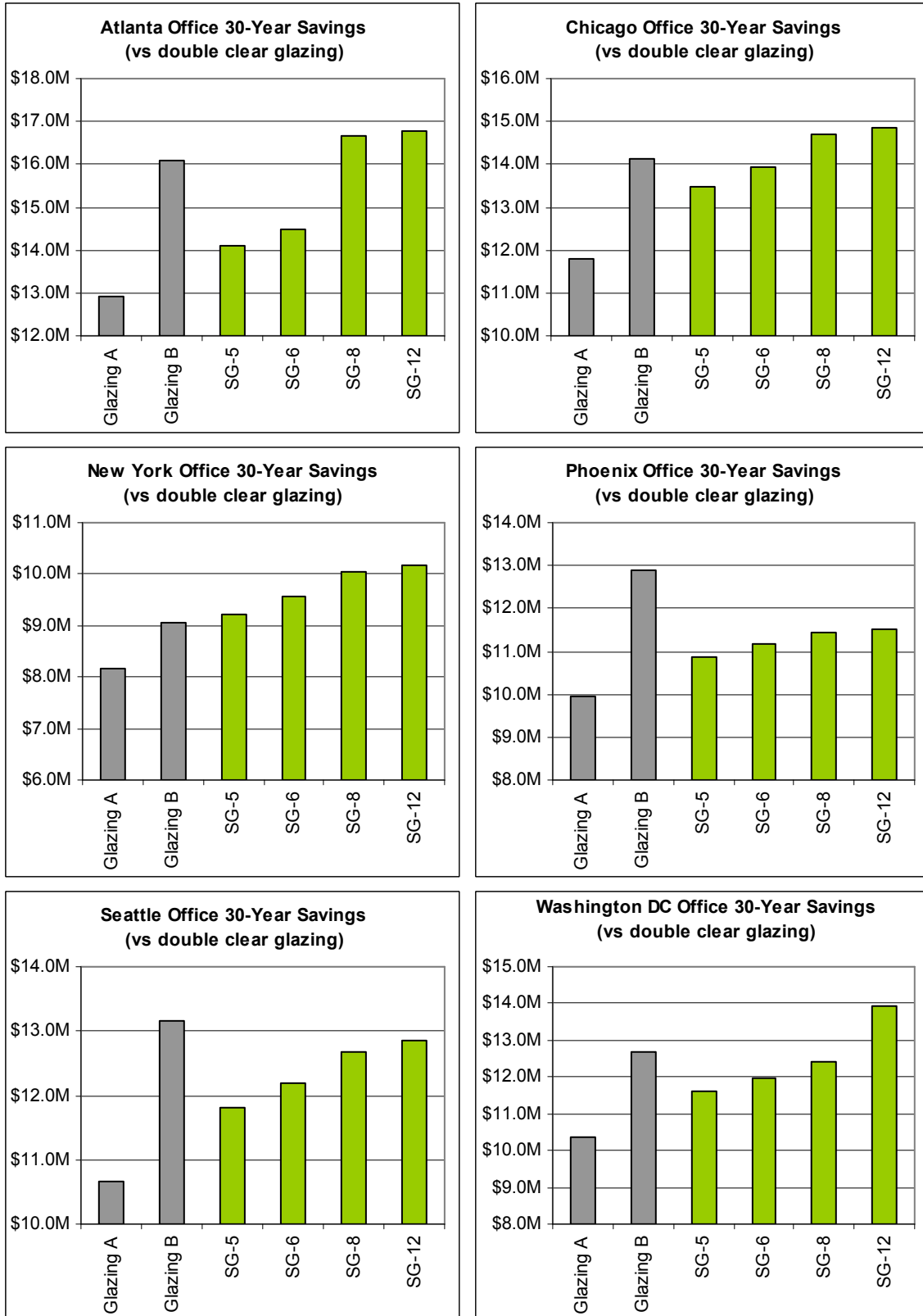


Figure 6: Office 30-year savings compared to double clear glazing, by city (including a 5% energy escalation rate)

3.2 School Savings

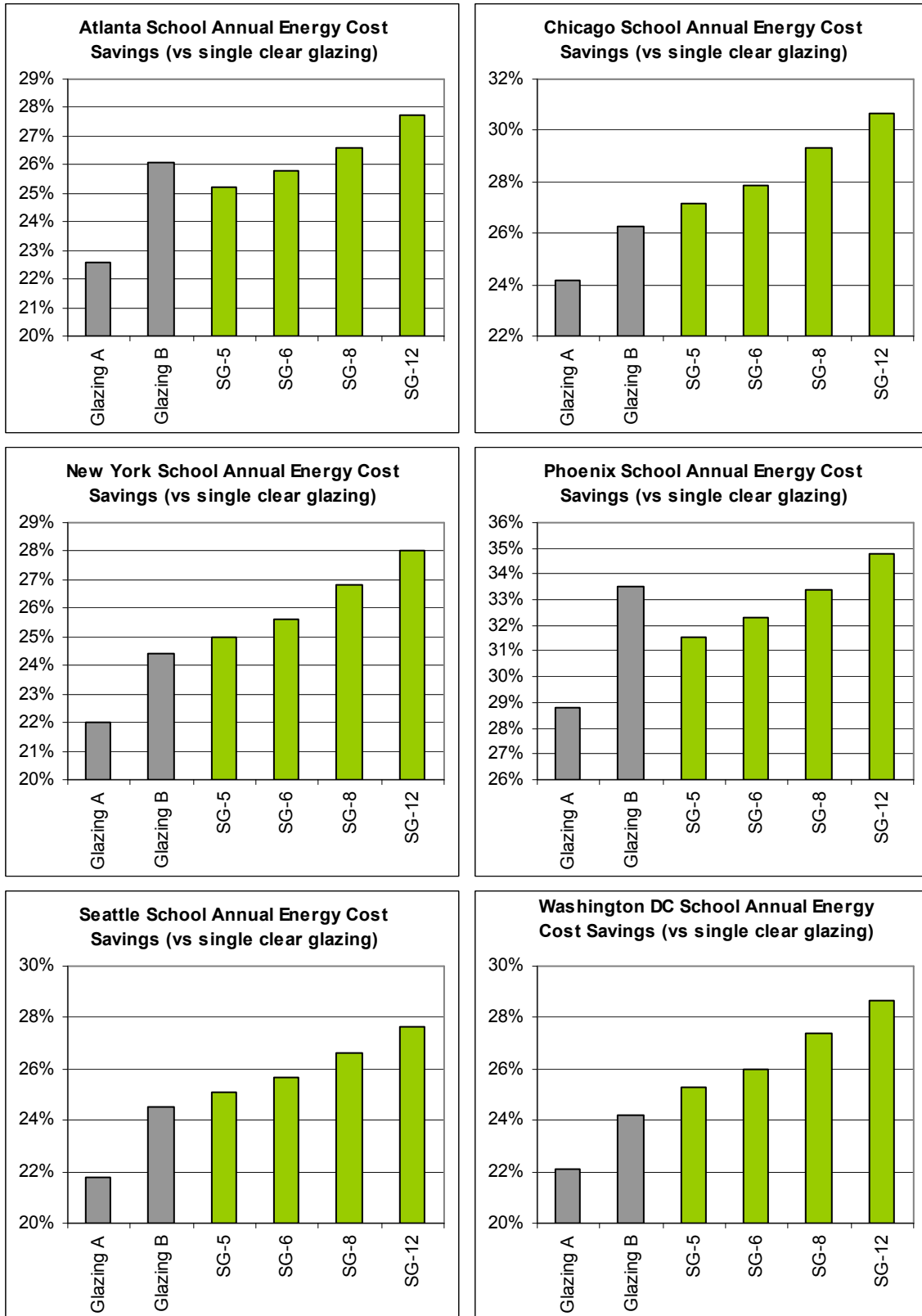


Figure 7: Annual middle school energy savings compared to single clear glazing, by city

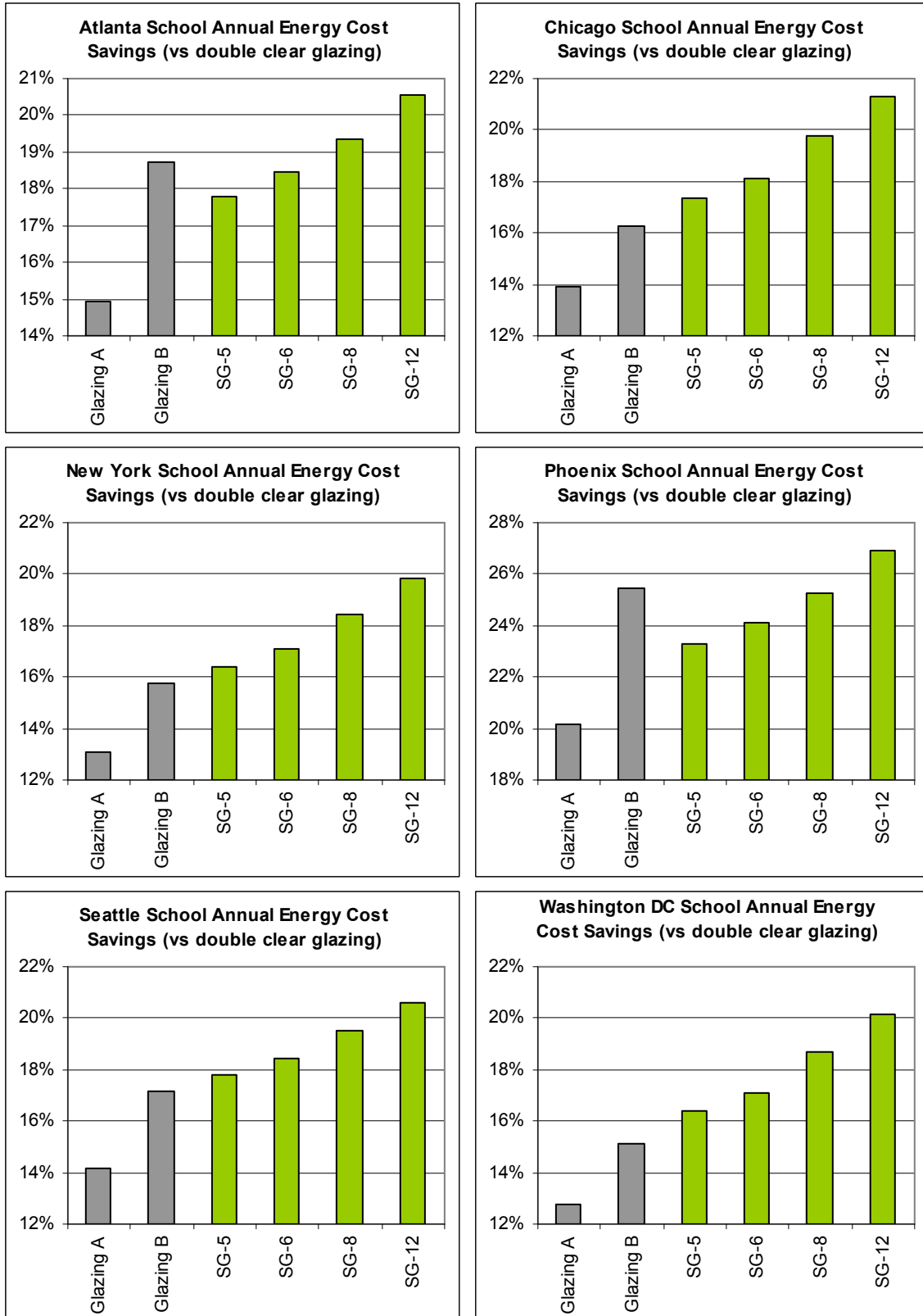


Figure 8: Annual middle school energy savings compared to double clear glazing, by city

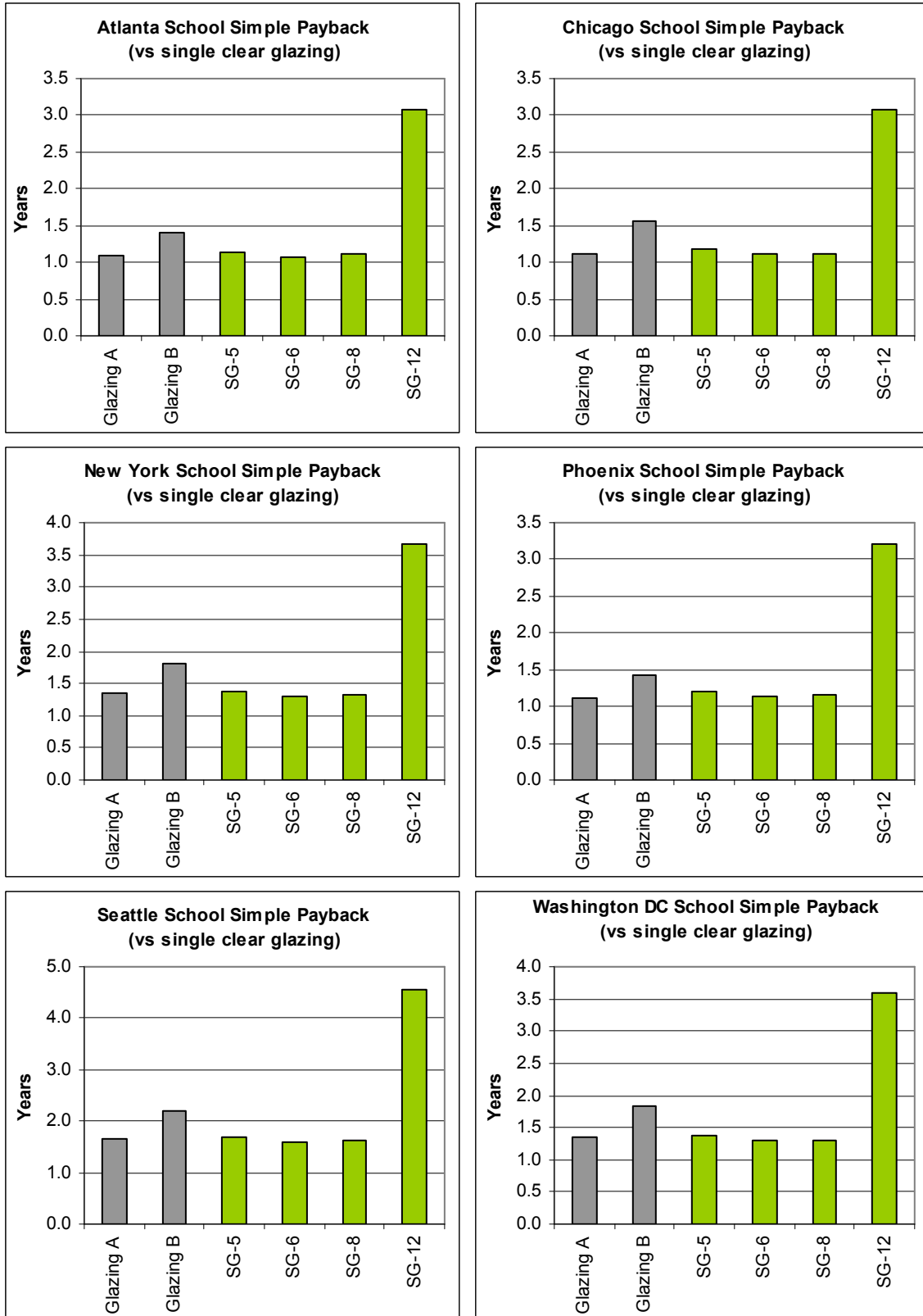


Figure 9: Middle school simple payback period compared to single clear glazing, by city

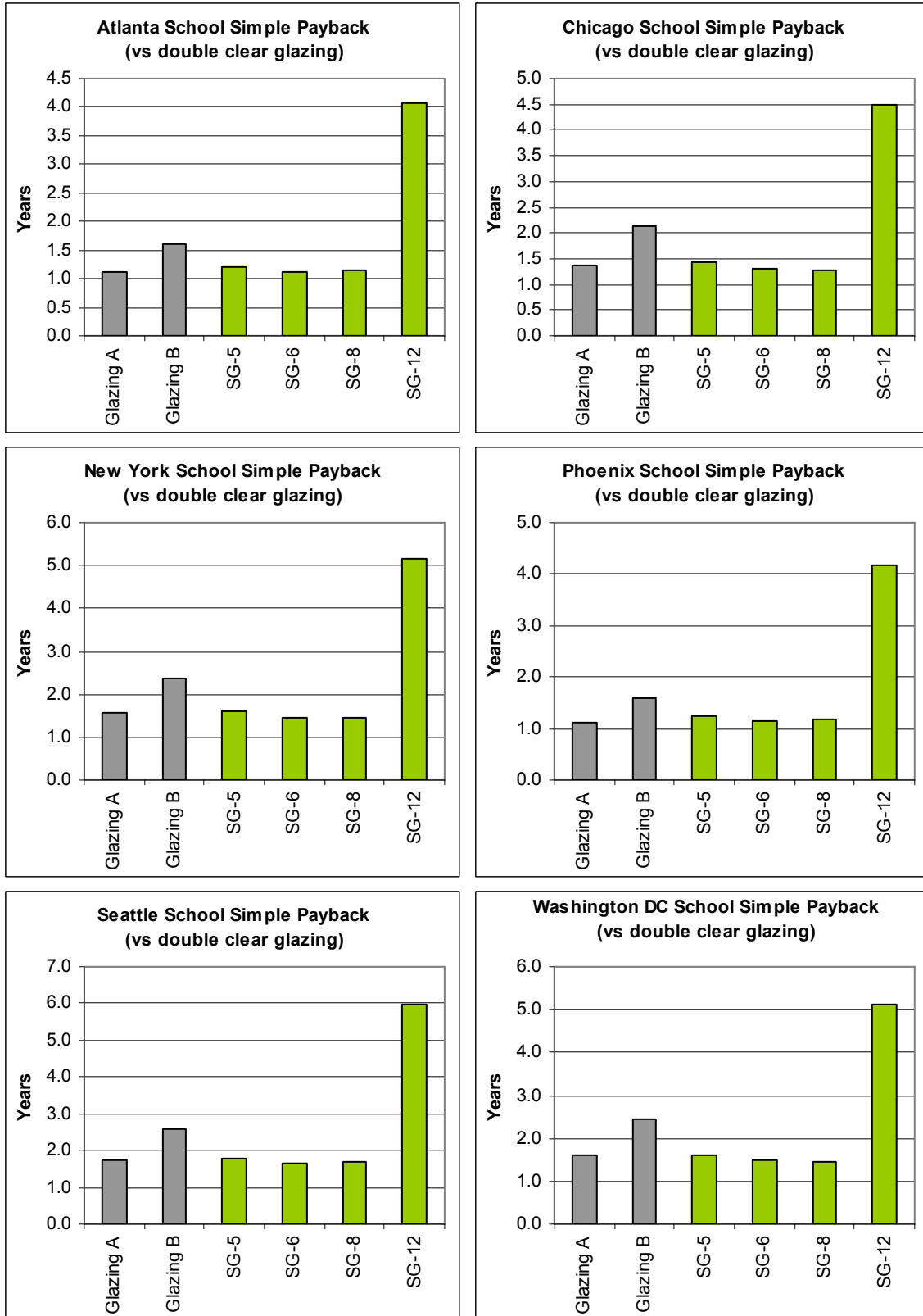


Figure 10: Middle school simple payback period compared to double clear glazing, by city

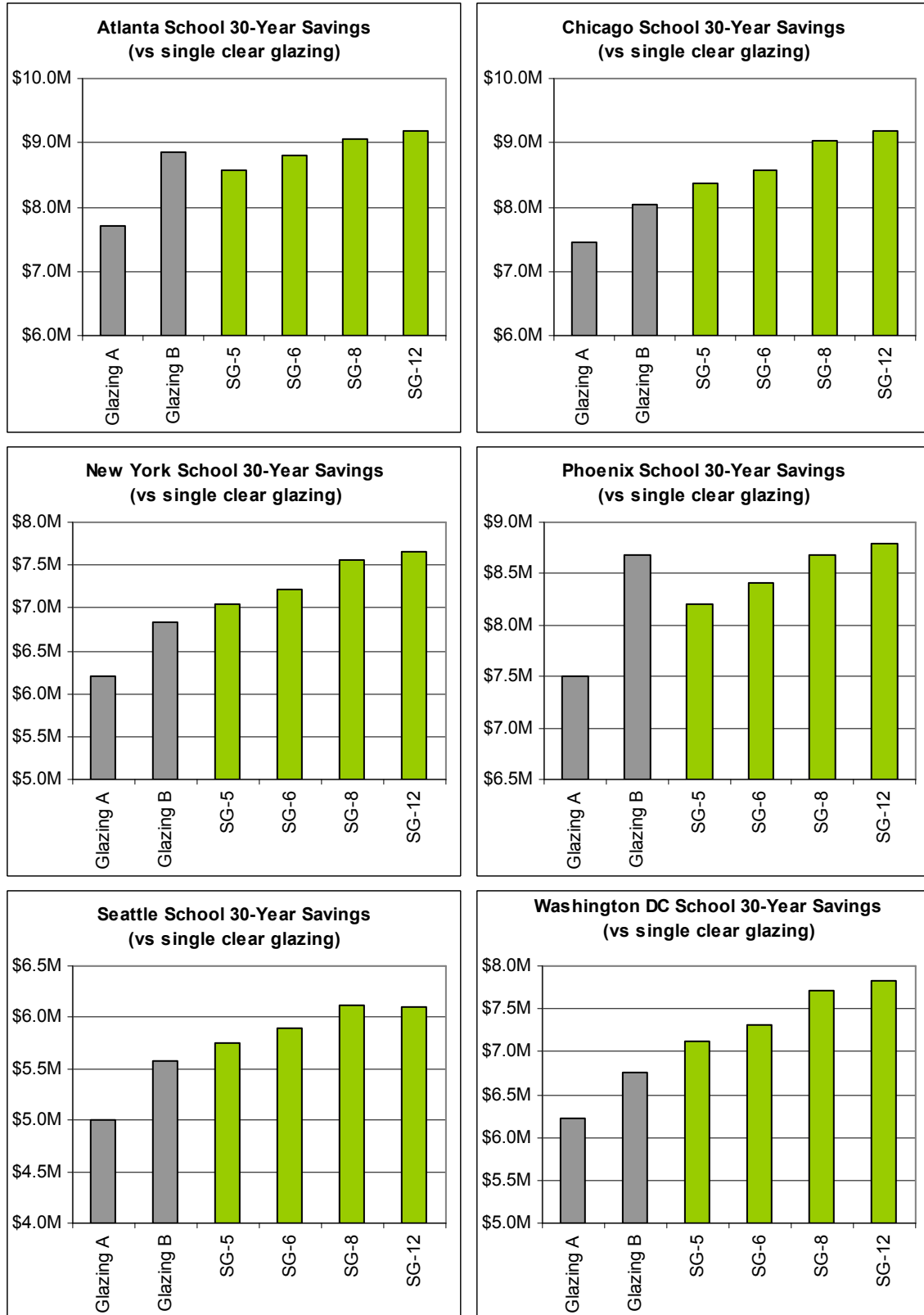


Figure 11: Middle school 30-year savings compared to single clear glazing, by city (including a 5% energy escalation rate)

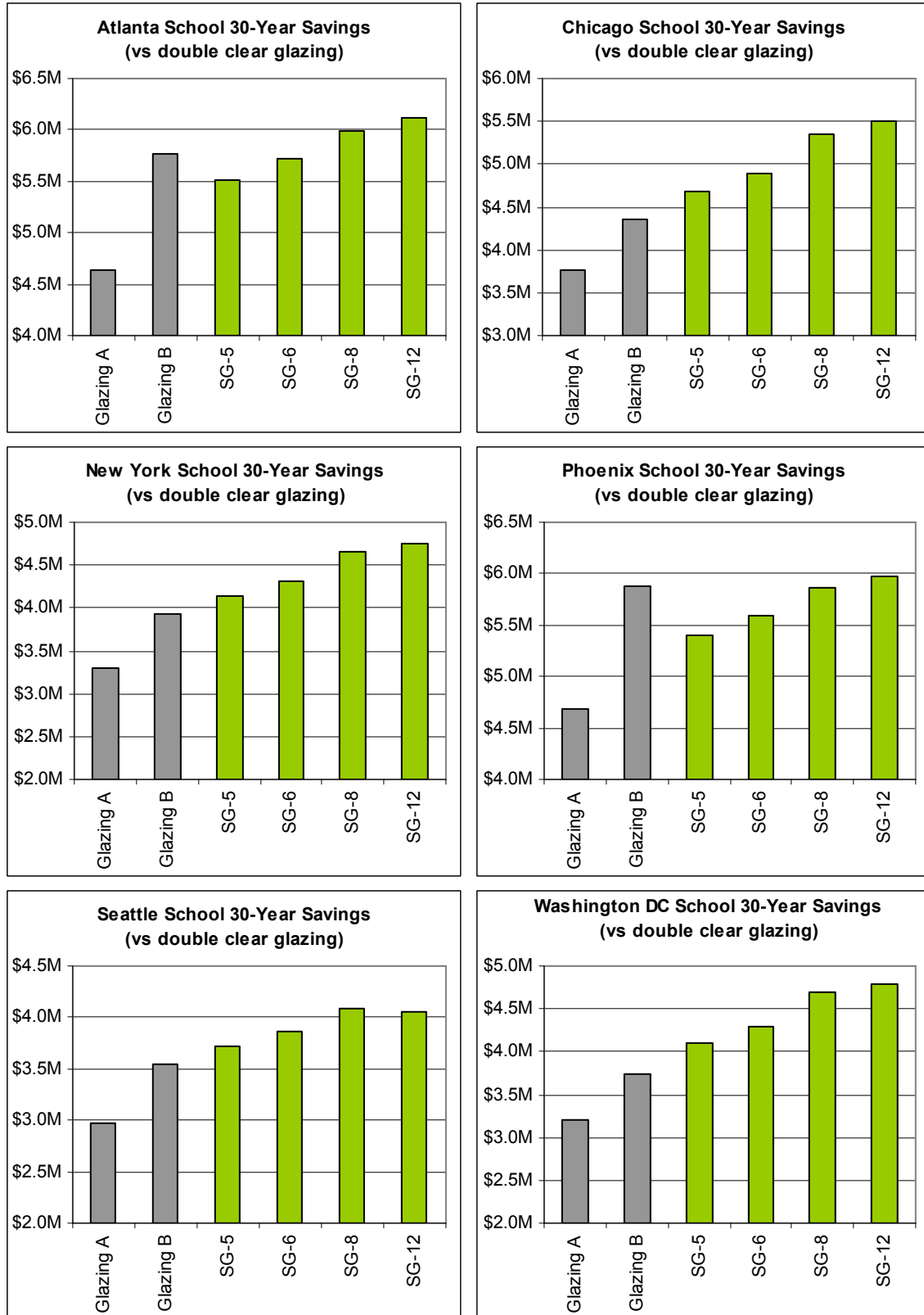


Figure 12: Middle school 30-year savings compared to double clear glazing, by city (including a 5% energy escalation rate)

3.3 Hotel Savings

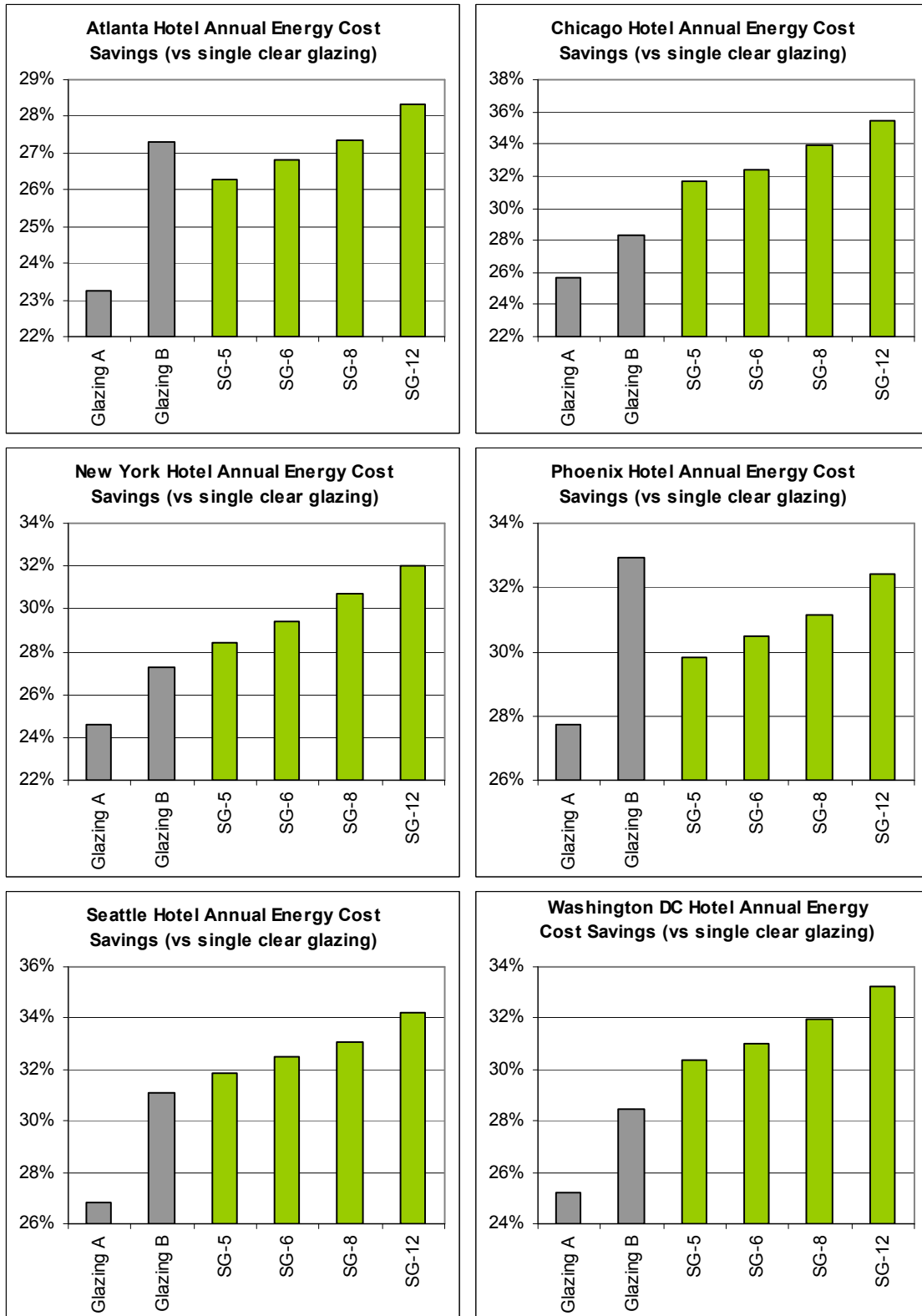


Figure 13: Hotel annual energy cost savings compared to single clear glazing, by city



Figure 14: Hotel annual energy cost savings compared to double clear glazing, by city

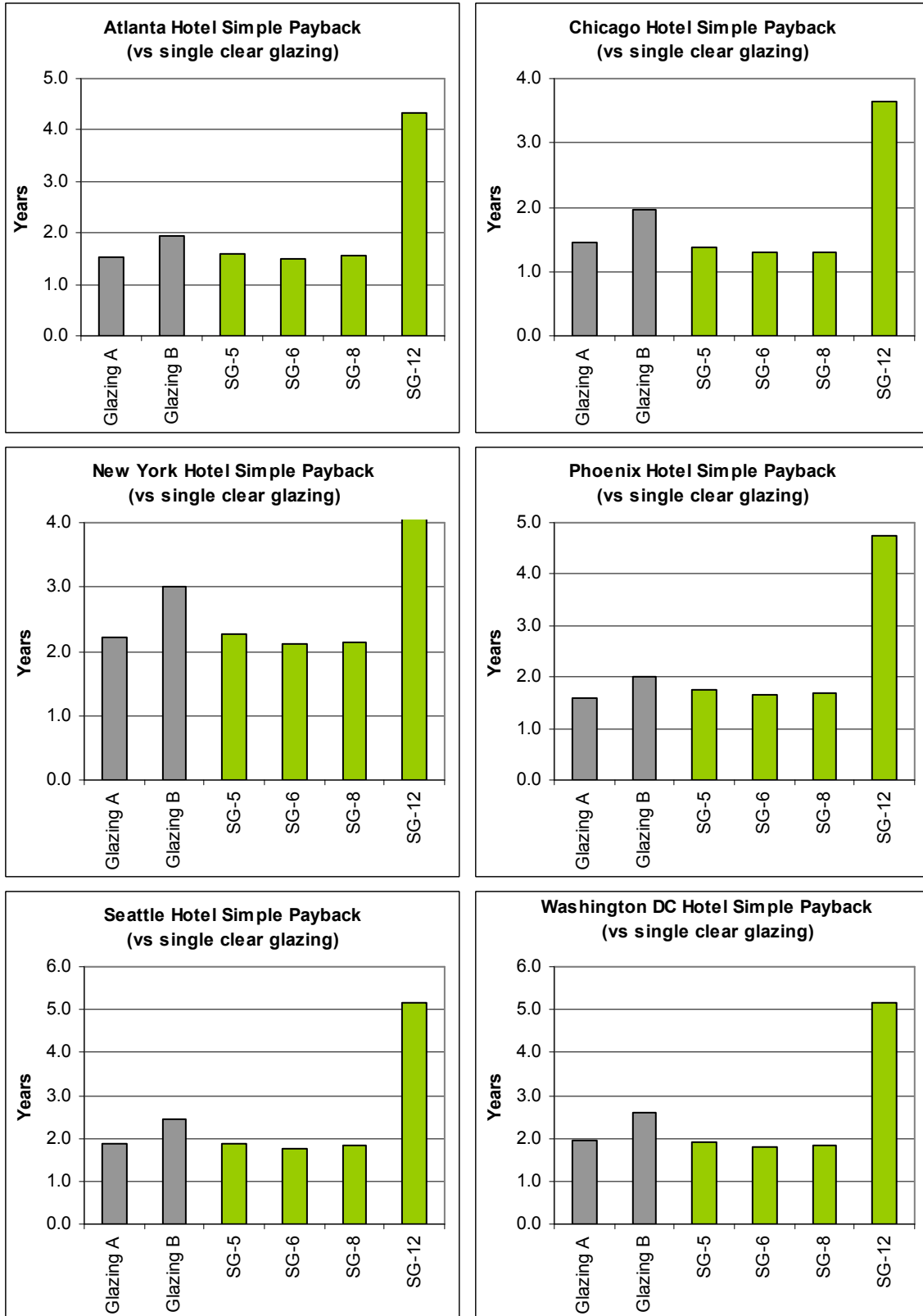


Figure 15: Hotel simple payback period compared to single clear glazing, by city

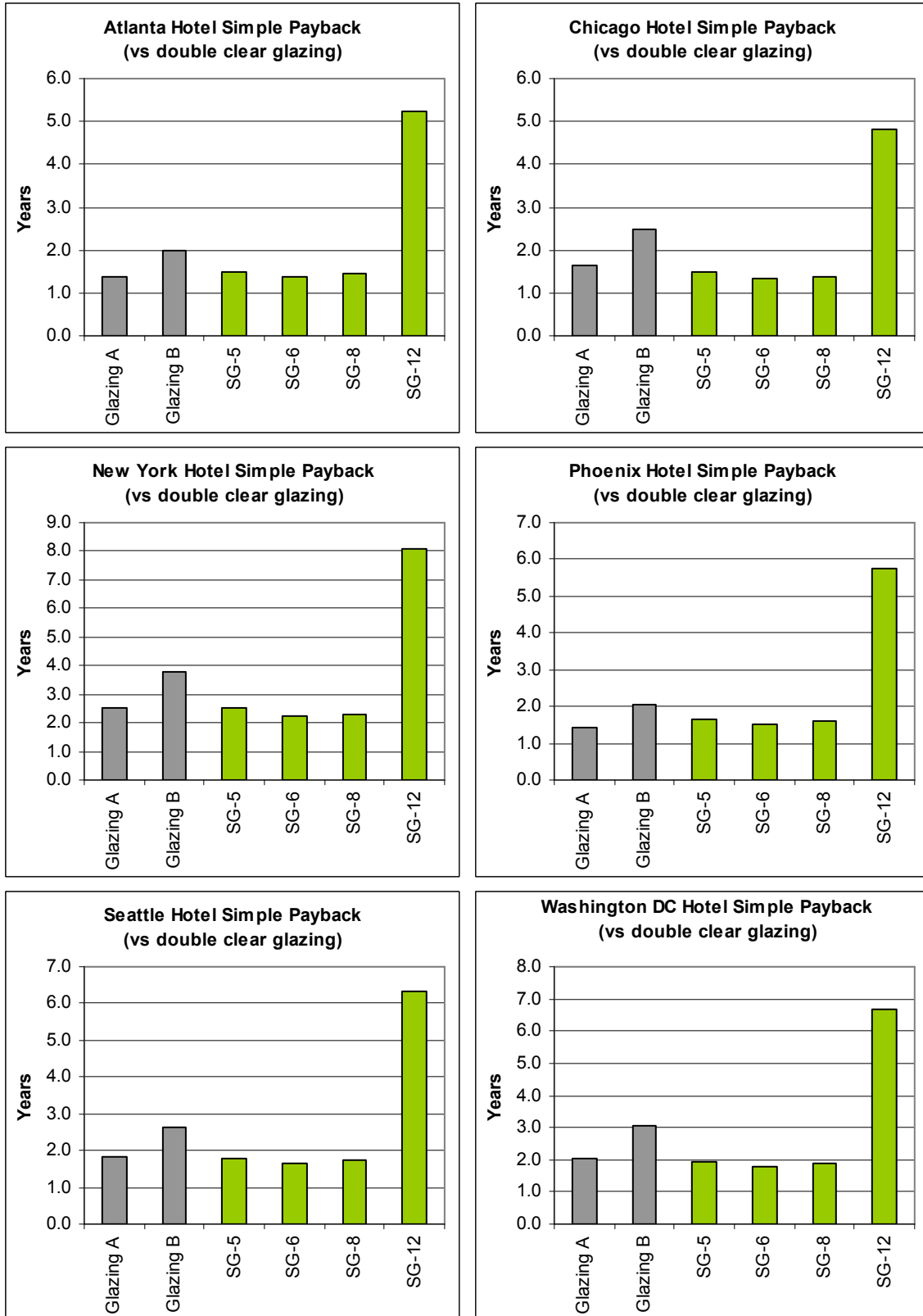


Figure 16: Hotel simple payback period compared to double clear glazing, by city

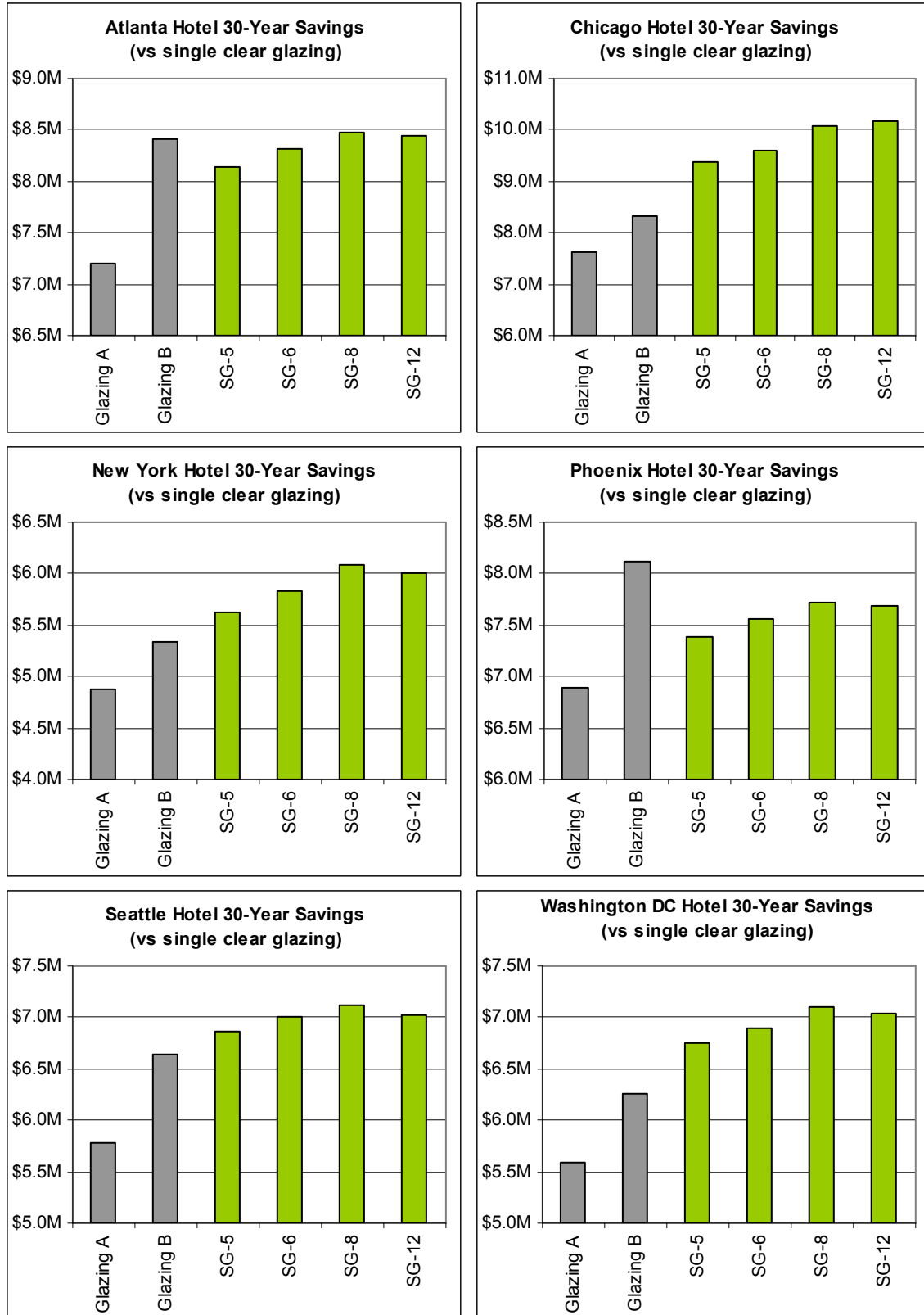


Figure 17: Hotel 30-year savings compared to single clear glazing, by city (including a 5% energy escalation rate)

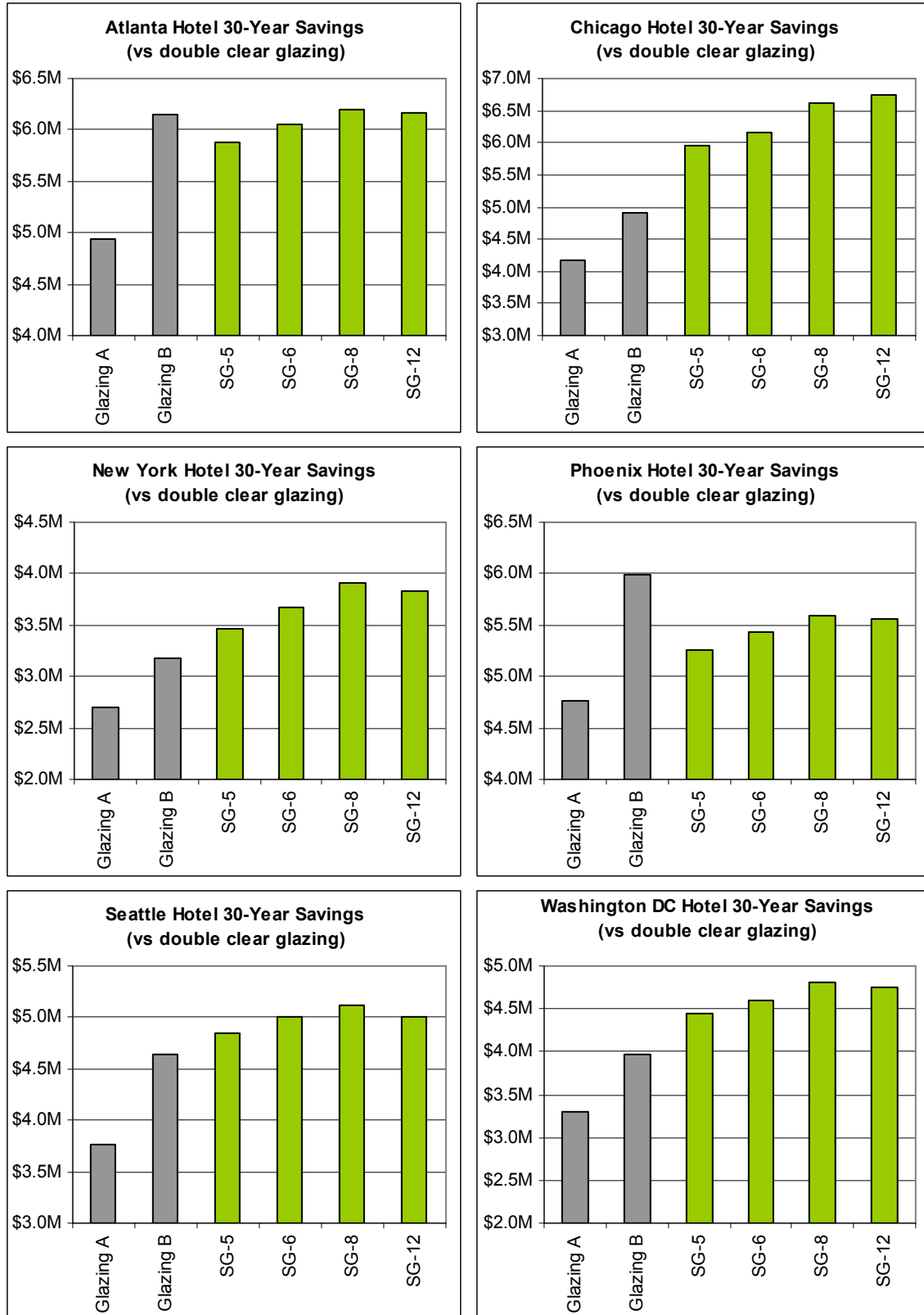


Figure 18: Hotel 30-year savings compared to double clear glazing, by city (including a 5% energy escalation rate)

3.4 Hospital Savings

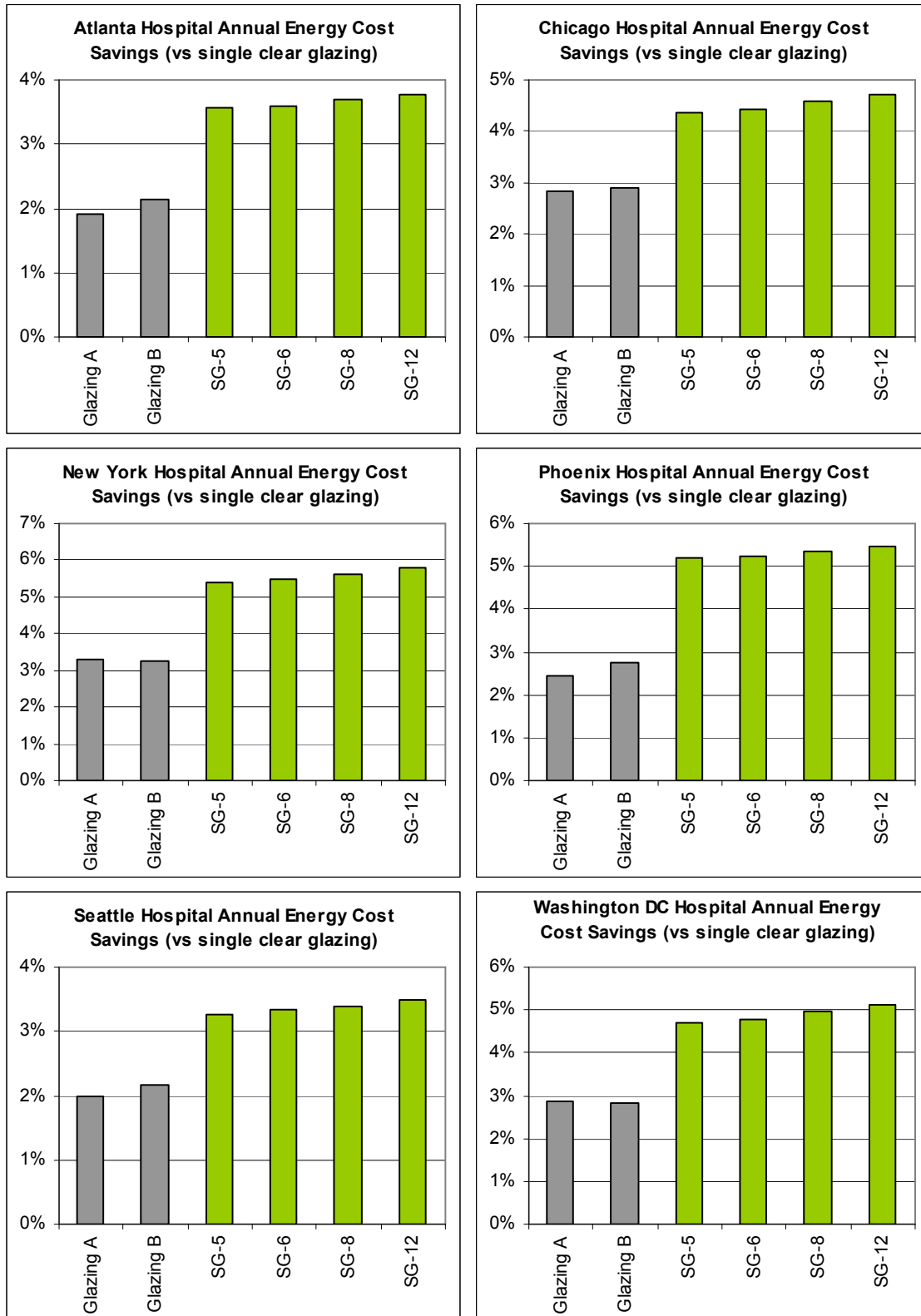


Figure 19: Hospital annual energy cost savings compared to single clear glazing, by city

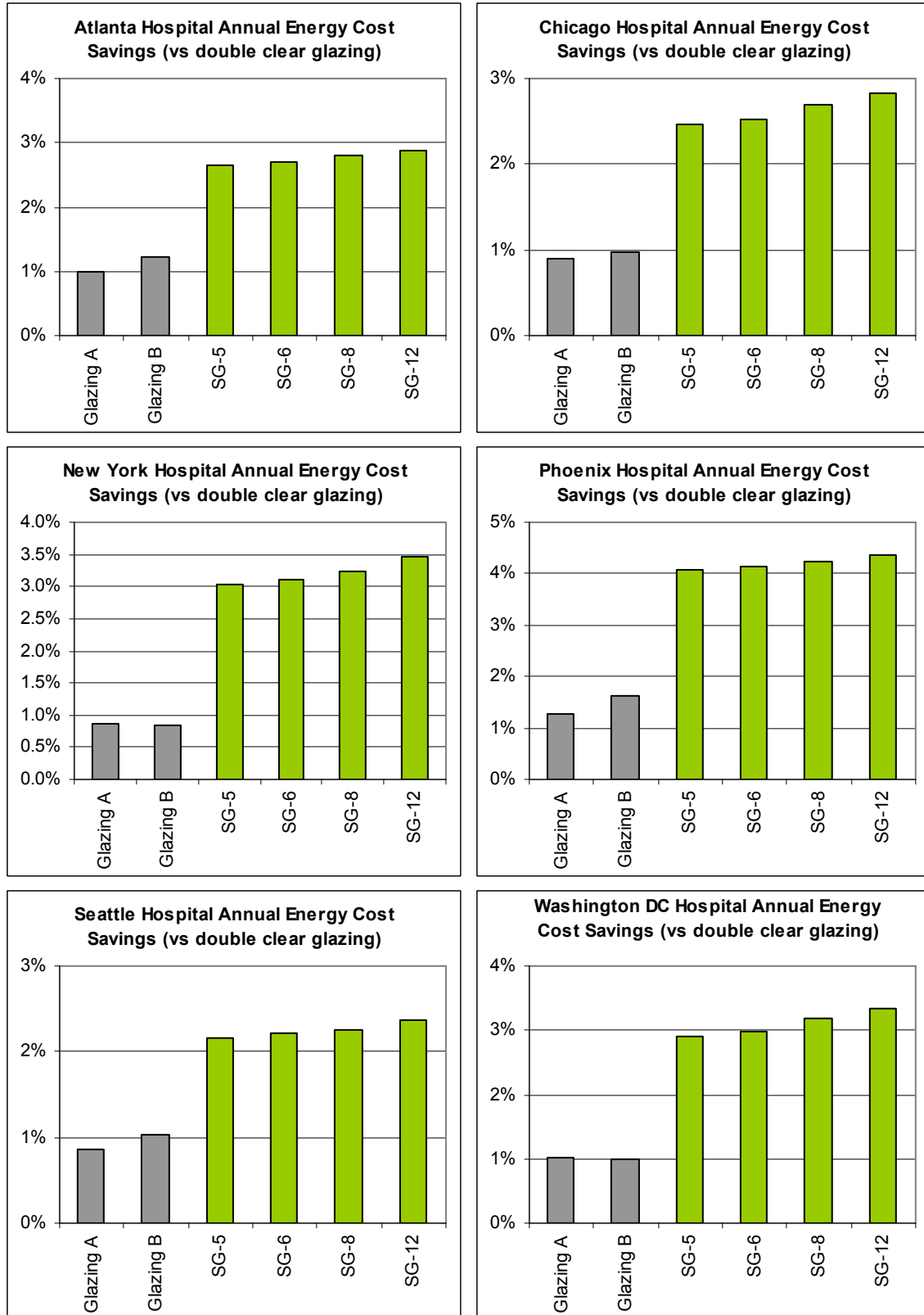


Figure 20: Hospital annual energy cost savings compared to double clear glazing, by city

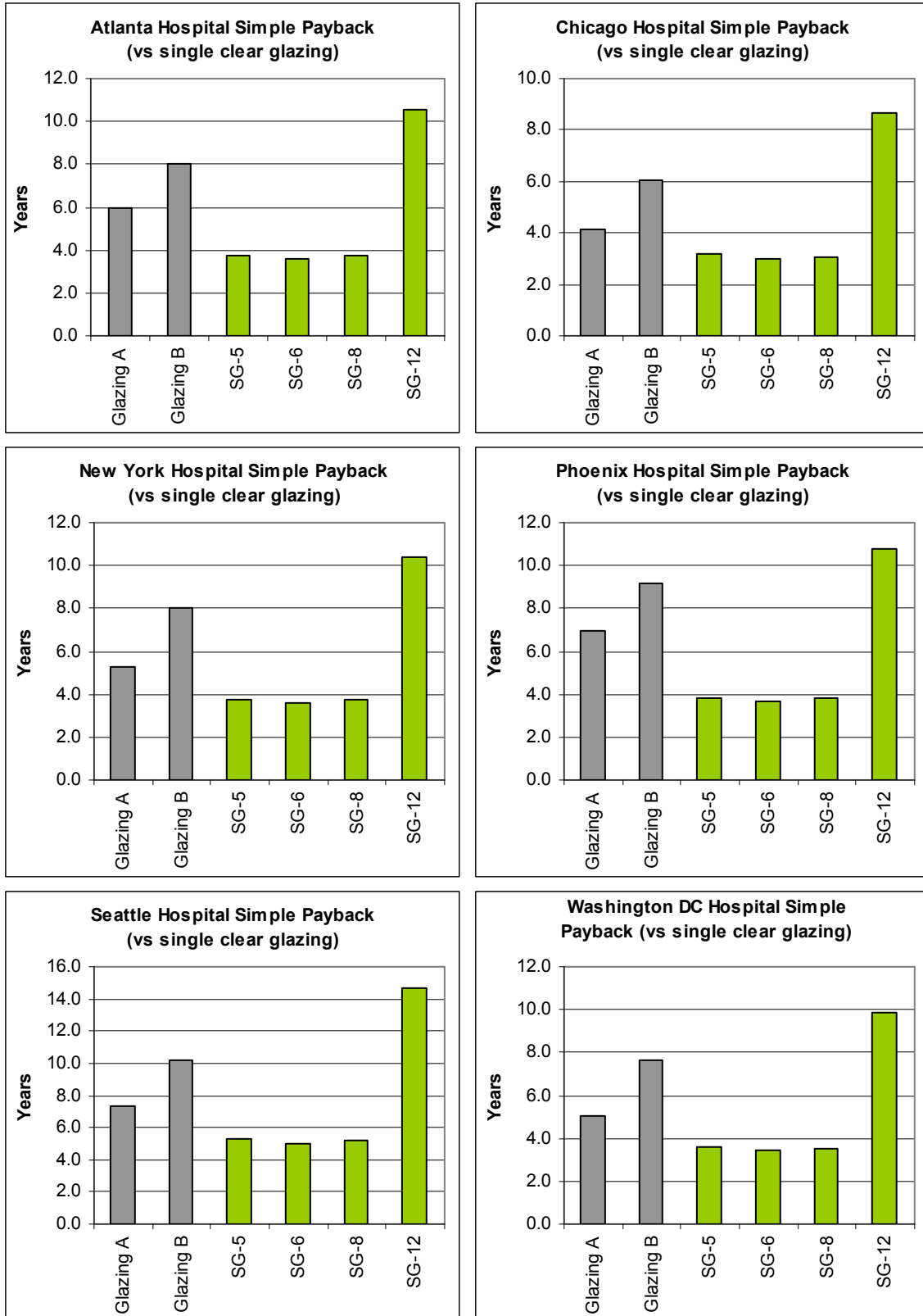


Figure 21: Hospital simple payback period compared to single clear glazing, by city

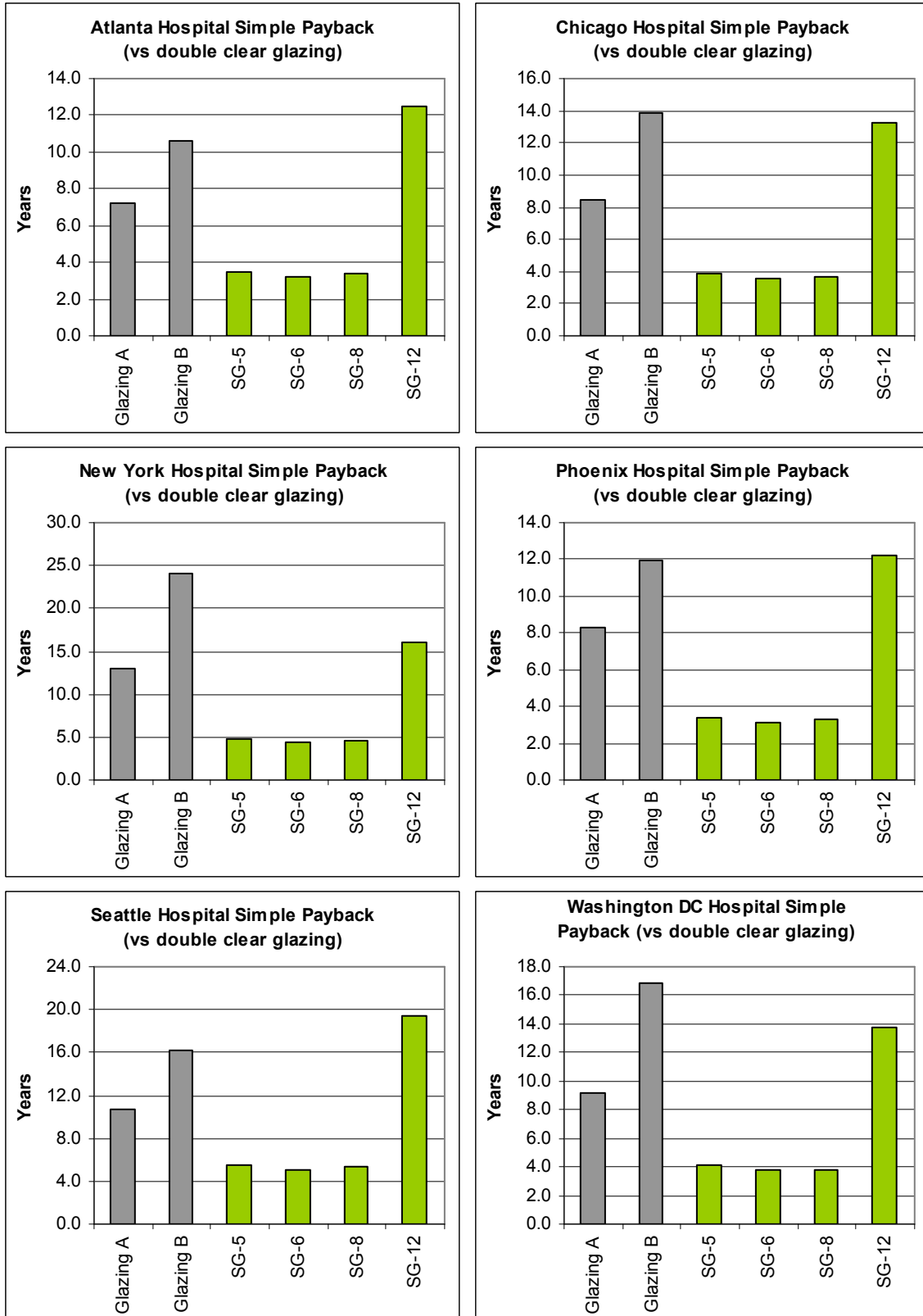


Figure 22: Hospital simple payback period compared to double clear glazing, by city

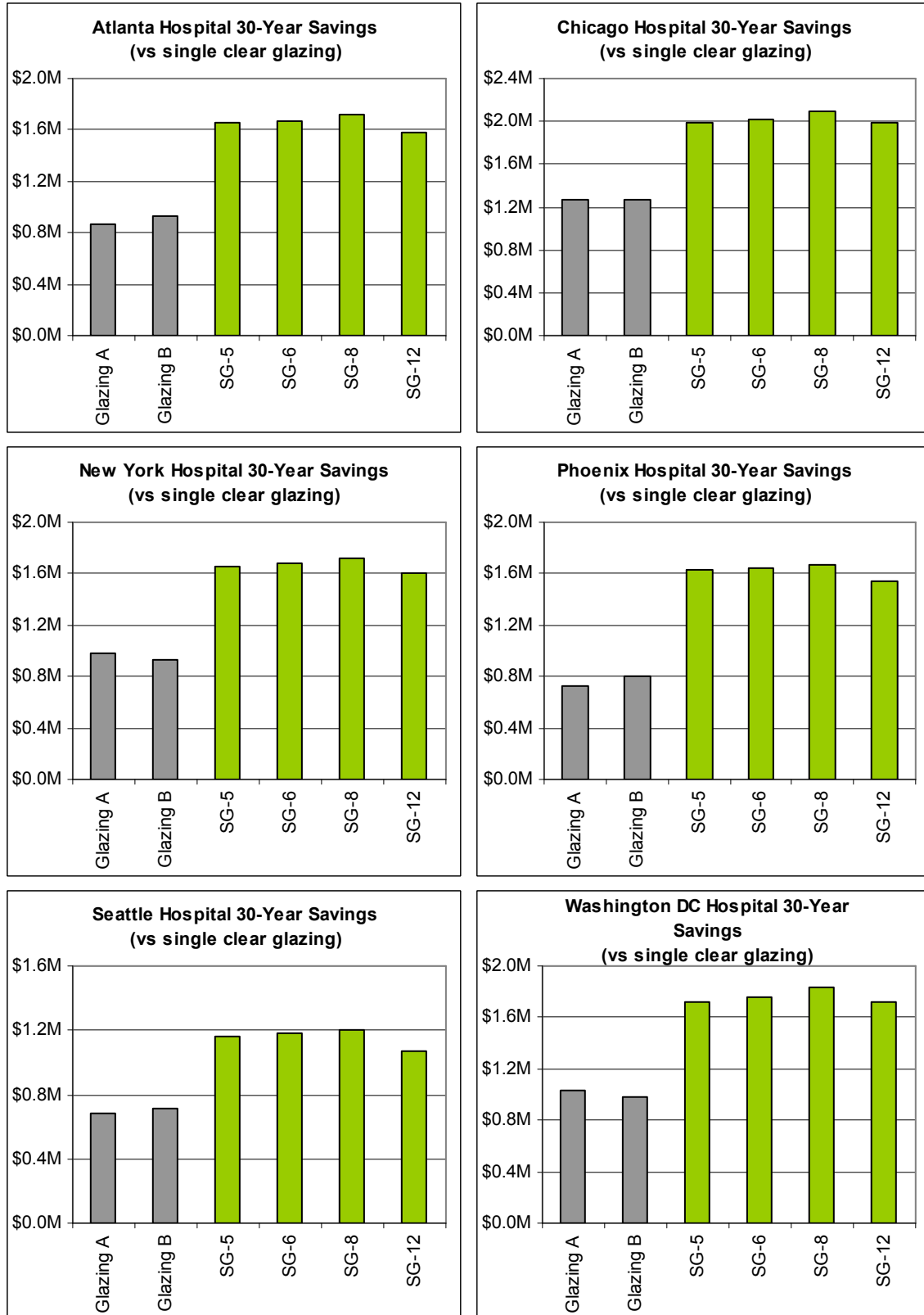


Figure 23: Hospital 30-year savings compared to single clear glazing, by city (including a 5% energy escalation rate)

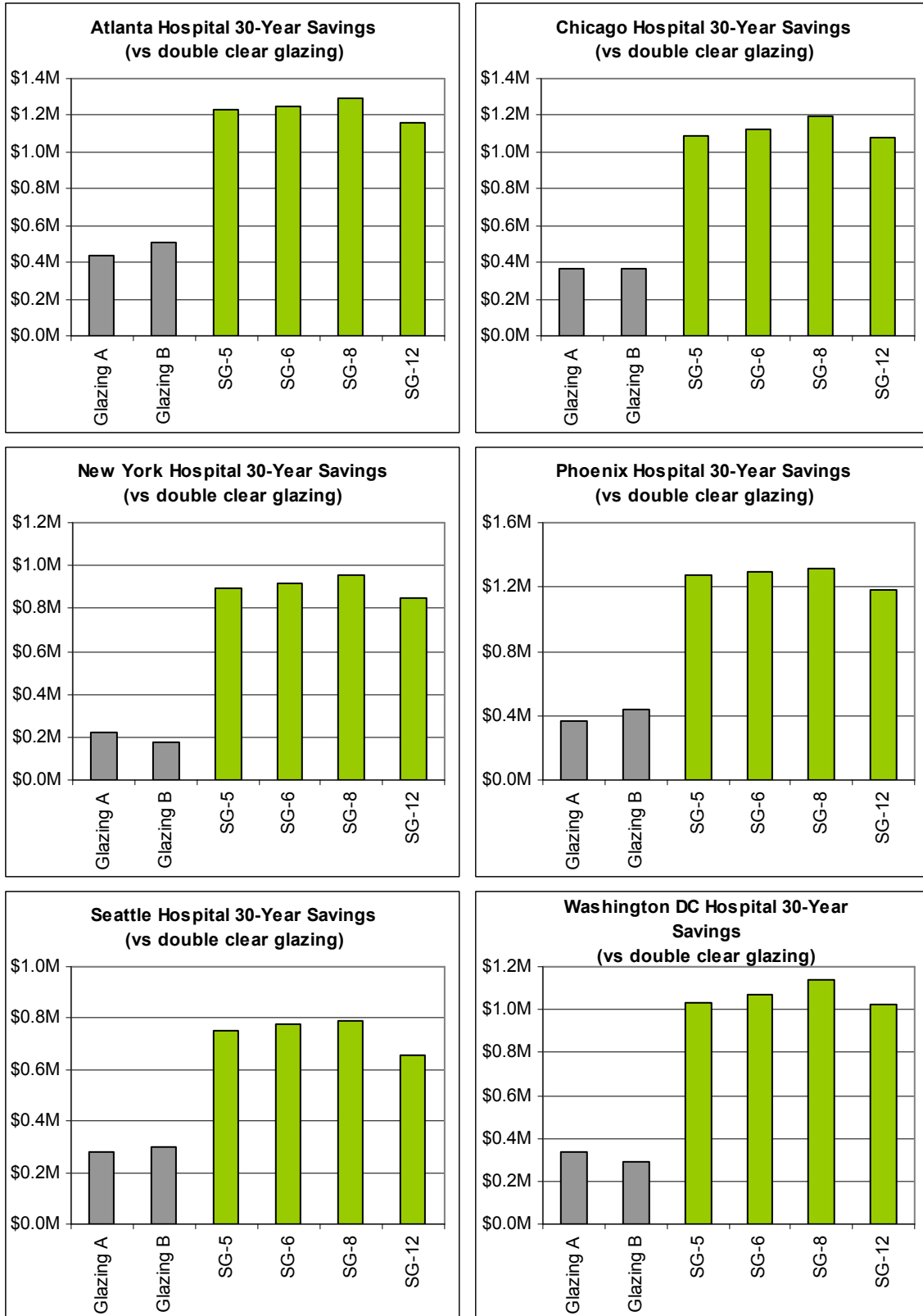


Figure 24: Hospital 30-year savings compared to double clear glazing, by city (including a 5% energy escalation rate)

4.0 Interpretation of Results

The results of the building simulations are highly dependent upon utility rates and structures, building internal loads, Window-Wall-Ratio, and climate. However, the results of the study follow a logical pattern. For instance, the selection of window glazing type produces the most profound differences in the office and hotel buildings, as these buildings have the highest Window-Wall-Ratios and lowest internal loads. Conversely, in the middle school and hospital—two building types with lower Window-Wall-Ratios and relatively high internal gains—the energy savings associated with fenestration is lower across-the-board, regardless of climate zone.

Several conclusions can be drawn from these results:

- Serious Materials products yielded higher annual and 30-year savings than selected competitor's products in most cases examined. SG-8 and SG-12 packages generally produced the highest 30-year savings of all glazings studied, in some cases up to \$24M when compared to single clear glazing and \$17M when compared to double clear glazing. Annual percent savings reached as high as 36% compared to single clear glazing and 28% when compared to double clear glazing.
- In the Atlanta and Phoenix climates, particularly in the Office and Hotel cases, Competitor B showed the highest annual and 30-year savings. This is due to a lower Solar Heat Gain Coefficient, which more effectively blocks unwanted summer solar heat gain.
- While the SG-5, SG-6, and SG-8 packages outperform Competitor A in all cases, the simple payback periods of these glazing packages are similar, and in some cases slightly lower than that of Competitor A, and all are significantly shorter than the simple payback period of Competitor B.
- While projected energy savings in the Hospital building is lower than that of the other building types, the simple payback periods of Serious Materials products are most attractive (relative to the competitor's products) in the Hospital application.

More detailed analysis for each building type follows.

4.1 Office Building

In terms of annual savings, all four Serious Materials products outperform Competitor A in all climate zones. In addition, SG-8 and SG-12 outperform Competitor B in most climate zones. The major exception occurs in Phoenix, where the lower Solar Heat Gain Coefficient of Competitor B yields the greatest savings. However, in most cases, the highest savings comes from the SG-12 glazing. Serious Materials products generate energy cost savings ranging from 27-37% savings compared to single clear glazing, and 18-27% compared to double clear.

When calculating simple payback, SG-5, SG-6, and SG-8 yield very similar payback periods, comparable to that of Competitor A. Competitor B has a slightly longer payback period than any of the aforementioned products, and SG-12 has a payback roughly 2 to 3 times longer in all climate zones. Simple payback periods range from roughly 1 year to 4 years, depending upon the glazing type and location.

The calculated 30-year saving for each of the products follows a hierarchy very similar to that found in the annual savings results. In general, SG-8 and SG-12 produce the best results, with Competitor B yielding better results in only two cases. Savings for Serious Materials products ranges from \$15M to \$24M over single clear glazing, and from \$9M to \$17M over double clear.

4.2 Middle School

In the Middle School Building, all Serious Materials products perform significantly better than Competitors A and B in all climates, with the exception of Atlanta and Phoenix, where Competitor B performs at a level similar to SG-8. The SG-12 package produces the highest savings in all climate zones. For all Serious Materials products, savings ranged from 25% to 35% over single clear glazing, and from 16% to 27% over double clear.

The simple payback period for SG-5, SG-6, and SG-8 are nearly identical to that of Competitor A, and slightly shorter than Competitor B. In all cases, SG-12 has the longest simple payback period. In general, Serious Materials products yield simple payback periods of between 1 and 4 years, depending on climate and glazing type.

In terms of 30-year savings, all Serious Materials products perform significantly better than the competition in all climate zones, with the exception of Atlanta and Phoenix, where Competitor B performs comparably to SG-8. SG-12 performs the best, irrespective of the climate. 30-year savings totals range from \$5.5M to \$9M savings over single clear glazing, and from \$3.75M to \$6M over double clear.

4.3 Hotel

In the Hotel Building, all Serious Materials products perform significantly better than Competitors A and B, except in Atlanta and Phoenix, where Competitor B performs similarly to SG-8 and SG-12. SG-12 generally performs the best, depending on the climate. The savings ranges from 26% to 36% when compared to single clear glazing, and from 20% to 27% when compared to double clear.

SG-5, SG-6, and SG-8 show payback periods comparable to Competitor A, and shorter payback periods than Competitor B. SG-12 yields the longest payback period, regardless of climate. In general, Simple Payback Periods are in the range of 1.5 to 8 years.

All Serious Materials products yield significantly better 30-year savings than the competitor's products, except in Atlanta and Phoenix, where Competitor B performs similarly to SG-8 and SG-12. In general, SG-8 yields the highest savings, depending on climate. 30-year savings ranges from \$5.5M to \$10M when compared to single clear glazing, and from \$3.5M to \$6.5M when compared to double clear.

4.4 Hospital

In the Hospital, all Serious Materials products show significantly higher annual savings than Competitors A and B in all climates. SG-12 shows marginally better savings than SG-5, SG-6 or

SG-8. Annual savings ranges from 3% to 5.5% over single clear glazing, and from 2% to 4% over double clear.

SG-5, SG-6, and SG-8 show shorter simple payback periods than Competitors A and B. In addition, in some cases, the simple payback of SG-12 is better than that of Competitor B. The payback periods for SG-5, SG-6, and SG-8 range from 3 to 5 years compared to either single clear or double clear glazing.

In terms of 30-year savings, all Serious Materials products perform significantly better than the competitors, and all show similar levels of savings. 30-year savings ranges from \$1.2M to \$2M when compared to single clear glazing, and \$0.6M to \$1.3M when compared to double clear.

Appendix A: Utility Rates

Atlanta Electricity

Consumption Charges (\$/kWh)	\$0.108 (first 3,000 kWh), \$0.098 (next 7,000 kWh)
Demand Charges (\$/kW)	\$0.084 (next 190,000 kWh), \$0.0646 (remaining)
Peak Period	\$7.80
	no peak period

Atlanta Natural Gas

Monthly Charges (\$/mo)	\$6.95
Consumption Charges (\$/therm)	\$1.43

Chicago Electricity

Monthly Charges (\$/mo)	\$41.00
Consumption Charges (\$/kWh)	\$0.085
Demand Charges (\$/kW)	included in weighted consumption charges
Peak Period	no peak period

Chicago Natural Gas

Monthly Charges (\$/mo)	\$30.00
Consumption Charges (\$/therm)	\$1.243

New York Electricity

Monthly Charges (\$/mo)	\$28.83
Consumption Charges (\$/kWh)	\$0.0174
	\$21.47 (first 100kW), \$20.43 (next 800kW)
Peak Demand Charges (\$/kW)	\$19.41 (next 1100kW), \$18.12 (remaining)
	\$17.06 (first 100kW), \$16.03 (next 800kW)
Off-Peak Demand Charges (\$/kW)	\$15.00 (next 1100kW), \$13.72 (remaining)
Peak Period	June 1 - September 30

New York Natural Gas

Monthly Charges (\$/mo)	\$39.93
Consumption Charges (\$/therm)	\$1.226

Phoenix Electricity

Monthly Charges (\$/mo)	\$17.83
Peak Consumption Charges (\$/kWh)	\$0.091 (first 200 kWh), \$0.053 (remaining)
Off-Peak Consumption Charges (\$/kWh)	\$0.076 (first 200 kWh), \$0.036 (remaining)
Demand Charges (\$/kW)	\$8.472 (first 100kW), \$4.509 (remaining)
Peak Period	May 1 - October 31

Phoenix Natural Gas

Monthly Charges (\$/mo)	\$43.50
Consumption Charges (\$/therm)	\$1.298

Seattle Electricity

Monthly Charges (\$/mo)	\$100.00
Consumption Charges (\$/kWh)	\$0.0622
Demand Charges (\$/kW)	\$8.52 (peak), \$5.68 (off-peak)
Peak Period	October 1 - March 31

Seattle Natural Gas

Monthly Charges (\$/mo)	\$30.00
Consumption Charges (\$/therm)	\$1.204

Washington DC Electricity

Monthly Charges (\$/mo)	\$14.93
Peak Consumption Charges (\$/kWh)	\$0.03904 (first 6,000kWh), \$0.03236 (remaining)
Off-Peak Consumption Charges (\$/kWh)	\$0.02456 (first 6,000kWh), \$0.01588 (remaining)
Demand Charges (\$/kW)	\$7.69 (peak), \$7.64 (off-peak)
Peak Period	June 1 - October 31

Washington DC Natural Gas

Monthly Charges (\$/mo)	\$39.93
Consumption Charges (\$/therm)	\$1.370

Appendix B: Building Description

B.1 Envelope Parameters

Table 2: Building Envelope Parameters

	Office Building	Middle School
Floor Area	400,000 square feet	201,000 square feet
Number of Stories	20	3
Exterior Wall Construction	1" stone cladding, R-13 insulation, air layer, 5/8" gypsum board	8" concrete masonry unit, R-13 insulation, 5/8" gypsum board
Roof Construction	3/8" built-up roofing, 4" lightweight concrete, R-19 insulation, air layer, 1/2" acoustic tile	3/8" built-up roofing, 5/8" plywood, R-19 insulation, air layer, 5/8" gypsum board
Window Area	57,730 square feet – 50% WWR	28,792 square feet – 35% WWR
	Hotel	Hospital
Floor Area	250,000 square feet	449,000 square feet
Number of Stories	4	4
Exterior Wall Construction	10" poured concrete, R-13 insulation, air layer, 5/8" gypsum board	4" brick, 1/2" insulation board, R-13 CMU insulation, 1/2" gypsum board
Roof Construction	3/8" built-up roofing, 6" lightweight concrete, R-14 insulation, air layer, 1/2" acoustic tile	3/8" built-up roofing, 5/8" plywood, R-19 insulation, air layer, 5/8" gypsum board
Window Area	38,184 square feet – 40% WWR	19,104 square feet – 35% WWR

B.2 System Parameters

Table 3: Building System Parameters

	Office	Middle School	Hotel	Hospital
HVAC Systems				
Main System Type	VAV with Hot Water Reheat	Packaged Multi-Zone System	Lobby – Packaged VAV Kitchen - Packaged Single Zone Guest Rooms – Packaged Terminal Units	VAV with Hot Water Reheat
Central Heating Equipment Type	Hot Water Boiler	Hot Water Boiler	Furnace / Heat Pump	Hot Water Boiler
Cooling Equipment Type	Chiller Plant	DX Cooling	DX Cooling	Open Centrifugal Chiller
Exhaust Air Heat Recovery	OA Temperature Economizer	No Exhaust Heat Recovery	No Exhaust Heat Recovery	OA Temperature Economizer
Cooling Equipment Efficiency	COP=6.10	COP=2.80	COP=2.80	COP=5.21
Heating Equipment Efficiency	75% (boiler)	80% (furnace)	75% (furnace)/COP=2.7 (heat pump)	78% (boiler)

B.3 Internal Loads

Table 4: Building Internal Loads

Zone	Office	Middle School	Hotel	Hospital
Lighting Power Density [W/ft ²]	0.80	1.104	0.80	0.96
Equipment Power Density [W/ft ²]	0.50	0.45	0.50	0.90

Appendix C: Simulation Data

Run	City	Glass Type	Window Area	Cost/sf	First Cost	Elec Consumption	Elec Demand	Gas	Annual Total	Life Cycle Cost (5% escalation, 0% discount)	Compared to Single Clear			Compared to Double Clear		
											Annual Savings %	Simple Payback	30-year Savings	Annual Savings %	Simple Payback	5% Escalation
OFF G0 Atlanta	Atlanta	Single Clear	57729.5	\$2.0	\$115,459	\$627,571	\$198,245	\$178,165	\$1,003,981	\$73,586,601	-	-	-	-	-	-
OFF G00 Atlanta	Atlanta	Double Clear	57729.5	\$3.5	\$202,053	\$581,649	\$185,608	\$139,272	\$906,529	\$66,541,676	-	-	-	-	-	-
OFF G1 Atlanta	Atlanta	Glazing A	57729.5	\$6.0	\$346,377	\$464,328	\$157,404	\$106,456	\$728,188	\$53,635,039	27.5%	0.84	\$19,951,562	19.7%	0.81	\$12,906,637
OFF G2 Atlanta	Atlanta	Glazing B	57729.5	\$8.0	\$461,836	\$432,265	\$148,907	\$101,883	\$683,055	\$60,447,674	32.0%	1.08	\$23,138,928	24.7%	1.16	\$16,094,003
OFF G3 Atlanta	Atlanta	SG-5	57729.5	\$6.7	\$386,788	\$455,630	\$154,792	\$100,751	\$711,173	\$52,430,295	29.2%	0.93	\$21,156,306	21.5%	0.95	\$14,111,381
OFF G4 Atlanta	Atlanta	SG-6	57729.5	\$6.5	\$377,551	\$452,875	\$153,966	\$99,307	\$706,148	\$52,053,330	29.7%	0.88	\$21,533,271	22.1%	0.88	\$14,488,347
OFF G5 Atlanta	Atlanta	SG-8	57729.5	\$6.8	\$392,561	\$434,706	\$147,068	\$94,681	\$676,455	\$49,895,411	32.6%	0.85	\$23,691,190	25.4%	0.83	\$16,646,265
OFF G6 Atlanta	Atlanta	SG-12	57729.5	\$16.0	\$921,363	\$430,079	\$145,510	\$91,960	\$667,549	\$49,772,474	33.5%	2.40	\$23,814,127	26.4%	3.01	\$16,769,202
OFF G0 Chicago	Chicago	Single Clear	57729.5	\$2.0	\$115,459	\$677,735	\$0	\$288,661	\$966,396	\$70,836,138	-	-	-	-	-	-
OFF G00 Chicago	Chicago	Double Clear	57729.5	\$3.5	\$202,053	\$609,662	\$0	\$224,520	\$834,182	\$61,247,336	-	-	-	-	-	-
OFF G1 Chicago	Chicago	Glazing A	57729.5	\$6.0	\$346,377	\$488,075	\$0	\$182,814	\$670,889	\$49,441,909	30.6%	0.78	\$21,394,229	19.6%	0.88	\$11,805,428
OFF G2 Chicago	Chicago	Glazing B	57729.5	\$8.0	\$461,836	\$459,455	\$0	\$178,357	\$637,812	\$47,136,799	34.0%	1.05	\$23,699,339	23.5%	1.32	\$14,110,537
OFF G3 Chicago	Chicago	SG-5	57729.5	\$6.7	\$386,788	\$476,898	\$0	\$170,751	\$647,649	\$47,781,621	33.0%	0.85	\$23,054,517	22.4%	0.99	\$13,465,716
OFF G4 Chicago	Chicago	SG-6	57729.5	\$6.5	\$377,551	\$473,394	\$0	\$167,796	\$641,190	\$47,299,716	33.7%	0.81	\$23,536,423	23.1%	0.91	\$13,947,621
OFF G5 Chicago	Chicago	SG-8	57729.5	\$6.8	\$392,561	\$470,532	\$0	\$160,413	\$630,945	\$46,564,998	34.7%	0.83	\$24,271,140	24.4%	0.94	\$14,682,338
OFF G6 Chicago	Chicago	SG-12	57729.5	\$16.0	\$921,363	\$466,662	\$0	\$154,761	\$621,423	\$46,396,982	35.7%	2.34	\$24,439,156	25.5%	3.38	\$14,850,354
OFF G0 NY	New York	Single Clear	57729.5	\$2.0	\$115,459	\$137,908	\$402,724	\$236,933	\$777,565	\$57,017,521	-	-	-	-	-	-
OFF G00 NY	New York	Double Clear	57729.5	\$3.5	\$202,053	\$126,082	\$379,354	\$190,722	\$696,158	\$51,146,766	-	-	-	-	-	-
OFF G1 NY	New York	Glazing A	57729.5	\$6.0	\$346,377	\$101,152	\$325,420	\$156,181	\$582,753	\$42,992,133	25.1%	1.19	\$14,025,388	16.3%	1.27	\$8,154,633
OFF G2 NY	New York	Glazing B	57729.5	\$8.0	\$461,836	\$97,772	\$317,848	\$153,186	\$568,806	\$42,086,953	26.8%	1.66	\$14,930,568	18.3%	2.04	\$9,059,813
OFF G3 NY	New York	SG-5	57729.5	\$6.7	\$386,788	\$99,271	\$320,337	\$147,941	\$567,549	\$41,919,918	27.0%	1.29	\$15,097,603	18.5%	1.44	\$9,226,848
OFF G4 NY	New York	SG-6	57729.5	\$6.5	\$377,551	\$98,642	\$318,596	\$145,965	\$563,203	\$41,592,641	27.6%	1.22	\$15,424,879	19.1%	1.32	\$9,554,124
OFF G5 NY	New York	SG-8	57729.5	\$6.8	\$392,561	\$98,159	\$317,017	\$141,077	\$556,253	\$41,099,051	28.5%	1.25	\$15,918,469	20.1%	1.36	\$10,047,714
OFF G6 NY	New York	SG-12	57729.5	\$16.0	\$921,363	\$96,999	\$313,528	\$136,993	\$547,520	\$40,988,774	29.6%	3.50	\$16,028,746	21.4%	4.84	\$10,157,992
OFF G0 Phoenix	Phoenix	Single Clear	57729.5	\$2.0	\$115,459	\$488,455	\$122,227	\$74,542	\$685,224	\$50,260,024	-	-	-	-	-	-
OFF G00 Phoenix	Phoenix	Double Clear	57729.5	\$3.5	\$202,053	\$443,981	\$112,954	\$56,569	\$613,504	\$45,098,162	-	-	-	-	-	-
OFF G1 Phoenix	Phoenix	Glazing A	57729.5	\$6.0	\$346,377	\$341,420	\$95,423	\$38,964	\$475,807	\$35,165,845	30.6%	1.10	\$15,094,179	22.4%	1.05	\$9,932,317
OFF G2 Phoenix	Phoenix	Glazing B	57729.5	\$8.0	\$461,836	\$307,589	\$90,396	\$35,917	\$433,902	\$32,214,703	36.7%	1.38	\$18,045,320	29.3%	1.45	\$12,883,458
OFF G3 Phoenix	Phoenix	SG-5	57729.5	\$6.7	\$386,788	\$331,537	\$93,531	\$37,532	\$462,600	\$34,239,769	32.5%	1.22	\$16,020,254	24.6%	1.22	\$10,858,392
OFF G4 Phoenix	Phoenix	SG-6	57729.5	\$6.5	\$377,551	\$328,113	\$92,927	\$37,283	\$458,323	\$33,917,643	33.1%	1.16	\$16,342,481	25.3%	1.13	\$11,180,619
OFF G5 Phoenix	Phoenix	SG-8	57729.5	\$6.8	\$392,561	\$325,432	\$92,225	\$36,947	\$454,604	\$33,660,397	33.7%	1.20	\$16,599,627	25.9%	1.20	\$11,437,765
OFF G6 Phoenix	Phoenix	SG-12	57729.5	\$16.0	\$921,363	\$318,723	\$91,005	\$36,442	\$446,170	\$33,572,000	34.9%	3.37	\$16,688,023	27.3%	4.30	\$11,526,161
OFF G0 Seattle	Seattle	Single Clear	57729.5	\$2.0	\$115,459	\$451,730	\$158,008	\$224,679	\$834,417	\$61,177,939	-	-	-	-	-	-
OFF G00 Seattle	Seattle	Double Clear	57729.5	\$3.5	\$202,053	\$423,106	\$149,541	\$180,897	\$753,544	\$55,346,263	-	-	-	-	-	-
OFF G1 Seattle	Seattle	Glazing A	57729.5	\$6.0	\$346,377	\$343,193	\$127,037	\$135,713	\$605,943	\$44,689,173	27.4%	1.01	\$16,488,767	19.6%	0.98	\$10,657,090
OFF G2 Seattle	Seattle	Glazing B	57729.5	\$8.0	\$461,836	\$322,253	\$120,208	\$127,795	\$570,256	\$42,193,064	31.7%	1.31	\$18,984,876	24.3%	1.42	\$13,153,199
OFF G3 Seattle	Seattle	SG-5	57729.5	\$6.7	\$386,788	\$337,646	\$125,043	\$126,823	\$589,512	\$43,527,166	29.4%	1.11	\$17,650,774	21.8%	1.13	\$11,819,097
OFF G4 Seattle	Seattle	SG-6	57729.5	\$6.5	\$377,551	\$335,752	\$124,372	\$124,571	\$584,695	\$43,165,422	29.9%	1.05	\$18,012,517	22.4%	1.04	\$12,180,841
OFF G5 Seattle	Seattle	SG-8	57729.5	\$6.8	\$392,561	\$334,692	\$123,850	\$119,260	\$577,802	\$42,676,003	30.8%	1.08	\$18,501,936	23.3%	1.08	\$12,670,259
OFF G6 Seattle	Seattle	SG-12	57729.5	\$16.0	\$921,363	\$331,033	\$122,537	\$114,605	\$568,175	\$42,500,303	31.9%	3.03	\$18,677,636	24.6%	3.88	\$12,845,959
OFF G0 WashDC	Washington DC	Single Clear	57729.5	\$2.0	\$115,459	\$407,326	\$196,457	\$225,269	\$829,052	\$60,785,330	-	-	-	-	-	-
OFF G00 WashDC	Washington DC	Double Clear	57729.5	\$3.5	\$202,053	\$371,326	\$183,541	\$172,315	\$727,182	\$53,417,096	-	-	-	-	-	-
OFF G1 WashDC	Washington DC	Glazing A	57729.5	\$6.0	\$346,377	\$294,231	\$155,329	\$133,829	\$583,389	\$43,038,675	29.6%	0.94	\$17,746,655	19.8%	1.00	\$10,378,421
OFF G2 WashDC	Washington DC	Glazing B	57729.5	\$8.0	\$461,836	\$274,271	\$146,780	\$129,505	\$550,556	\$40,751,421	33.6%	1.24	\$20,033,908	24.3%	1.47	\$12,665,675
OFF G3 WashDC	Washington DC	SG-5	57729.5	\$6.7	\$386,788	\$288,571	\$152,751	\$124,866	\$566,188	\$41,820,320	31.7%	1.03	\$18,965,010	22.1%	1.15	\$11,596,776
OFF G4 WashDC	Washington DC	SG-6	57729.5	\$6.5	\$377,551	\$286,435	\$151,911	\$122,896	\$561,242	\$41,449,136	32.3%	0.98	\$19,336,194	22.8%	1.06	\$11,967,961
OFF G5 WashDC	Washington DC	SG-8	57729.5	\$6.8	\$392,561	\$285,658	\$151,185	\$117,958	\$554,801	\$40,992,794	33.1%	1.01	\$19,792,535	23.7%	1.11	\$12,424,302
OFF G6 WashDC	Washington DC	SG-12	57729.5	\$16.0	\$921,363	\$271,283	\$143,941	\$111,804	\$527,028	\$39,489,174	36.4%	2.67	\$21,296,156	27.5%	3.59	\$13,927,923

Middle School

Run	City	Glass Type	Window Area	Cost/sf	First Cost	Elec Consumption	Elec Demand	Gas	Annual Total	Life Cycle Cost (5% escalation, 0% discount)	Compared to Single Clear			Compared to Double Clear		
											Annual Savings %	Simple Payback	5% Escalation	Annual Savings %	Simple Payback	5% Escalation
OFF_G0_Atlanta	Atlanta	Single Clear	28972.5	\$2.0	\$57,945	\$234,220	\$102,979	\$135,694	\$472,893	\$34,664,167	-	-	-	-	-	-
OFF_G00_Atlanta	Atlanta	Double Clear	28972.5	\$3.5	\$101,404	\$218,740	\$95,172	\$116,429	\$430,341	\$31,593,678	-	-	-	-	-	-
OFF_G1_Atlanta	Atlanta	Glazing A	28972.5	\$6.0	\$173,835	\$182,514	\$84,280	\$99,190	\$365,984	\$26,956,476	22.6%	1.08	\$7,707,691	15.0%	1.13	\$4,637,202
OFF_G2_Atlanta	Atlanta	Glazing B	28972.5	\$8.0	\$231,780	\$171,644	\$81,376	\$96,667	\$349,687	\$25,821,809	26.1%	1.41	\$8,842,357	18.7%	1.62	\$5,771,868
OFF_G3_Atlanta	Atlanta	SG-5	28972.5	\$6.7	\$194,116	\$178,415	\$82,456	\$92,877	\$363,748	\$26,081,328	25.2%	1.14	\$8,582,838	17.8%	1.21	\$5,512,349
OFF_G4_Atlanta	Atlanta	SG-6	28972.5	\$6.5	\$189,480	\$177,160	\$81,984	\$91,832	\$350,976	\$25,873,838	25.8%	1.08	\$8,790,328	18.4%	1.11	\$5,719,840
OFF_G5_Atlanta	Atlanta	SG-8	28972.5	\$6.8	\$197,013	\$176,247	\$81,265	\$89,567	\$347,079	\$25,596,189	26.6%	1.11	\$9,067,977	19.3%	1.15	\$5,997,488
OFF_G6_Atlanta	Atlanta	SG-12	28972.5	\$16.0	\$462,401	\$174,007	\$80,355	\$87,491	\$341,853	\$25,479,140	27.7%	3.09	\$9,185,027	20.6%	4.08	\$6,114,538
OFF_G0_Chicago	Chicago	Single Clear	28972.5	\$2.0	\$57,945	\$237,803	\$0	\$189,571	\$427,374	\$31,333,095	-	-	-	-	-	-
OFF_G00_Chicago	Chicago	Double Clear	28972.5	\$3.5	\$101,404	\$215,658	\$0	\$160,817	\$376,475	\$27,651,774	-	-	-	-	-	-
OFF_G1_Chicago	Chicago	Glazing A	28972.5	\$6.0	\$173,835	\$178,966	\$0	\$145,057	\$324,023	\$23,885,778	24.2%	1.12	\$7,447,317	13.9%	1.38	\$3,765,996
OFF_G2_Chicago	Chicago	Glazing B	28972.5	\$8.0	\$231,780	\$170,299	\$0	\$144,947	\$315,246	\$23,301,423	26.2%	1.55	\$8,031,671	16.3%	2.13	\$4,350,351
OFF_G3_Chicago	Chicago	SG-5	28972.5	\$6.7	\$194,116	\$174,593	\$0	\$136,646	\$311,239	\$22,970,528	27.2%	1.17	\$8,362,567	17.3%	1.42	\$4,681,246
OFF_G4_Chicago	Chicago	SG-6	28972.5	\$6.5	\$189,480	\$173,214	\$0	\$135,161	\$308,375	\$22,756,305	27.8%	1.11	\$8,576,789	18.1%	1.29	\$4,895,469
OFF_G5_Chicago	Chicago	SG-8	28972.5	\$6.8	\$197,013	\$171,186	\$0	\$130,789	\$301,975	\$22,295,487	29.3%	1.11	\$9,037,607	19.8%	1.28	\$5,356,287
OFF_G6_Chicago	Chicago	SG-12	28972.5	\$16.0	\$462,401	\$168,528	\$0	\$127,700	\$296,228	\$22,140,311	30.7%	3.08	\$9,192,784	21.3%	4.50	\$5,511,463
OFF_G0_NY	New York	Single Clear	28972.5	\$2.0	\$57,945	\$45,286	\$203,311	\$143,895	\$392,492	\$28,780,436	-	-	-	-	-	-
OFF_G00_NY	New York	Double Clear	28972.5	\$3.5	\$101,404	\$41,424	\$188,421	\$122,334	\$352,179	\$25,873,797	-	-	-	-	-	-
OFF_G1_NY	New York	Glazing A	28972.5	\$6.0	\$173,835	\$33,734	\$164,960	\$107,338	\$306,032	\$22,569,200	22.0%	1.34	\$6,211,237	13.1%	1.57	\$3,304,598
OFF_G2_NY	New York	Glazing B	28972.5	\$8.0	\$231,780	\$31,744	\$158,817	\$106,185	\$296,746	\$21,947,597	24.4%	1.82	\$6,832,839	15.7%	2.35	\$3,926,200
OFF_G3_NY	New York	SG-5	28972.5	\$6.7	\$194,116	\$32,900	\$160,874	\$100,574	\$294,348	\$21,734,448	25.0%	1.39	\$7,045,989	16.4%	1.60	\$4,139,350
OFF_G4_NY	New York	SG-6	28972.5	\$6.5	\$189,480	\$32,647	\$159,917	\$99,433	\$291,997	\$21,557,766	25.6%	1.31	\$7,222,670	17.1%	1.46	\$4,316,031
OFF_G5_NY	New York	SG-8	28972.5	\$6.8	\$197,013	\$32,348	\$158,320	\$96,495	\$287,163	\$21,211,548	26.8%	1.32	\$7,568,889	18.5%	1.47	\$4,662,250
OFF_G6_NY	New York	SG-12	28972.5	\$16.0	\$462,401	\$31,844	\$156,397	\$94,183	\$282,424	\$21,130,137	28.0%	3.67	\$7,650,300	19.8%	5.18	\$4,743,661
OFF_G0_Phoenix	Phoenix	Single Clear	28972.5	\$2.0	\$57,945	\$181,915	\$69,433	\$109,832	\$361,180	\$26,489,030	-	-	-	-	-	-
OFF_G00_Phoenix	Phoenix	Double Clear	28972.5	\$3.5	\$101,404	\$163,655	\$64,173	\$94,307	\$322,135	\$23,675,183	-	-	-	-	-	-
OFF_G1_Phoenix	Phoenix	Glazing A	28972.5	\$6.0	\$173,835	\$127,759	\$55,881	\$73,500	\$257,140	\$18,991,292	28.8%	1.11	\$7,497,738	20.2%	1.11	\$4,683,891
OFF_G2_Phoenix	Phoenix	Glazing B	28972.5	\$8.0	\$231,780	\$117,664	\$53,618	\$68,833	\$240,115	\$17,803,351	33.5%	1.44	\$8,685,679	25.5%	1.59	\$5,871,832
OFF_G3_Phoenix	Phoenix	SG-5	28972.5	\$6.7	\$194,116	\$123,383	\$54,663	\$69,114	\$247,160	\$18,281,238	31.6%	1.19	\$8,207,792	23.3%	1.24	\$5,393,945
OFF_G4_Phoenix	Phoenix	SG-6	28972.5	\$6.5	\$189,480	\$122,081	\$54,159	\$68,209	\$244,449	\$18,078,212	32.3%	1.13	\$8,410,818	24.1%	1.13	\$5,596,971
OFF_G5_Phoenix	Phoenix	SG-8	28972.5	\$6.8	\$197,013	\$120,408	\$53,697	\$66,576	\$240,681	\$17,810,004	33.4%	1.15	\$8,679,026	25.3%	1.17	\$5,865,179
OFF_G6_Phoenix	Phoenix	SG-12	28972.5	\$16.0	\$462,401	\$117,820	\$52,890	\$64,751	\$235,461	\$17,693,393	34.8%	3.22	\$8,795,637	26.9%	4.17	\$5,981,790
OFF_G0_Seattle	Seattle	Single Clear	28972.5	\$2.0	\$57,945	\$129,502	\$70,480	\$121,162	\$321,144	\$23,559,203	-	-	-	-	-	-
OFF_G00_Seattle	Seattle	Double Clear	28972.5	\$3.5	\$101,404	\$121,400	\$66,468	\$104,842	\$292,710	\$21,521,867	-	-	-	-	-	-
OFF_G1_Seattle	Seattle	Glazing A	28972.5	\$6.0	\$173,835	\$101,441	\$57,207	\$92,532	\$251,180	\$18,555,141	21.8%	1.66	\$5,004,062	14.2%	1.74	\$2,966,726
OFF_G2_Seattle	Seattle	Glazing B	28972.5	\$8.0	\$231,780	\$96,233	\$54,504	\$91,734	\$242,471	\$17,975,763	24.5%	2.21	\$5,583,440	17.2%	2.60	\$3,546,104
OFF_G3_Seattle	Seattle	SG-5	28972.5	\$6.7	\$194,116	\$99,233	\$55,360	\$86,052	\$240,645	\$17,804,472	25.1%	1.69	\$5,754,731	17.8%	1.78	\$3,717,395
OFF_G4_Seattle	Seattle	SG-6	28972.5	\$6.5	\$189,480	\$98,627	\$55,085	\$85,093	\$238,805	\$17,665,186	25.6%	1.60	\$5,894,018	18.4%	1.63	\$3,856,681
OFF_G5_Seattle	Seattle	SG-8	28972.5	\$6.8	\$197,013	\$98,132	\$54,826	\$82,700	\$235,658	\$17,442,421	26.8%	1.63	\$6,116,782	19.5%	1.68	\$4,079,445
OFF_G6_Seattle	Seattle	SG-12	28972.5	\$16.0	\$462,401	\$97,095	\$54,294	\$80,941	\$232,330	\$17,464,267	27.7%	4.55	\$6,094,936	20.6%	5.98	\$4,057,600
OFF_G0_WashDC	Washington DC	Single Clear	28972.5	\$2.0	\$57,945	\$128,672	\$99,188	\$164,257	\$392,117	\$28,752,994	-	-	-	-	-	-
OFF_G00_WashDC	Washington DC	Double Clear	28972.5	\$3.5	\$101,404	\$117,628	\$91,139	\$141,415	\$350,182	\$25,727,657	-	-	-	-	-	-
OFF_G1_WashDC	Washington DC	Glazing A	28972.5	\$6.0	\$173,835	\$97,445	\$80,651	\$127,389	\$305,485	\$22,529,170	22.1%	1.34	\$6,223,824	12.8%	1.62	\$3,198,487
OFF_G2_WashDC	Washington DC	Glazing B	28972.5	\$8.0	\$231,780	\$92,345	\$77,881	\$127,044	\$297,270	\$21,985,943	24.2%	1.83	\$6,767,051	15.1%	2.46	\$3,741,714
OFF_G3_WashDC	Washington DC	SG-5	28972.5	\$6.7	\$194,116	\$94,902	\$78,674	\$119,284	\$292,860	\$21,625,556	25.3%	1.37	\$7,127,438	16.4%	1.62	\$4,102,101
OFF_G4_WashDC	Washington DC	SG-6	28972.5	\$6.5	\$189,480	\$94,169	\$78,204	\$117,951	\$290,324	\$21,435,336	26.0%	1.29	\$7,317,658	17.1%	1.47	\$4,292,321
OFF_G5_WashDC	Washington DC	SG-8	28972.5	\$6.8	\$197,013	\$93,166	\$77,361	\$114,246	\$284,773	\$21,036,648	27.4%	1.30	\$7,716,346	18.7%	1.46	\$4,691,009
OFF_G6_WashDC	Washington DC	SG-12	28972.5	\$16.0	\$462,401	\$91,741	\$76,371	\$111,555	\$279,667	\$20,928,380	28.7%	3.60	\$7,824,614	20.1%	5.12	\$4,799,277

Hotel													Compared to Single Clear			Compared to Double Clear		
Run	City	Glass Type	Window Area	Cost/sf	First Cost	Elec Consumption	Elec Demand	Gas	Annual Total	Life Cycle Cost (5% escalation, 0% discount)	30-year Savings			30-year Savings				
											Annual Savings %	Simple Payback	5% Escalation	Annual Savings %	Simple Payback	5% Escalation		
OFF G0 Atlanta	Atlanta	Single Clear	38184	\$2.0	\$76,368	\$342,498	\$81,792	\$8,430	\$432,720	\$31,742,737	-	-	-	-	-	-		
OFF G00 Atlanta	Atlanta	Double Clear	38184	\$3.5	\$133,644	\$319,380	\$73,276	\$8,248	\$400,904	\$29,471,724	-	-	-	-	-	-		
OFF G1 Atlanta	Atlanta	Glazing A	38184	\$6.0	\$229,104	\$262,391	\$61,387	\$8,411	\$332,189	\$24,538,633	23.2%	1.52	\$7,204,104	17.1%	1.39	\$4,933,091		
OFF G2 Atlanta	Atlanta	Glazing B	38184	\$8.0	\$305,472	\$247,043	\$59,033	\$8,505	\$314,581	\$23,326,451	27.3%	1.94	\$8,416,286	21.5%	1.99	\$6,145,273		
OFF G3 Atlanta	Atlanta	SG-5	38184	\$6.7	\$255,833	\$252,515	\$59,060	\$7,357	\$318,932	\$23,595,217	26.3%	1.58	\$8,147,520	20.4%	1.49	\$5,876,507		
OFF G4 Atlanta	Atlanta	SG-6	38184	\$6.5	\$249,723	\$250,841	\$58,427	\$7,354	\$316,622	\$23,420,062	26.8%	1.49	\$8,322,675	21.0%	1.38	\$6,051,662		
OFF G5 Atlanta	Atlanta	SG-8	38184	\$6.8	\$259,651	\$249,811	\$57,310	\$7,337	\$314,458	\$23,271,629	27.3%	1.55	\$8,471,108	21.6%	1.46	\$6,200,095		
OFF G6 Atlanta	Atlanta	SG-12	38184	\$16.0	\$609,417	\$246,762	\$55,956	\$7,334	\$310,052	\$23,298,964	28.3%	4.35	\$8,443,773	22.7%	5.24	\$6,172,760		
OFF G0 Chicago	Chicago	Single Clear	38184	\$2.0	\$76,368	\$395,117	\$0	\$17,799	\$412,916	\$30,293,484	-	-	-	-	-	-		
OFF G00 Chicago	Chicago	Double Clear	38184	\$3.5	\$133,644	\$347,968	\$0	\$17,202	\$365,170	\$26,856,717	-	-	-	-	-	-		
OFF G1 Chicago	Chicago	Glazing A	38184	\$6.0	\$229,104	\$289,464	\$0	\$17,384	\$306,848	\$22,684,183	25.7%	1.44	\$7,609,300	16.0%	1.64	\$4,172,533		
OFF G2 Chicago	Chicago	Glazing B	38184	\$8.0	\$305,472	\$278,318	\$0	\$17,541	\$295,859	\$21,956,378	28.3%	1.96	\$8,337,105	19.0%	2.48	\$4,900,338		
OFF G3 Chicago	Chicago	SG-5	38184	\$6.7	\$255,833	\$266,219	\$0	\$15,985	\$282,204	\$20,907,469	31.7%	1.37	\$9,386,015	22.7%	1.47	\$5,949,248		
OFF G4 Chicago	Chicago	SG-6	38184	\$6.5	\$249,723	\$263,315	\$0	\$15,947	\$279,262	\$20,686,064	32.4%	1.30	\$9,607,419	23.5%	1.35	\$6,170,652		
OFF G5 Chicago	Chicago	SG-8	38184	\$6.8	\$259,651	\$257,067	\$0	\$15,782	\$272,849	\$20,226,690	33.9%	1.31	\$10,066,794	25.3%	1.36	\$6,630,026		
OFF G6 Chicago	Chicago	SG-12	38184	\$16.0	\$609,417	\$250,904	\$0	\$15,688	\$266,592	\$20,118,569	35.4%	3.64	\$10,174,914	27.0%	4.83	\$6,738,147		
OFF G0 NY	New York	Single Clear	38184	\$2.0	\$76,368	\$77,953	\$188,490	\$12,589	\$279,032	\$20,495,878	-	-	-	-	-	-		
OFF G00 NY	New York	Double Clear	38184	\$3.5	\$133,644	\$69,851	\$166,624	\$12,195	\$248,670	\$18,331,268	-	-	-	-	-	-		
OFF G1 NY	New York	Glazing A	38184	\$6.0	\$229,104	\$56,565	\$141,472	\$12,382	\$210,419	\$15,627,527	24.6%	2.23	\$4,868,351	15.4%	2.50	\$2,703,741		
OFF G2 NY	New York	Glazing B	38184	\$8.0	\$305,472	\$53,460	\$136,986	\$12,524	\$202,970	\$15,158,779	27.3%	3.01	\$5,337,099	18.4%	3.76	\$3,172,489		
OFF G3 NY	New York	SG-5	38184	\$6.7	\$255,833	\$52,998	\$135,743	\$11,017	\$199,758	\$14,874,086	28.4%	2.26	\$5,621,792	19.7%	2.50	\$3,457,182		
OFF G4 NY	New York	SG-6	38184	\$6.5	\$249,723	\$52,491	\$133,402	\$10,998	\$196,891	\$14,658,170	29.4%	2.11	\$5,837,708	20.8%	2.24	\$3,673,098		
OFF G5 NY	New York	SG-8	38184	\$6.8	\$259,651	\$51,735	\$130,757	\$10,911	\$193,403	\$14,412,847	30.7%	2.14	\$6,083,031	22.2%	2.28	\$3,918,422		
OFF G6 NY	New York	SG-12	38184	\$16.0	\$609,417	\$50,737	\$128,094	\$10,877	\$189,708	\$14,492,213	32.0%	5.97	\$6,003,665	23.7%	8.07	\$3,839,056		
OFF G0 Phoenix	Phoenix	Single Clear	38184	\$2.0	\$76,368	\$281,735	\$60,968	\$3,828	\$346,531	\$25,435,442	-	-	-	-	-	-		
OFF G00 Phoenix	Phoenix	Double Clear	38184	\$3.5	\$133,644	\$257,090	\$55,881	\$3,734	\$316,705	\$23,310,057	-	-	-	-	-	-		
OFF G1 Phoenix	Phoenix	Glazing A	38184	\$6.0	\$229,104	\$200,504	\$46,063	\$3,794	\$250,361	\$18,550,475	27.8%	1.59	\$6,884,967	20.9%	1.44	\$4,759,582		
OFF G2 Phoenix	Phoenix	Glazing B	38184	\$8.0	\$305,472	\$185,134	\$43,522	\$3,842	\$232,498	\$17,319,632	32.9%	2.01	\$8,115,810	26.6%	2.04	\$5,990,425		
OFF G3 Phoenix	Phoenix	SG-5	38184	\$6.7	\$255,833	\$194,671	\$44,872	\$3,602	\$243,145	\$18,049,139	29.8%	1.74	\$7,386,303	23.2%	1.66	\$5,260,918		
OFF G4 Phoenix	Phoenix	SG-6	38184	\$6.5	\$249,723	\$192,853	\$44,505	\$3,598	\$240,956	\$17,882,839	30.5%	1.64	\$7,552,603	23.9%	1.53	\$5,427,218		
OFF G5 Phoenix	Phoenix	SG-8	38184	\$6.8	\$259,651	\$190,977	\$43,987	\$3,577	\$238,541	\$17,716,037	31.2%	1.70	\$7,719,405	24.7%	1.61	\$5,594,020		
OFF G6 Phoenix	Phoenix	SG-12	38184	\$16.0	\$609,417	\$187,354	\$43,254	\$3,568	\$234,176	\$17,746,373	32.4%	4.74	\$7,689,069	26.1%	5.76	\$5,563,684		
OFF G0 Seattle	Seattle	Single Clear	38184	\$2.0	\$76,368	\$228,752	\$63,075	\$10,015	\$301,842	\$22,165,109	-	-	-	-	-	-		
OFF G00 Seattle	Seattle	Double Clear	38184	\$3.5	\$133,644	\$207,200	\$56,754	\$9,691	\$273,645	\$20,158,934	-	-	-	-	-	-		
OFF G1 Seattle	Seattle	Glazing A	38184	\$6.0	\$229,104	\$163,771	\$47,286	\$9,805	\$220,862	\$16,391,744	26.8%	1.89	\$5,773,365	19.3%	1.81	\$3,767,190		
OFF G2 Seattle	Seattle	Glazing B	38184	\$8.0	\$305,472	\$152,504	\$45,548	\$9,885	\$207,937	\$15,522,263	31.1%	2.44	\$6,642,846	24.0%	2.62	\$4,636,671		
OFF G3 Seattle	Seattle	SG-5	38184	\$6.7	\$255,833	\$152,994	\$44,524	\$8,118	\$205,636	\$15,304,237	31.9%	1.87	\$6,860,872	24.9%	1.80	\$4,854,697		
OFF G4 Seattle	Seattle	SG-6	38184	\$6.5	\$249,723	\$151,655	\$43,959	\$8,114	\$203,728	\$15,158,500	32.5%	1.77	\$7,006,609	25.6%	1.66	\$5,000,434		
OFF G5 Seattle	Seattle	SG-8	38184	\$6.8	\$259,651	\$150,365	\$43,526	\$8,105	\$201,996	\$15,041,681	33.1%	1.84	\$7,123,428	26.2%	1.76	\$5,117,253		
OFF G6 Seattle	Seattle	SG-12	38184	\$16.0	\$609,417	\$147,857	\$42,683	\$8,117	\$198,657	\$15,147,099	34.2%	5.17	\$7,018,010	27.4%	6.34	\$5,011,835		
OFF G0 WashDC	Washington DC	Single Clear	38184	\$2.0	\$76,368	\$215,980	\$81,831	\$13,676	\$311,487	\$22,870,929	-	-	-	-	-	-		
OFF G00 WashDC	Washington DC	Double Clear	38184	\$3.5	\$133,644	\$193,238	\$72,764	\$13,335	\$279,337	\$20,575,474	-	-	-	-	-	-		
OFF G1 WashDC	Washington DC	Glazing A	38184	\$6.0	\$229,104	\$157,298	\$62,126	\$13,586	\$223,010	\$17,280,732	25.2%	1.95	\$5,590,196	16.6%	2.06	\$3,294,741		
OFF G2 WashDC	Washington DC	Glazing B	38184	\$8.0	\$305,472	\$149,021	\$60,080	\$13,735	\$222,836	\$16,612,569	28.5%	2.58	\$6,258,360	20.2%	3.04	\$3,962,905		
OFF G3 WashDC	Washington DC	SG-5	38184	\$6.7	\$255,833	\$146,117	\$58,766	\$11,970	\$216,853	\$16,125,095	30.4%	1.90	\$6,745,834	22.4%	1.96	\$4,450,379		
OFF G4 WashDC	Washington DC	SG-6	38184	\$6.5	\$249,723	\$144,709	\$58,239	\$11,958	\$214,906	\$15,976,504	31.0%	1.79	\$6,894,424	23.1%	1.80	\$4,598,969		
OFF G5 WashDC	Washington DC	SG-8	38184	\$6.8	\$259,651	\$142,711	\$57,265	\$11,891	\$211,867	\$15,764,039	32.0%	1.84	\$7,106,890	24.2%	1.87	\$4,811,435		
OFF G6 WashDC	Washington DC	SG-12	38184	\$16.0	\$609,417	\$140,015	\$56,117	\$11,868	\$208,000	\$15,830,818	33.2%	5.15	\$7,040,111	25.5%	6.67	\$4,744,656		

Hospital		Window	Run	City	Glass Type	Area	Cost/sf	First Cost	Elec Consumption	Elec Demand	Gas	Annual Total	Life Cycle Cost (5% escalation, 0% discount)	Compared to Single Clear			Compared to Double Clear		
														Annual Savings %	Simple Payback	5% Escalation	Annual Savings %	Simple Payback	5% Escalation
OFF G0 Atlanta	Atlanta	Single Clear	19104	\$2.0	\$38,208	\$451,848	\$97,328	\$119,464	\$668,640	\$48,969,159	-	-	-	-	-	-	-		
OFF G00 Atlanta	Atlanta	Double Clear	19104	\$3.5	\$66,864	\$452,274	\$96,600	\$113,574	\$662,448	\$48,544,685	-	-	-	-	-	-	-		
OFF G1 Atlanta	Atlanta	Glazing A	19104	\$6.0	\$114,624	\$448,400	\$94,856	\$112,580	\$655,836	\$48,108,580	1.9%	5.97	\$860,578	1.0%	7.22	\$436,105			
OFF G2 Atlanta	Atlanta	Glazing B	19104	\$8.0	\$152,832	\$446,845	\$94,346	\$113,184	\$654,375	\$48,039,872	2.1%	8.04	\$929,286	1.2%	10.65	\$504,813			
OFF G3 Atlanta	Atlanta	SG-5	19104	\$6.7	\$127,997	\$447,455	\$94,580	\$102,815	\$644,850	\$47,318,000	3.6%	3.77	\$1,651,159	2.7%	3.47	\$1,226,686			
OFF G4 Atlanta	Atlanta	SG-6	19104	\$6.5	\$124,940	\$447,448	\$94,538	\$102,595	\$644,581	\$47,295,258	3.6%	3.60	\$1,673,901	2.7%	3.25	\$1,249,428			
OFF G5 Atlanta	Atlanta	SG-8	19104	\$6.8	\$129,907	\$447,800	\$94,516	\$101,641	\$643,957	\$47,254,560	3.7%	3.72	\$1,714,598	2.8%	3.41	\$1,290,125			
OFF G6 Atlanta	Atlanta	SG-12	19104	\$16.0	\$304,900	\$447,850	\$94,437	\$101,124	\$643,411	\$47,389,597	3.8%	10.57	\$1,579,562	2.9%	12.50	\$1,155,088			
OFF G0 Chicago	Chicago	Single Clear	19104	\$2.0	\$38,208	\$484,171	\$0	\$165,311	\$649,482	\$47,567,180	-	-	-	-	-	-	-		
OFF G00 Chicago	Chicago	Double Clear	19104	\$3.5	\$66,864	\$483,920	\$0	\$152,886	\$636,806	\$46,668,208	-	-	-	-	-	-	-		
OFF G1 Chicago	Chicago	Glazing A	19104	\$6.0	\$114,624	\$480,782	\$0	\$150,361	\$631,143	\$46,301,551	2.8%	4.17	\$1,265,629	0.9%	8.43	\$366,657			
OFF G2 Chicago	Chicago	Glazing B	19104	\$8.0	\$152,832	\$479,080	\$0	\$151,532	\$630,612	\$46,300,901	2.9%	6.07	\$1,266,279	1.0%	13.88	\$367,308			
OFF G3 Chicago	Chicago	SG-5	19104	\$6.7	\$127,997	\$478,815	\$0	\$142,278	\$621,093	\$45,579,467	4.4%	3.16	\$1,987,713	2.5%	3.89	\$1,088,742			
OFF G4 Chicago	Chicago	SG-6	19104	\$6.5	\$124,940	\$478,990	\$0	\$141,701	\$620,691	\$45,546,992	4.4%	3.01	\$2,020,188	2.5%	3.60	\$1,121,217			
OFF G5 Chicago	Chicago	SG-8	19104	\$6.8	\$129,907	\$479,888	\$0	\$139,723	\$619,611	\$45,472,925	4.6%	3.07	\$2,094,255	2.7%	3.67	\$1,195,284			
OFF G6 Chicago	Chicago	SG-12	19104	\$16.0	\$304,900	\$480,318	\$0	\$138,463	\$618,781	\$45,567,178	4.7%	8.69	\$1,980,002	2.8%	13.21	\$1,081,030			
OFF G0 NY	New York	Single Clear	19104	\$2.0	\$38,208	\$102,576	\$208,095	\$129,462	\$440,133	\$32,247,059	-	-	-	-	-	-	-		
OFF G00 NY	New York	Double Clear	19104	\$3.5	\$66,864	\$102,964	\$205,561	\$120,859	\$429,384	\$31,489,105	-	-	-	-	-	-	-		
OFF G1 NY	New York	Glazing A	19104	\$6.0	\$114,624	\$102,238	\$203,867	\$119,577	\$425,682	\$31,265,953	3.3%	5.29	\$981,105	0.9%	12.90	\$223,152			
OFF G2 NY	New York	Glazing B	19104	\$8.0	\$152,832	\$101,898	\$203,474	\$120,441	\$425,813	\$31,313,748	3.3%	8.00	\$933,311	0.8%	24.07	\$175,357			
OFF G3 NY	New York	SG-5	19104	\$6.7	\$127,997	\$101,897	\$202,482	\$111,964	\$416,343	\$30,595,900	5.4%	3.77	\$1,651,159	3.0%	4.69	\$893,205			
OFF G4 NY	New York	SG-6	19104	\$6.5	\$124,940	\$101,917	\$202,458	\$111,631	\$416,006	\$30,568,182	5.5%	3.59	\$1,678,877	3.1%	4.34	\$920,923			
OFF G5 NY	New York	SG-8	19104	\$6.8	\$129,907	\$102,051	\$203,023	\$110,370	\$415,444	\$30,532,022	5.6%	3.71	\$1,715,037	3.2%	4.52	\$957,083			
OFF G6 NY	New York	SG-12	19104	\$16.0	\$304,900	\$102,122	\$202,847	\$109,578	\$414,547	\$30,641,372	5.6%	10.42	\$1,605,687	3.5%	16.04	\$847,733			
OFF G0 Phoenix	Phoenix	Single Clear	19104	\$2.0	\$38,208	\$308,335	\$62,353	\$80,732	\$451,420	\$33,073,039	-	-	-	-	-	-	-		
OFF G00 Phoenix	Phoenix	Double Clear	19104	\$3.5	\$66,864	\$306,390	\$61,371	\$78,408	\$446,169	\$32,717,428	-	-	-	-	-	-	-		
OFF G1 Phoenix	Phoenix	Glazing A	19104	\$6.0	\$114,624	\$302,875	\$60,155	\$77,407	\$440,437	\$32,345,722	2.4%	6.96	\$727,318	1.3%	8.33	\$371,707			
OFF G2 Phoenix	Phoenix	Glazing B	19104	\$8.0	\$152,832	\$301,514	\$59,851	\$77,583	\$438,948	\$32,274,965	2.8%	9.19	\$798,075	1.6%	11.91	\$442,463			
OFF G3 Phoenix	Phoenix	SG-5	19104	\$6.7	\$127,997	\$302,070	\$59,932	\$65,940	\$427,942	\$31,444,713	5.2%	3.82	\$1,628,327	4.1%	3.35	\$1,272,716			
OFF G4 Phoenix	Phoenix	SG-6	19104	\$6.5	\$124,940	\$301,929	\$59,889	\$65,938	\$427,756	\$31,428,044	5.2%	3.67	\$1,644,995	4.1%	3.15	\$1,289,384			
OFF G5 Phoenix	Phoenix	SG-8	19104	\$6.8	\$129,907	\$301,812	\$59,825	\$65,642	\$427,279	\$31,398,105	5.3%	3.80	\$1,674,935	4.2%	3.34	\$1,319,323			
OFF G6 Phoenix	Phoenix	SG-12	19104	\$16.0	\$304,900	\$301,528	\$59,728	\$65,490	\$426,746	\$31,534,093	5.5%	10.81	\$1,538,947	4.4%	12.26	\$1,183,336			
OFF G0 Seattle	Seattle	Single Clear	19104	\$2.0	\$38,208	\$323,985	\$76,611	\$121,315	\$521,911	\$38,231,658	-	-	-	-	-	-	-		
OFF G00 Seattle	Seattle	Double Clear	19104	\$3.5	\$66,864	\$325,840	\$76,526	\$113,584	\$515,950	\$37,823,989	-	-	-	-	-	-	-		
OFF G1 Seattle	Seattle	Glazing A	19104	\$6.0	\$114,624	\$324,136	\$75,383	\$111,980	\$511,499	\$37,546,025	2.0%	7.34	\$685,532	0.9%	10.73	\$277,963			
OFF G2 Seattle	Seattle	Glazing B	19104	\$8.0	\$152,832	\$323,170	\$74,798	\$112,694	\$510,662	\$37,522,982	2.2%	10.19	\$708,576	1.0%	16.26	\$301,007			
OFF G3 Seattle	Seattle	SG-5	19104	\$6.7	\$127,997	\$323,296	\$74,999	\$106,554	\$504,849	\$37,072,752	3.3%	5.26	\$1,158,805	2.2%	5.51	\$751,236			
OFF G4 Seattle	Seattle	SG-6	19104	\$6.5	\$124,940	\$323,425	\$74,934	\$106,184	\$504,543	\$37,047,303	3.3%	4.99	\$1,184,255	2.2%	5.09	\$776,686			
OFF G5 Seattle	Seattle	SG-8	19104	\$6.8	\$129,907	\$324,013	\$75,357	\$104,898	\$504,268	\$37,032,145	3.4%	5.20	\$1,199,412	2.3%	5.40	\$791,843			
OFF G6 Seattle	Seattle	SG-12	19104	\$16.0	\$304,900	\$324,319	\$75,330	\$104,054	\$503,703	\$37,165,791	3.5%	14.65	\$1,065,766	2.4%	19.44	\$658,197			
OFF G0 WashDC	Washington DC	Single Clear	19104	\$2.0	\$38,208	\$285,615	\$93,769	\$148,443	\$527,827	\$38,664,489	-	-	-	-	-	-	-		
OFF G00 WashDC	Washington DC	Double Clear	19104	\$3.5	\$66,864	\$285,926	\$93,002	\$139,068	\$517,996	\$37,973,715	-	-	-	-	-	-	-		
OFF G1 WashDC	Washington DC	Glazing A	19104	\$6.0	\$114,624	\$283,747	\$91,314	\$137,701	\$512,762	\$37,638,452	2.9%	5.07	\$1,026,038	1.0%	9.12	\$335,263			
OFF G2 WashDC	Washington DC	Glazing B	19104	\$8.0	\$152,832	\$283,416	\$90,732	\$138,732	\$512,880	\$37,685,295	2.8%	7.67	\$979,195	1.0%	16.80	\$288,420			
OFF G3 WashDC	Washington DC	SG-5	19104	\$6.7	\$127,997	\$282,888	\$90,841	\$129,288	\$503,017	\$36,938,687	4.7%	3.62	\$1,725,802	2.9%	4.08	\$1,035,028			
OFF G4 WashDC	Washington DC	SG-6	19104	\$6.5	\$124,940	\$282,940	\$90,797	\$128,859	\$502,596	\$36,904,822	4.8%	3.44	\$1,759,668	3.0%	3.77	\$1,068,893			
OFF G5 WashDC	Washington DC	SG-8	19104	\$6.8	\$129,907	\$283,369	\$90,910	\$127,267	\$501,546	\$36,832,950	5.0%	3.49	\$1,831,539	3.2%	3.83	\$1,140,765			
OFF G6 WashDC	Washington DC	SG-12	19104	\$16.0	\$304,900	\$283,567	\$90,855	\$126,310	\$500,732	\$36,948,374	5.1%	9.84	\$1,716,115	3.3%	13.79	\$1,025,340			