

**Attachment #1**

	Case 1: Design Heating Requirement=78000 BTU/hr		Case 2: Design Heating Requirement=132000 BTU/hr		Ref #
	Non-condensing	Condensing	Non-condensing	Condensing	
Boiler Type					
Boiler AFUE	82.0	90.0	82.0	90.0	1
Boiler Gross Output (BTU/hr)	78000	80000	132000	135000	1
Initial Cost To Consumer:					
Boiler	1626	3164	2007	3690	3
Labor & Other Materials	1549	4061	1549	4061	4
Total	3175	7225	3556	7751	2
Incremental Cost of Condensing Boiler		4050		4195	
Annual Fuel Usage (Ef)(MMBTU/yr)	97	88.3	156	142	1A
Annual Electrical Usage (EAE) (kW-hr/year)	71	189	66	182	1A
Average Cost of Natural Gas (\$/Therm)	1.1011	1.1011	1.1011	1.1011	5
Average Cost of Electricity (\$/kW-hr)	0.1165	0.1165	0.1165	0.1165	5
Heating Load Hours (hr)	2250	2250	2250	2250	6
Design Heating Requirement (BTU/hr)	78000	78000	132000	132000	7
Rated Design Heating Requirement (BTU/hr)	50000	50000	80000	80000	8
Adjustment Factor	1.6875	1.6875	1.7849	1.7849	9
EAFU (MMBTU/yr)	163.6875	149.00625	278.4375	253.449519	10
EAEU (kW-hr/yr)	119.8125	318.9375	117.8005	324.8438	11
Annual Fuel cost	1802.36	1640.71	3065.88	2790.73	12
Annual Electrical Cost	13.96	37.16	13.72	37.84	12
Total Energy Cost	1816.32	1677.86	3079.60	2828.58	
Annual Energy Savings over Non-Condensing Boiler		138.46		251.02	
<b>Payback Period Before Maintenance/Depreciation(years)</b>		<b>29.3</b>		<b>16.7</b>	
Boiler Life Expectancy (years)	35	15	35	15	13
Depreciation Cost	46.46	210.93	57.34	246.00	
Annual Maintenance	66.67	200.00	66.67	200.00	14
Total Annual Operating cost	1929.45	2088.80	3203.61	3274.58	
<b>Payback Period After Maintenance/Depreciation(years)</b>		<b>-25.4</b>		<b>-59.1</b>	

**References**

1) Representative boilers having Federal minimum and Energy Star ver 2.0 AFUE levels.

1A) Based on 100W PE for condensing boiler and 40W PE for non-condensing boiler. Also based on 93W BE for condensing boiler and 29W BE for non-condensing boiler. Condensing boiler has an inducer and also a higher head pump, which explains the higher electrical consumption.

2) Installed costs for smaller boilers is averaged value provided by three contractors in the northeastern US. Installed costs for larger boilers are based on assumption that "labor and other material" cost is independent of boiler size. Installed cost for larger boilers is therefore calculated using same "labor and other material" costs as for smaller boilers and adding homeowner's cost for boiler (3)

3) Boiler cost to homeowner calculated by applying standard discounts to trade ("list") price and then applying typical mark-ups for wholesaler and contractor.

4) For smaller boilers: Reference (2) - Reference (3). For larger boilers: assumed same as for smaller boiler.

5) Representative Average Unit Costs of Energy, 3/10/11 Federal Register.

6) January 1, 2010 GAMA Directory, Chapter 1, Figure 1 (Mid Atlantic Region)

7) Smaller Gross Output for each pair of boilers

8) January 1, 2010 GAMA Directory, Chapter 1, Table 1

9) January 1, 2010 GAMA Directory, Chapter 1, Procedure for Estimating the Annual Heating Requirements and Comparing the Cost of Operation of Different Models, Step 5

10) January 1, 2010 GAMA Directory, Chapter 1, Procedure for Estimating the Annual Heating Requirements and Comparing the Cost of Operation of Different Models, Step 6

11) January 1, 2010 GAMA Directory, Chapter 1, Procedure for Estimating the Annual Heating Requirements and Comparing the Cost of Operation of Different Models, Step 7

12) January 1, 2010 GAMA Directory, Chapter 1, Procedure for Estimating the Annual Heating Requirements and Comparing the Cost of Operation of Different Models, Step 8

13) For non-condensing boilers - Median life expectancy for cast iron boilers from 1995 AHSRAE Applications Handbook, Chapter 33, Table 3. Life expectancy for condensing boilers based on discussions with various European boiler manufacturers. The latter value can be confirmed by inspection of warranties for various condensing boilers.

14) Assumes one annual \$200 service/maintenance visit for the condensing boiler and a similar visit for the non-condensing boiler every three years. Relative maintenance costs will probably be higher for the condensing boiler.