

2028 FTPP 1700 Ton Chiller Replacement FTPP						
Cooling	Qty.	Capacity (Each)	Total Capacity	Units	Unit Estimate	Total Estimate
1700 Ton Chiller with VFD's (Equipment)	1	1,700	1,700	tons	\$ 376	\$ 639,200
Chw Plant Pumps with VFD's - 3400 gpm, 115ft head	1	160	160	hp	\$ 448	\$ 71,680
Condenser Water Pumps with VFD's - 5100 gpm, 75 ft head	1	160	160	hp	\$ 448	\$ 71,680
Chiller Demolition	1	1,100	1,100	tons	\$ 13	\$ 14,300
Pump Demolition	1	200	200	hp	\$ 28	\$ 5,567
Auxiliary Equipment	1	1,700	1,700	tons	\$ 48	\$ 81,600
CHW Piping to Header (14")	1	100	100	ft	\$ 270	\$ 27,000
CW Piping to Header (16")	1	100	100	ft	\$ 300	\$ 30,000
Gear Relocation	1	1	1	N/A	\$ 200,000	\$ 200,000
Controls	Qty.	Capacity (Each)	Total Capacity	Units	Unit Estimate	Total Estimate
Chiller Controls	1	30	30	pt.	\$ 2,000	\$ 60,000
Pump Controls	1	6	6	pt.	\$ 1,740	\$ 10,437
Cooling Tower Controls	1	8	8	pt.	\$ 1,740	\$ 13,916
Electrical Controls	1	30	30	pt.	\$ 1,740	\$ 52,186
Soft Costs & Contingencies				Cost	Sub-Total	Total Estimate
General Conditions				2.0%	\$ 25,551	\$ 1,303,118
Design Contingency (10%)				10%	\$ 127,757	\$ 1,430,874
Construction Contingency (10%)				10%	\$ 127,757	\$ 1,558,631
<b>Total with Contingencies</b>						<b>\$ 1,558,631</b>
Design & CA				8%	\$ 124,690	\$ 1,683,322
Construction Management				5%	\$ 77,932	\$ 1,761,253
Commissioning				2.0%	\$ 31,173	\$ 1,792,426
Start-up & TAB				2.0%	\$ 31,173	\$ 1,823,598
<b>Total with Contingencies &amp; Professional Services</b>						<b>\$ 1,823,598</b>

\* Costs are estimates of probable construction cost and are estimated in 2017 dollars.

**APPENDIX E**  
**LIFE CYCLE COST ANALYSIS**

Life Cycle Cost Analysis (LCCA)												
Base Case - Central Steam												
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026		
	0	1	2	3	4	5	6	7	8	9		
Capital Investments												
Initial Cost / Payments	\$0	\$16,455,350	\$7,290,287	\$10,478,146	\$4,160,271	\$5,814,307	\$23,544,096	\$8,374,291	\$4,500,780	\$5,904,624		
O&M - Annually Recurring Costs												
Boiler Maintenance	\$71,910	\$73,708	\$77,168	\$79,097	\$81,966	\$84,015	\$96,282	\$99,842	\$103,198	\$105,939		
Chiller Maintenance	\$77,925	\$79,873	\$83,417	\$85,502	\$89,092	\$91,319	\$104,347	\$108,427	\$112,433	\$115,487		
Utility Costs												
Natural Gas	\$348,046	\$382,531	\$438,284	\$488,779	\$500,990	\$507,410	\$582,408	\$610,271	\$637,249	\$664,974		
Electricity	\$2,828,208	\$2,864,569	\$3,059,832	\$3,325,780	\$3,474,176	\$3,767,336	\$4,075,791	\$4,168,887	\$4,384,757	\$4,557,140		
<b>Total Base Case Operating Expense</b>	<b>\$3,376,089</b>	<b>\$19,856,031</b>	<b>\$10,948,987</b>	<b>\$14,457,304</b>	<b>\$8,306,495</b>	<b>\$10,264,388</b>	<b>\$28,402,924</b>	<b>\$13,361,718</b>	<b>\$9,738,417</b>	<b>\$11,348,164</b>		
<b>Option 1 - Local Heating</b>												
Capital Investments												
Initial Cost / Payments	\$0	\$12,247,725	\$6,429,825	\$8,751,890	\$3,311,439	\$3,468,898	\$20,447,714	\$6,473,583	\$3,261,665	\$4,253,627		
O&M - Annually Recurring Costs												
Boiler Maintenance	\$107,865	\$110,562	\$115,751	\$118,645	\$122,949	\$126,023	\$144,423	\$149,763	\$154,797	\$158,908		
Chiller Maintenance	\$77,925	\$79,873	\$83,417	\$85,502	\$89,092	\$91,319	\$104,347	\$108,427	\$112,433	\$115,487		
Utility Costs												
Natural Gas	\$313,241	\$344,278	\$394,455	\$439,901	\$450,891	\$456,669	\$524,167	\$549,244	\$573,524	\$598,476		
Electricity	\$2,828,208	\$2,864,569	\$3,059,832	\$3,325,780	\$3,474,176	\$3,767,336	\$4,075,791	\$4,168,887	\$4,384,757	\$4,557,140		
<b>Total Option 1 Operating Expense</b>	<b>\$3,327,239</b>	<b>\$15,647,007</b>	<b>\$10,083,281</b>	<b>\$12,721,719</b>	<b>\$7,448,547</b>	<b>\$7,910,245</b>	<b>\$25,296,443</b>	<b>\$11,449,903</b>	<b>\$8,487,175</b>	<b>\$9,683,639</b>		
<b>Option 2 - Central HHW</b>												
Capital Investments												
Initial Cost / Payments	\$0	\$2,825,925	\$9,496,599	\$8,644,201	\$3,210,992	\$3,062,722	\$37,279,505	\$11,888,046	\$10,658,589	\$3,395,658		
O&M - Annually Recurring Costs												
Boiler Maintenance	\$64,719	\$66,337	\$69,451	\$71,187	\$73,770	\$75,614	\$86,654	\$89,858	\$92,878	\$95,345		
Chiller Maintenance	\$77,925	\$79,873	\$83,417	\$85,502	\$89,092	\$91,319	\$104,347	\$108,427	\$112,433	\$115,487		
Utility Costs												
Natural Gas	\$313,241	\$344,278	\$394,455	\$439,901	\$450,891	\$456,669	\$524,167	\$549,244	\$573,524	\$598,476		
Electricity	\$2,828,208	\$2,864,569	\$3,059,832	\$3,325,780	\$3,474,176	\$3,767,336	\$4,075,791	\$4,168,887	\$4,384,757	\$4,557,140		
<b>Total Option 2 Operating Expense</b>	<b>\$3,284,093</b>	<b>\$6,180,982</b>	<b>\$13,103,755</b>	<b>\$12,566,572</b>	<b>\$7,298,920</b>	<b>\$7,453,660</b>	<b>\$42,070,464</b>	<b>\$16,804,462</b>	<b>\$15,822,180</b>	<b>\$8,762,107</b>		
<b>Option 3 - Central/Local Heating Combination</b>												
Capital Investments												
Initial Cost / Payments	\$0	\$6,147,950	\$7,068,605	\$11,809,183	\$4,152,544	\$9,294,518	\$5,051,625	\$5,444,181	\$7,240,968	\$4,247,383		
O&M - Annually Recurring Costs												
Boiler Maintenance	\$74,028	\$75,879	\$79,440	\$81,426	\$84,380	\$86,490	\$99,118	\$102,782	\$106,237	\$109,059		
Chiller Maintenance	\$66,793	\$68,463	\$71,500	\$73,288	\$76,365	\$78,274	\$89,441	\$92,937	\$96,371	\$98,988		
Utility Costs												
Natural Gas	\$345,958	\$380,236	\$435,654	\$485,846	\$497,984	\$504,366	\$578,913	\$606,610	\$633,426	\$660,984		
Electricity	\$2,966,618	\$3,004,817	\$3,209,673	\$3,488,658	\$3,644,353	\$3,951,976	\$4,275,769	\$4,373,467	\$4,599,956	\$4,780,804		
<b>Total Option 3 Operating Expense</b>	<b>\$3,453,397</b>	<b>\$9,677,344</b>	<b>\$10,864,872</b>	<b>\$15,938,401</b>	<b>\$8,455,625</b>	<b>\$13,915,623</b>	<b>\$10,094,865</b>	<b>\$10,619,977</b>	<b>\$12,676,958</b>	<b>\$9,897,219</b>		

Life Cycle Cost Analysis (LCCA)												
Base Case - Central Steam	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036		
	10	11	12	13	14	15	16	17	18	19		
Capital Investments												
Initial Cost / Payments	\$8,824,903	\$1,131,019	\$1,104,154	\$897,411	\$991,908	\$3,358,603	\$5,601,040	\$3,986,640	\$756,434	\$856,876		
O&M - Annually Recurring Costs												
Boiler Maintenance	\$108,587	\$122,476	\$126,805	\$130,920	\$134,370	\$137,729	\$153,442	\$158,670	\$163,674	\$167,961		
Chiller Maintenance	\$118,374	\$133,152	\$138,099	\$142,976	\$146,818	\$150,489	\$167,241	\$173,200	\$179,096	\$183,867		
Utility Costs												
Natural Gas	\$690,824	\$787,885	\$823,832	\$854,396	\$883,839	\$905,104	\$1,001,173	\$1,031,663	\$1,069,443	\$1,093,106		
Electricity	\$4,822,821	\$5,206,155	\$5,414,622	\$5,581,695	\$5,701,048	\$5,868,627	\$6,206,701	\$6,319,867	\$6,464,675	\$6,622,966		
<b>Total Base Case Operating Expense</b>	<b>\$14,565,509</b>	<b>\$7,380,686</b>	<b>\$7,607,511</b>	<b>\$7,607,397</b>	<b>\$7,857,983</b>	<b>\$10,420,551</b>	<b>\$13,129,598</b>	<b>\$11,670,040</b>	<b>\$8,633,323</b>	<b>\$8,924,776</b>		
<b>Option 1 - Local Heating</b>	<b>2027</b>	<b>2028</b>	<b>2029</b>	<b>2030</b>	<b>2031</b>	<b>2032</b>	<b>2033</b>	<b>2034</b>	<b>2035</b>	<b>2036</b>		
Capital Investments												
Initial Cost / Payments	\$7,576,820	\$1,134,955	\$983,114	\$838,135	\$892,999	\$3,358,603	\$4,909,260	\$3,848,173	\$689,369	\$744,971		
O&M - Annually Recurring Costs												
Boiler Maintenance	\$162,881	\$183,714	\$190,207	\$196,379	\$201,555	\$206,593	\$230,164	\$238,005	\$245,511	\$251,941		
Chiller Maintenance	\$118,374	\$133,152	\$138,099	\$142,976	\$146,818	\$150,489	\$167,241	\$173,200	\$179,096	\$183,867		
Utility Costs												
Natural Gas	\$621,742	\$709,096	\$741,448	\$768,956	\$795,455	\$814,593	\$901,056	\$928,497	\$962,499	\$983,795		
Electricity	\$4,822,821	\$5,206,155	\$5,414,622	\$5,581,695	\$5,701,048	\$5,868,627	\$6,206,701	\$6,319,867	\$6,464,675	\$6,622,966		
<b>Total Option 1 Operating Expense</b>	<b>\$13,302,638</b>	<b>\$7,367,072</b>	<b>\$7,467,490</b>	<b>\$7,528,141</b>	<b>\$7,737,876</b>	<b>\$10,398,905</b>	<b>\$12,414,422</b>	<b>\$11,507,742</b>	<b>\$8,541,150</b>	<b>\$8,787,540</b>		
<b>Option 2 - Central HHW</b>	<b>2027</b>	<b>2028</b>	<b>2029</b>	<b>2030</b>	<b>2031</b>	<b>2032</b>	<b>2033</b>	<b>2034</b>	<b>2035</b>	<b>2036</b>		
Capital Investments												
Initial Cost / Payments	\$7,775,234	\$1,537,766	\$1,020,771	\$853,298	\$938,215	\$3,358,603	\$6,374,467	\$3,892,300	\$706,525	\$796,128		
O&M - Annually Recurring Costs												
Boiler Maintenance	\$97,729	\$110,228	\$114,124	\$117,828	\$120,933	\$123,956	\$138,098	\$142,803	\$147,307	\$151,165		
Chiller Maintenance	\$118,374	\$133,152	\$138,099	\$142,976	\$146,818	\$150,489	\$167,241	\$173,200	\$179,096	\$183,867		
Utility Costs												
Natural Gas	\$621,742	\$709,096	\$741,448	\$768,956	\$795,455	\$814,593	\$901,056	\$928,497	\$962,499	\$983,795		
Electricity	\$4,822,821	\$5,206,155	\$5,414,622	\$5,581,695	\$5,701,048	\$5,868,627	\$6,206,701	\$6,319,867	\$6,464,675	\$6,622,966		
<b>Total Option 2 Operating Expense</b>	<b>\$13,435,899</b>	<b>\$7,696,397</b>	<b>\$7,429,064</b>	<b>\$7,464,753</b>	<b>\$7,702,469</b>	<b>\$10,316,268</b>	<b>\$13,787,564</b>	<b>\$11,456,666</b>	<b>\$8,460,102</b>	<b>\$8,737,921</b>		
<b>Option 3 - Central/Local Heating Combination</b>												
Capital Investments												
Initial Cost / Payments	\$5,431,399	\$6,319,009	\$759,862	\$709,933	\$727,682	\$776,288	\$4,710,336	\$1,547,486	\$544,321	\$557,929		
O&M - Annually Recurring Costs												
Boiler Maintenance	\$111,785	\$126,083	\$130,539	\$134,775	\$138,327	\$141,785	\$157,961	\$163,343	\$168,494	\$172,907		
Chiller Maintenance	\$101,463	\$114,131	\$118,370	\$122,551	\$125,844	\$128,990	\$143,350	\$148,457	\$153,511	\$157,601		
Utility Costs												
Natural Gas	\$686,680	\$783,157	\$818,889	\$849,269	\$878,536	\$899,673	\$995,166	\$1,025,473	\$1,063,027	\$1,086,547		
Electricity	\$5,059,646	\$5,462,030	\$5,680,779	\$5,856,090	\$5,981,316	\$6,157,253	\$6,512,175	\$6,630,945	\$6,782,905	\$6,948,993		
<b>Total Option 3 Operating Expense</b>	<b>\$11,390,973</b>	<b>\$12,804,410</b>	<b>\$7,508,439</b>	<b>\$7,672,619</b>	<b>\$7,851,705</b>	<b>\$8,103,989</b>	<b>\$12,518,988</b>	<b>\$9,515,703</b>	<b>\$8,712,258</b>	<b>\$8,923,976</b>		