



The expected life of the chiller and cooling tower, which will cost \$220,000, is 20 years. A major overhaul (\$90,000) of the chiller is expected to occur in year ten. Annual costs for preventative maintenance (\$1,400), labor (\$10,000), water (\$2,000) and chemical treatments (\$1,800) are all expected to keep pace with inflation, which is expected to average 3% annually over the study period. The annual electric cost (\$18,750) is expected to increase at a rate of 5% per year. The municipality uses a discount rate of 8% to evaluate financial decisions. Assuming a study period of 20 years, which option has the lowest life-cycle cost?

The tables shown compare the two alternatives. Note that for Alternative 1, the only cost is for the chilled water contract. The cost in year two, \$66,881, is 2.5% higher than in year one to account for inflation. To determine the present value of the year

two payment, the discount rate of 8% is used per the given formula  $[F/(1+i)^n = P]$  or  $\$66,881/(1+0.08)^2 = \$57,340$ . The present values of the other payments are calculated in a similar manner.

Alternative 2 includes the immediate (year zero) cost of purchasing and installing the chiller, as well as the cost of energy and maintenance, and the major plant renovation required in year 10. The present value of each payment is calculated using the discount rate as above.

For the values provided, alternative 1 has a 20-year life-cycle cost of \$769,283 and Alternative 2 has a 20-year life-cycle cost of \$717,100. Therefore, Alternative 2 is the more attractive option in this example.

*Alternative 2: Install chiller and tower*

	Year										
	0	1	2	3	4	5	6	7	8	9	10
First costs	\$220,000	\$-	\$-	\$-	\$-	\$-	\$-	\$-	\$-	\$-	\$-
Energy costs		\$18,750	\$19,688	\$20,672	\$21,705	\$22,791	\$23,930	\$25,127	\$26,383	\$27,702	\$29,087
Replacement costs		\$-	\$-	\$-	\$-	\$-	\$-	\$-	\$-	\$-	\$90,000
Maintenance costs		\$15,200	\$15,656	\$16,126	\$16,609	\$17,108	\$17,621	\$18,150	\$18,694	\$19,255	\$19,833
Net Annual Cash Flow	\$220,000	\$33,950	\$35,344	\$36,798	\$38,315	\$39,898	\$41,551	\$43,276	\$45,077	\$46,957	\$138,920
Present Value of Cash Flow	\$220,000	\$31,435	\$30,301	\$29,211	\$28,163	\$27,154	\$26,184	\$25,251	\$24,354	\$23,490	\$64,347
						Year					
		11	12	13	14	15	16	17	18	19	20
First costs											
Energy costs		\$30,542	\$32,069	\$33,672	\$35,356	\$37,124	\$38,980	\$40,929	\$42,975	\$45,124	\$47,380
Replacement costs											
Maintenance costs		\$20,428	\$21,040	\$21,672	\$22,322	\$22,991	\$23,681	\$24,392	\$25,123	\$25,877	\$26,653
Net Annual Cash Flow		\$50,969	\$53,109	\$55,344	\$57,678	\$60,115	\$62,661	\$65,320	\$68,099	\$71,001	\$74,034
Present Value of Cash Flow		\$21,860	\$21,090	\$20,350	\$19,637	\$18,951	\$18,290	\$17,654	\$17,042	\$16,452	\$15,884
20-year Life Cycle Cost:	\$717,100										

**Some available resources for LCCA:**

ASHRAE: [www.ashrae.org/lifecycle](http://www.ashrae.org/lifecycle)

NIST Office of Applied Economics: [www.bfrl.nist.gov/oea/oea.html](http://www.bfrl.nist.gov/oea/oea.html)

ACTIVE ASTM STANDARD: E2204-05 Standard Guide for Summarizing the Economic Impacts of Building-Related Projects  
[www.astm.org/cgi-bin/SoftCart.exe/DATABASE.CART/REDLINE\\_PAGES/E917.htm?L+mystore+s](http://www.astm.org/cgi-bin/SoftCart.exe/DATABASE.CART/REDLINE_PAGES/E917.htm?L+mystore+s)

ACTIVE ASTM STANDARD: E917-05 Standard Practice for Measuring Life-Cycle Costs of Buildings and Building Systems  
[www.astm.org/cgi-bin/SoftCart.exe/DATABASE.CART/REDLINE\\_PAGES/E2204.htm?L+mystore+s](http://www.astm.org/cgi-bin/SoftCart.exe/DATABASE.CART/REDLINE_PAGES/E2204.htm?L+mystore+s)

Current volume of ASTM building standards:

[www.astm.org/cgi-bin/SoftCart.exe/BOOKSTORE/COMPS/198.htm?L+mystore+s+1191620252](http://www.astm.org/cgi-bin/SoftCart.exe/BOOKSTORE/COMPS/198.htm?L+mystore+s+1191620252)



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