2. Clark Center Glazing Option Analysis

Project Description

In 2001, the James H. Clark Center Project Team considered eight glazing options during the design process. Since glazing is a large part of the building exterior, this decision would have a large impact on both the aesthetics and the energy performance of the building.

Objectives

The goal of this study is to evaluate an improved glazing option.

LCCA Metrics and Criteria

The life cycle costs of the seven options were reviewed, and the one that best met the criteria was compared to the base case.

Alternatives to be Studied

The Project Team narrowed the selection to one option and the base case after considering the following criteria:

- First cost
- Energy performance (U-factor, solar heat gain coefficient [SHGC], and visible transmittance [VT])

Cost Information

The general contractor provided the cost of the two options. As shown in the table below and in detail in Appendix A, the base case (Glazing Option 1) had a first cost of $400,000 and the alternative (Glazing Option 2) a first cost of $517,000. Since the glazing had not yet been purchased, only the $117,000 incremental cost of the more expensive glazing was considered. (The installation and maintenance costs for both options were considered to be the same.) The project HVAC consultant adjusted the glazing characteristics in the energy modeling software to arrive at approximately $20,000 per year avoided energy cost with the alternative (Glazing Option 2).

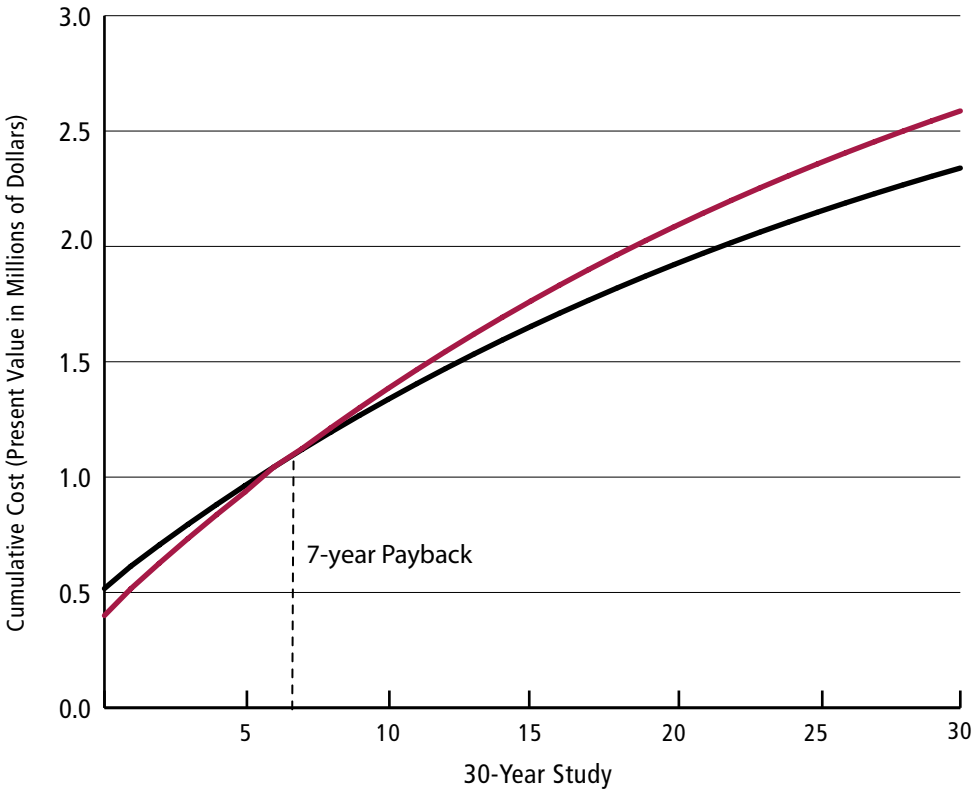
Life Cycle Cost Calculations – Payback Analysis

The LCCA showed that despite the $117,000 increase in first costs for the improved glazing, the avoided cost of approximately $20,000 per year in steam and chilled-water costs resulted in a payback of less than seven years. As a result, the alternative, Glazing Option 2, was selected.

Clark Center Glazing Options
First Cost and Energy Cost Summary by Alternative
(in dollars)

		Annual Utility Cost					
Alternatives	**First Cost**	**Electricity**	**Chilled Water**	**Steam**	**Total Utility Costs**	**Annual Energy Savings Against**	
Base Case (Option 1)	400,000	715,500	668,250	724,500	2,108,250		
Double Glazing (Option 2)	517,000	715,500	657,581	715,169	2,088,250	(20,000)	(2.21)%

Clark Center Glazing Options



APPENDIX A CLARK CENTER GLAZING STUDY – LCCA CALCULATIONS – OPTION 1

	NON-ANNUAL RECURRING COSTS						Electricity			Steam	
	Investment-Related Costs (e.g. 1st cost replacement, residual)			Operations-Related Costs (e.g. non-annual maintenance)							
Year #	Description of Cost	Constant	Discounted PV	Description of Cost	Constant	Discounted PV	Annual Recurring Electric Constant	Electric Differential Escalation %	Discounted Electric PV	Annual Recurring Steam Constant	Steam Differential Escalation %
0	First Cost	400,000	400,000	n/a	n/a	n/a	715,500	0.50%		724,500	0.50%
1		0	0		0	0	715,500	0.50%	688,772	724,500	0.50%
2		0	0		0	0	715,500	0.50%	663,042	724,500	0.50%
3		0	0		0	0	715,500	0.50%	638,273	724,500	0.50%
4		0	0		0	0	715,500	0.50%	614,429	724,500	0.50%
5		0	0		0	0	715,500	0.50%	591,476	724,500	0.50%
6		0	0		0	0	715,500	1.00%	572,214	724,500	1.00%
7		0	0		0	0	715,500	1.00%	553,578	724,500	1.00%
8		0	0		0	0	715,500	1.00%	535,550	724,500	1.00%
9		0	0		0	0	715,500	1.00%	518,109	724,500	1.00%
10		0	0		0	0	715,500	1.00%	501,236	724,500	1.00%
11		0	0		0	0	715,500	1.00%	484,912	724,500	1.00%
12		0	0		0	0	715,500	1.00%	469,120	724,500	1.00%
13		0	0		0	0	715,500	1.00%	453,842	724,500	1.00%
14		0	0		0	0	715,500	1.00%	439,061	724,500	1.00%
15		0	0		0	0	715,500	1.00%	424,763	724,500	1.00%
16		0	0		0	0	715,500	1.00%	410,929	724,500	1.00%
17		0	0		0	0	715,500	1.00%	397,547	724,500	1.00%
18		0	0		0	0	715,500	1.00%	384,600	724,500	1.00%
19		0	0		0	0	715,500	1.00%	372,074	724,500	1.00%
20		0	0		0	0	715,500	1.00%	359,957	724,500	1.00%
21		0	0		0	0	715,500	1.00%	348,234	724,500	1.00%
22		0	0		0	0	715,500	1.00%	336,893	724,500	1.00%
23		0	0		0	0	715,500	1.00%	325,922	724,500	1.00%
24		0	0		0	0	715,500	1.00%	315,307	724,500	1.00%
25		0	0		0	0	715,500	1.00%	305,039	724,500	1.00%
26		0	0		0	0	715,500	1.00%	295,104	724,500	1.00%
27		0	0		0	0	715,500	1.00%	285,494	724,500	1.00%
28		0	0		0	0	715,500	1.00%	276,196	724,500	1.00%
29		0	0		0	0	715,500	1.00%	267,201	724,500	1.00%
30		0	0		0	0	715,500	1.00%	258,499	724,500	1.00%
		400,000			**0**	**0**	**21,465,000**		**13,087,372**	**21,735,000**	

Assumptions: Analysis Month/Year: 4/2001 Years of Project Service: 30
Years before "On-Line": 0 Years in Analysis Period: 30 Disc. Rate: 4.4%

	Chilled Water			ANNUAL RECURRING COSTS		TOTAL COSTS			CUMULATIVE COSTS SAVINGS Payback		
Discounted Steam PV	Annual Recurring Chilled Water Constant	Chilled Water Differential Escalation %	Discounted Chilled Water PV	Annual Recurring (e.g. maintenance) Constant	Discounted Recurring PV	Year Date	Undiscounted Total Costs PV	Discounted Total Costs PV	Discounted Cumulative Costs PV	Discounted Cumulative Savings PV	Discounted Payback yrs
	668,250	0.50%		0			400,000	400,000	400,000	0	
697,435	668,250	0.50%	643,287	0	0	2001	2,118,791	2,029,494	2,429,494	0	
671,382	668,250	0.50%	619,256	0	0	2002	2,129,385	1,953,679	4,383,173	0	
646,301	668,250	0.50%	596,123	0	0	2003	2,140,032	1,880,697	6,263,870	0	
622,158	668,250	0.50%	573,854	0	0	2004	2,150,732	1,810,441	8,074,310	0	
598,916	668,250	0.50%	552,417	0	0	2005	2,161,486	1,742,810	9,817,120	0	
579,411	668,250	1.00%	534,426	0	0	2006	2,183,101	1,686,051	11,503,171	0	
560,542	668,250	1.00%	517,021	0	0	2007	2,204,932	1,631,142	13,134,313	0	
542,287	668,250	1.00%	500,184	0	0	2008	2,226,981	1,578,020	14,712,333	0	
524,626	668,250	1.00%	483,894	0	0	2009	2,249,251	1,526,629	16,238,962	0	
507,540	668,250	1.00%	468,135	0	0	2010	2,271,743	1,476,911	17,715,873	0	
491,011	668,250	1.00%	452,889	0	0	2011	2,294,461	1,428,812	19,144,685	0	
475,020	668,250	1.00%	438,140	0	0	2012	2,317,406	1,382,280	20,526,965	0	
459,550	668,250	1.00%	423,871	0	0	2013	2,340,580	1,337,263	21,864,228	0	
444,584	668,250	1.00%	410,067	0	0	2014	2,363,985	1,293,713	23,157,941	0	
430,105	668,250	1.00%	396,712	0	0	2015	2,387,625	1,251,580	24,409,521	0	
416,098	668,250	1.00%	383,792	0	0	2016	2,411,501	1,210,820	25,620,341	0	
402,547	668,250	1.00%	371,293	0	0	2017	2,435,616	1,171,387	26,791,728	0	
389,437	668,250	1.00%	359,202	0	0	2018	2,459,973	1,133,238	27,924,967	0	
376,755	668,250	1.00%	347,503	0	0	2019	2,484,572	1,096,332	29,021,299	0	
364,485	668,250	1.00%	336,186	0	0	2020	2,509,418	1,060,628	30,081,927	0	
352,615	668,250	1.00%	325,238	0	0	2021	2,534,512	1,026,086	31,108,013	0	
341,131	668,250	1.00%	314,646	0	0	2022	2,559,857	992,670	32,100,683	0	
330,021	668,250	1.00%	304,399	0	0	2023	2,585,456	960,341	33,061,024	0	
319,273	668,250	1.00%	294,485	0	0	2024	2,611,311	929,066	33,990,090	0	
308,876	668,250	1.00%	284,895	0	0	2025	2,637,424	898,809	34,888,899	0	
298,817	668,250	1.00%	275,616	0	0	2026	2,663,798	869,537	35,758,437	0	
289,085	668,250	1.00%	266,640	0	0	2027	2,690,436	841,219	36,599,656	0	
279,670	668,250	1.00%	257,957	0	0	2028	2,717,340	813,823	37,413,479	0	
270,562	668,250	1.00%	249,556	0	0	2029	2,744,514	787,319	38,200,799	0	
261,751	668,250	1.00%	241,429	0	0	2030	2,771,959	761,679	38,962,477	0	
13,251,993	**20,047,500**		**12,223,112**	**0**	**0**		**72,758,179**	**38,962,477**	**38,962,477**	**n/a**	

APPENDIX A CLARK CENTER GLAZING STUDY – LCCA CALCULATIONS – OPTION 2

NON-ANNUAL RECURRING COSTS							Electricity			Steam	
	Investment-Related Costs (e.g. 1st cost replacement, residual)			Operations-Related Costs (e.g. non-annual maintenance)			Annual Recurring Electric	Electric Differential Escalation	Discounted Electric	Annual Recurring Steam	Steam Differential Escalation
Year #	Description of Cost	Constant	Discounted PV	Description of Cost	Constant	Discounted PV	Constant	%	PV	Constant	%
0	First Cost	517,000	517,000	n/a	n/a	n/a	715,500	0.50%		715,169	0.50%
1		0	0		0	0	715,500	0.50%	688,772	715,169	0.50%
2		0	0		0	0	715,500	0.50%	663,042	715,169	0.50%
3		0	0		0	0	715,500	0.50%	638,273	715,169	0.50%
4		0	0		0	0	715,500	0.50%	614,429	715,169	0.50%
5		0	0		0	0	715,500	0.50%	591,476	715,169	0.50%
6		0	0		0	0	715,500	1.00%	572,214	715,169	1.00%
7		0	0		0	0	715,500	1.00%	553,578	715,169	1.00%
8		0	0		0	0	715,500	1.00%	535,550	715,169	1.00%
9		0	0		0	0	715,500	1.00%	518,109	715,169	1.00%
10		0	0		0	0	715,500	1.00%	501,236	715,169	1.00%
11		0	0		0	0	715,500	1.00%	484,912	715,169	1.00%
12		0	0		0	0	715,500	1.00%	469,120	715,169	1.00%
13		0	0		0	0	715,500	1.00%	453,842	715,169	1.00%
14		0	0		0	0	715,500	1.00%	439,061	715,169	1.00%
15		0	0		0	0	715,500	1.00%	424,763	715,169	1.00%
16		0	0		0	0	715,500	1.00%	410,929	715,169	1.00%
17		0	0		0	0	715,500	1.00%	397,547	715,169	1.00%
18		0	0		0	0	715,500	1.00%	384,600	715,169	1.00%
19		0	0		0	0	715,500	1.00%	372,074	715,169	1.00%
20		0	0		0	0	715,500	1.00%	359,957	715,169	1.00%
21		0	0		0	0	715,500	1.00%	348,234	715,169	1.00%
22		0	0		0	0	715,500	1.00%	336,893	715,169	1.00%
23		0	0		0	0	715,500	1.00%	325,922	715,169	1.00%
24		0	0		0	0	715,500	1.00%	315,307	715,169	1.00%
25		0	0		0	0	715,500	1.00%	305,039	715,169	1.00%
26		0	0		0	0	715,500	1.00%	295,104	715,169	1.00%
27		0	0		0	0	715,500	1.00%	285,494	715,169	1.00%
28		0	0		0	0	715,500	1.00%	276,196	715,169	1.00%
29		0	0		0	0	715,500	1.00%	267,201	715,169	1.00%
30		0	0		0	0	715,500	1.00%	258,499	715,169	1.00%
		517,000			**0**	**0**	**21,465,000**		**13,087,372**	**21,455,070**	

Assumptions: Analysis Month/Year: 4/2001 Years of Project Service: 30
Years before "On-Line": 0 Years in Analysis Period: 30 Disc. Rate: 4.4%

	Chilled Water			ANNUAL RECURRING COSTS		TOTAL COSTS			CUMULATIVE COSTS	SAVINGS	Payback
Discounted Steam PV	Annual Recurring Chilled Water Constant	Chilled Water Differential Escalation %	Discounted Chilled Water PV	Annual Recurring (e.g. maintenance) Constant	Discounted Recurring PV	Year Date	Undiscounted Total Costs PV	Discounted Total Costs PV	Discounted Cumulative Costs PV	Discounted Cumulative Savings PV	Discounted Payback yrs
	657,581	0.50%		0			517,000	517,000	517,000	(117,000)	
688,453	657,581	0.50%	633,016	0	0	2001	1,437,822	2,010,241	2,527,241	(97,747)	
662,735	657,581	0.50%	609,369	0	0	2002	1,445,011	1,935,145	4,462,386	(79,213)	
637,978	657,581	0.50%	586,605	0	0	2003	1,452,237	1,862,856	6,325,242	(61,372)	
614,145	657,581	0.50%	564,692	0	0	2004	1,459,498	1,793,266	8,118,508	(44,197)	
591,203	657,581	0.50%	543,597	0	0	2005	1,466,795	1,726,276	9,844,784	(27,664)	
571,949	657,581	1.00%	525,894	0	0	2006	1,481,463	1,670,057	11,514,841	(11,669)	
553,322	657,581	1.00%	508,767	0	0	2007	1,496,278	1,615,668	13,130,508	3,805	6.8
535,302	657,581	1.00%	492,198	0	0	2008	1,511,241	1,563,050	14,693,559	18,775	
517,869	657,581	1.00%	476,168	0	0	2009	1,526,353	1,512,146	16,205,705	33,257	
501,004	657,581	1.00%	460,661	0	0	2010	1,541,616	1,462,900	17,668,605	47,268	
484,687	657,581	1.00%	445,659	0	0	2011	1,557,033	1,415,258	19,083,863	60,822	
468,903	657,581	1.00%	431,145	0	0	2012	1,572,603	1,369,167	20,453,030	73,935	
453,632	657,581	1.00%	417,104	0	0	2013	1,588,329	1,324,577	21,777,607	86,621	
438,858	657,581	1.00%	403,520	0	0	2014	1,604,212	1,281,440	23,059,047	98,894	
424,566	657,581	1.00%	390,378	0	0	2015	1,620,254	1,239,707	24,298,754	110,767	
410,739	657,581	1.00%	377,665	0	0	2016	1,636,457	1,199,333	25,498,087	122,254	
397,363	657,581	1.00%	365,366	0	0	2017	1,652,822	1,160,275	26,658,362	133,366	
384,422	657,581	1.00%	353,467	0	0	2018	1,669,350	1,122,488	27,780,850	144,117	
371,902	657,581	1.00%	341,955	0	0	2019	1,686,043	1,085,932	28,866,782	154,517	
359,790	657,581	1.00%	330,819	0	0	2020	1,702,904	1,050,566	29,917,348	164,579	
348,073	657,581	1.00%	320,045	0	0	2021	1,719,933	1,016,352	30,933,700	174,313	
336,737	657,581	1.00%	309,622	0	0	2022	1,737,132	983,253	31,916,953	183,730	
325,771	657,581	1.00%	299,539	0	0	2023	1,754,503	951,231	32,868,184	192,840	
315,161	657,581	1.00%	289,784	0	0	2024	1,772,048	920,252	33,788,437	201,654	
304,898	657,581	1.00%	280,346	0	0	2025	1,789,769	890,282	34,678,719	210,180	
294,968	657,581	1.00%	271,216	0	0	2026	1,807,667	861,289	35,540,008	218,429	
285,362	657,581	1.00%	262,383	0	0	2027	1,825,743	833,239	36,373,247	226,410	
276,068	657,581	1.00%	253,838	0	0	2028	1,844,001	806,103	37,179,349	234,130	
267,078	657,581	1.00%	245,572	0	0	2029	1,862,441	779,850	37,959,200	241,599	
258,380	657,581	1.00%	237,574	0	0	2030	1,881,065	754,453	38,713,653	248,825	
13,081,318	**19,727,430**		**12,027,963**	**0**	**0**		**49,619,622**	**38,713,653**	**38,713,653**	**n/a**	**6.8**