

**APPENDIX 7-A. DETAILED NATIONAL ENERGY SAVINGS AND NATIONAL NET
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7-A.1 INTRODUCTION

Appendix 7-A contains detailed output results from the National Energy Savings/National Economic Impact spreadsheet model. Results are presented for each equipment class in terms of cumulative energy savings (source) and cumulative net present value at each trial standard level and at a national level.

See Chapter 7 for an explanation of the figures in this appendix

7-A.2 NATIONAL ENERGY SAVINGS AND NATIONAL NET PRESENT VALUE RESULTS CALCULATED FROM THE MARKET BASELINE

Tables 7-A.1 through 7-A.3 show the national energy savings and national net present value results from the NIA spreadsheet as calculated above the market baseline. As discussed in chapter 7, the subtraction of the impacts benefits from adoption of standards consistent with the ASHRAE 90.1-2007 levels in 2012 (impacts calculated from the market baseline) from the impacts benefits determined for adoption of higher standards (also calculated from the market baseline) allows determination of the net impacts for adoption of higher standards when compared with the adoption of standards at the ASHRAE 90.1-2007 baseline.

Table 7-A.1 Cumulative National Energy Savings for Commercial Boiler Equipment (2012-2042) (Quadrillion Btu) by Equipment Class

Equipment Class	Level 0 (ASHRAE)*	Level 1	Level 2	Level 3	Level 4
Small, Gas-fired, Hot Water	0.013	0.035	0.085	0.153	0.225
Small, Gas-fired, Steam, All Except natural Draft	0.001	0.001	0.015	0.030	0.046
Small, Gas-fired, Steam, Natural Draft	0.038	0.032	0.054	0.080	na
Small, Oil-fired, Hot Water	0.010	0.025	0.044	0.066	na
Small, Oil-fired, Steam	0.005	0.014	0.031	0.073	na
Large, Gas-fired, Hot Water	0.006	0.020	0.043	0.067	0.182
Large, Gas-fired, Steam, All Except Natural Draft	0.004	0.025	0.066	0.108	0.151
Large, Gas-fired, Steam, Natural Draft	0.029	0.007	0.031	0.061	0.096
Large, Gas-fired, Hot Water	0.000	0.014	0.024	0.034	na
Large, Oil-fired, Steam	0.000	0.039	0.106	0.198	0.410

* 0.000 indicates savings are less than 0.0005 quadrillion Btu. na means that this efficiency level was not available for analysis

**Table 7-A.2 Cumulative NPV Results Based on a Seven Percent Discount Rate
(Billion 2008\$) by Equipment Class**

Equipment Class	Level 0 (ASHRAE)*	Level 1	Level 2	Level 3	Level 4
Small, Gas-fired, Hot Water	\$0.046	\$0.031	\$0.034	(\$0.124)	(\$0.504)
Small, Gas-fired, Steam, All Except natural Draft	\$0.002	(\$0.036)	(\$0.039)	(\$0.080)	(\$0.112)
Small, Gas-fired, Steam, Natural Draft	\$0.041	\$0.004	\$0.025	\$0.013	na
Small, Oil-fired, Hot Water	\$0.038	\$0.030	\$0.037	(\$0.004)	na
Small, Oil-fired, Steam	\$0.018	(\$0.013)	(\$0.023)	(\$0.069)	na
Large, Gas-fired, Hot Water	\$0.020	\$0.031	\$0.047	\$0.022	(\$0.076)
Large, Gas-fired, Steam, All Except Natural Draft	\$0.012	\$0.039	\$0.139	\$0.237	\$0.333
Large, Gas-fired, Steam, Natural Draft	\$0.062	\$0.009	\$0.041	\$0.050	\$0.018
Large, Gas-fired, Hot Water	\$0.037	\$0.079	\$0.109	\$0.100	na
Large, Oil-fired, Steam	\$0.000	\$0.062	\$0.183	\$0.247	\$0.501

* 0.000 indicates savings are less than \$0.0005 billion. na means that this efficiency level was not available for analysis. Negative values shown in parentheses.

**Table 7-A.3 Cumulative NPV Results based on a Three percent Discount Rate
(Billion 2008\$) by Equipment Class**

Equipment Class	Level 0 (ASHRAE)*	Level 1	Level 2	Level 3	Level 4
Small, Gas-fired, Hot Water	\$0.156	\$0.233	\$0.426	\$0.291	(\$0.377)
Small, Gas-fired, Steam, All Except natural Draft	\$0.007	(\$0.069)	(\$0.007)	(\$0.029)	(\$0.046)
Small, Gas-fired, Steam, Natural Draft	\$0.270	\$0.171	\$0.311	\$0.394	NA
Small, Oil-fired, Hot Water	\$0.117	\$0.170	\$0.253	\$0.236	NA
Small, Oil-fired, Steam	\$0.056	\$0.033	\$0.069	\$0.101	NA
Large, Gas-fired, Hot Water	\$0.068	\$0.161	\$0.289	\$0.324	\$0.540
Large, Gas-fired, Steam, All Except Natural Draft	\$0.041	\$0.207	\$0.616	\$1.024	\$1.431
Large, Gas-fired, Steam, Natural Draft	\$0.311	\$0.054	\$0.230	\$0.387	\$0.484
Large, Gas-fired, Hot Water	\$0.071	\$0.216	\$0.313	\$0.332	NA
Large, Oil-fired, Steam	\$0.000	\$0.302	\$0.829	\$1.324	\$2.692

* 0.000 indicates savings are less than \$0.0005 billion. na means that this efficiency level was not available for analysis. Negative values shown in parentheses.

7-A.3 DETAILED NATIONAL ENERGY SAVINGS AND NATIONAL NET VALUE RESULTS GRAPHICS

Figures 7-A.1 through 7-A.92 show the cumulative national energy savings and national net present value results at both seven percent and three percent discount rates as well as show the annual operating cost savings and annual equipment costs (shown as negative savings) for each year from 2012-2085 for each efficiency level treated as a potential standard level. The results shown here represent the impacts for adoption of boiler standards higher than the levels specified in ASHRAE 90.1-2007.

7-A.3.1 SMALL GAS-FIRED HOT WATER BOILER

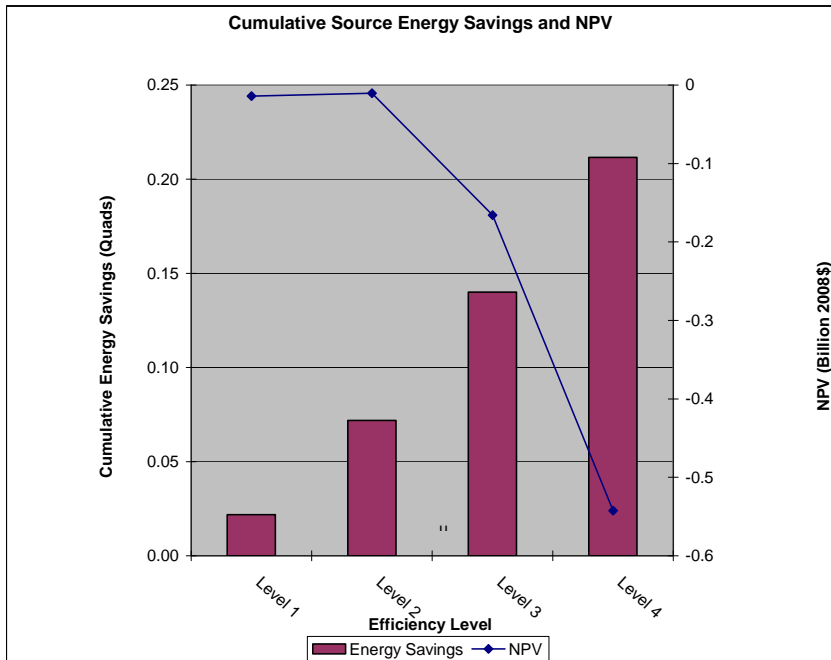


Figure 7-A. 1 Cumulative NPV Results for Small, Gas-fired, Hot Water Based on a Seven-Percent Discount Rate (Billion 2008\$)

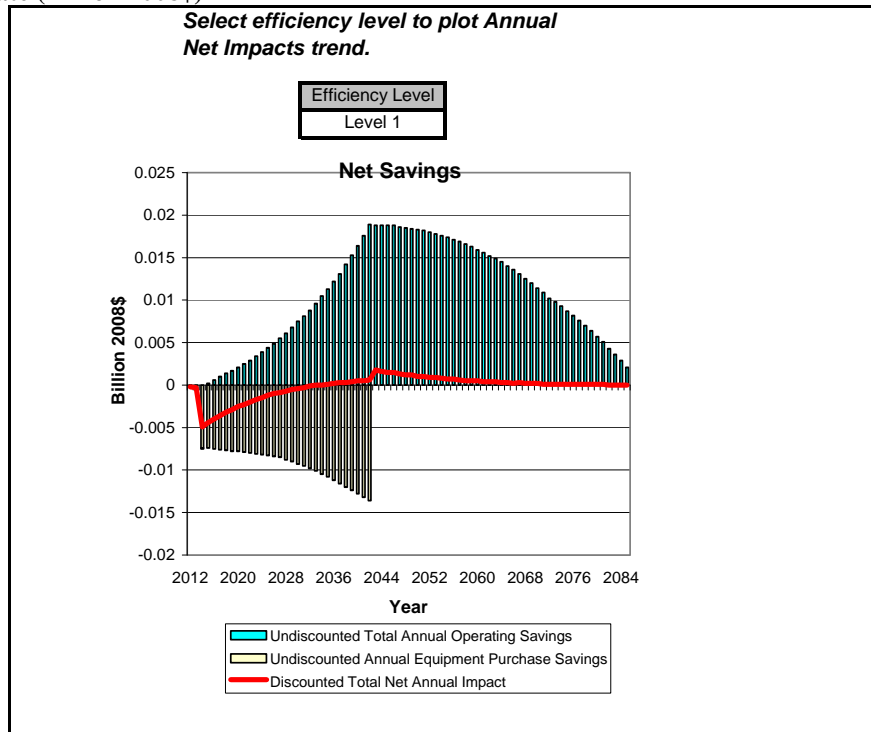


Figure 7-A. 2 National Annual Costs and Savings for Small, Gas-fired, Hot Water, Level 1, Seven-Percent Discount Rate

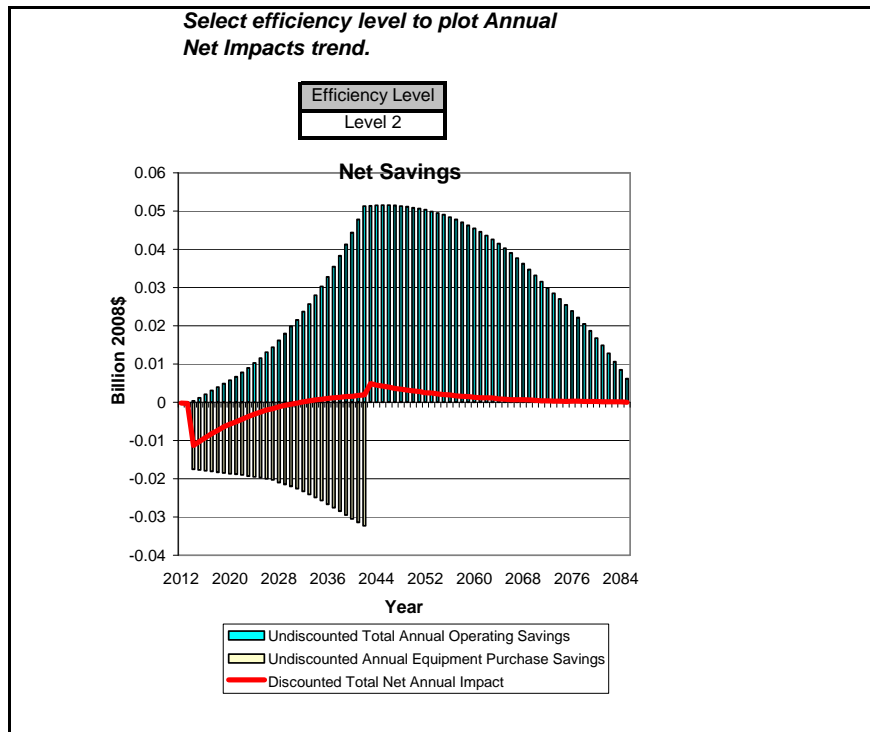


Figure 7-A. 3 National Annual Costs and Savings for Small, Gas-fired, Hot Water, Level 2, Seven-Percent Discount Rate

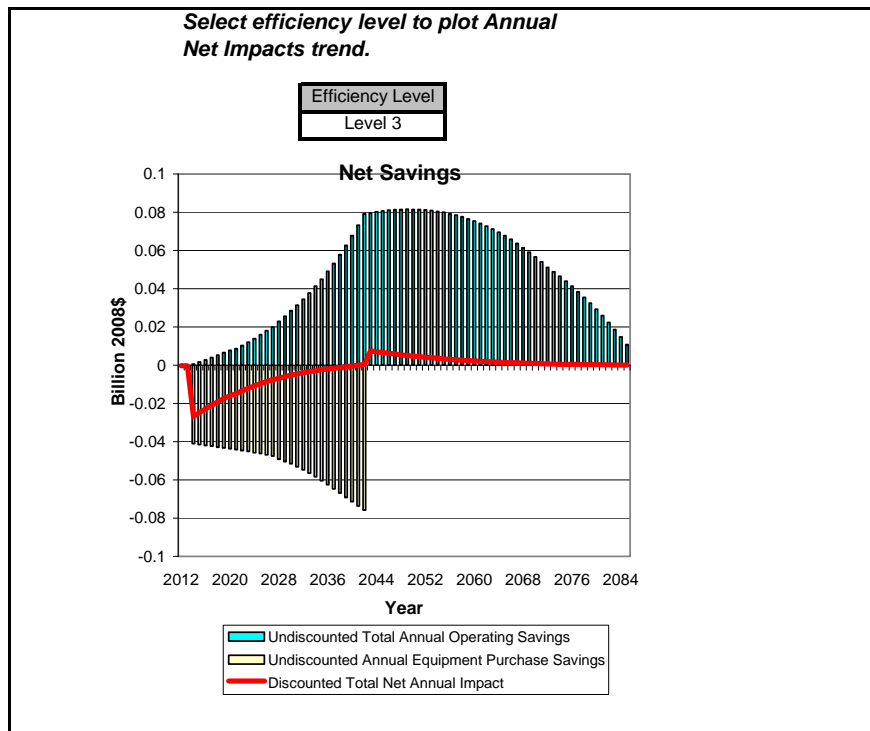


Figure 7-A. 4 National Annual Costs and Savings for Small, Gas-fired, Hot Water, Level 3, Seven-Percent Discount Rate

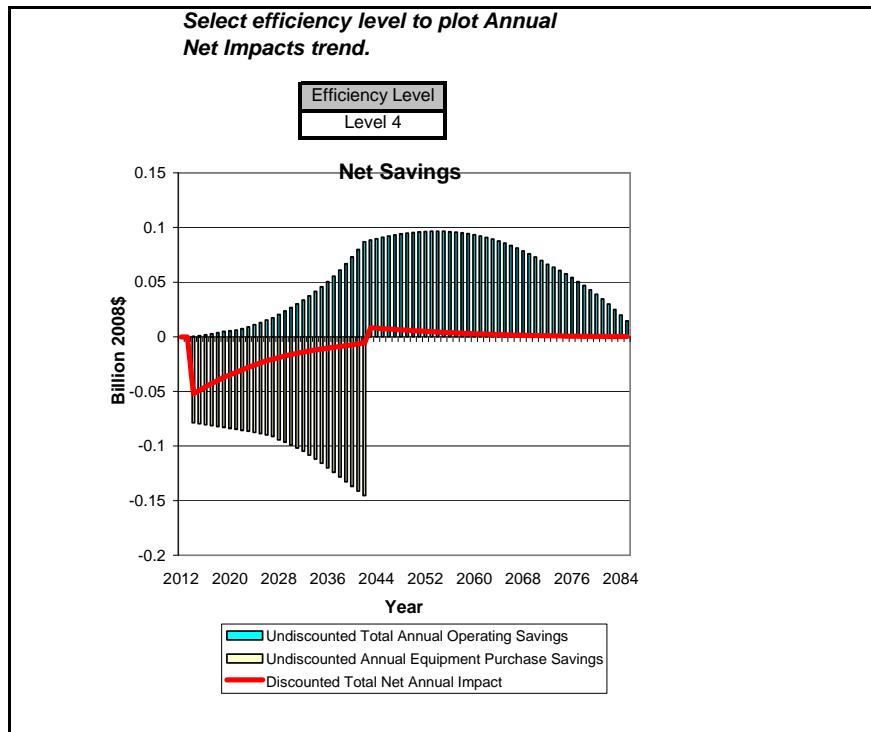


Figure 7-A. 5 National Annual Costs and Savings for Small, Gas-fired, Hot Water, Level 4, Seven-Percent Discount Rate

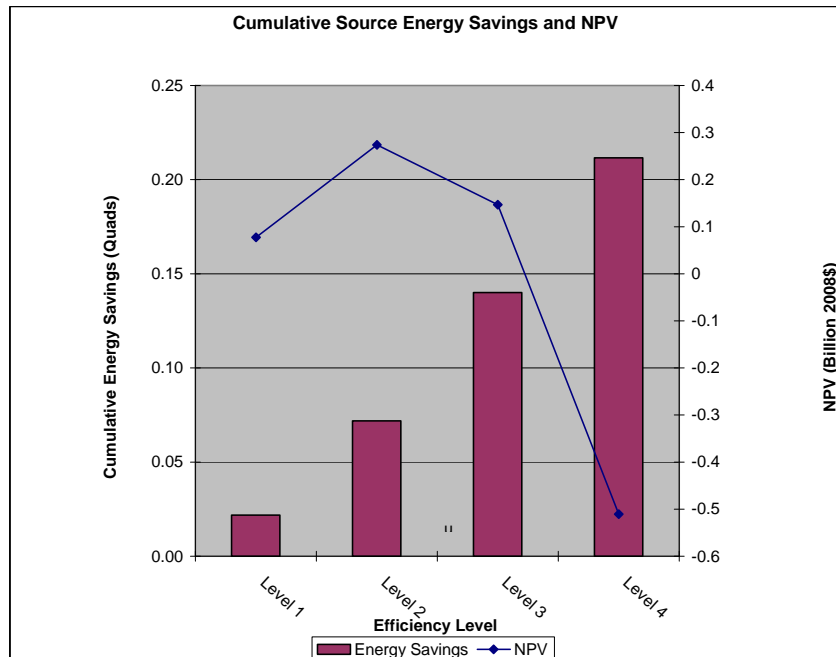


Figure 7-A. 6 Cumulative NPV Results for Small, Gas-fired, Hot Water Based on a Three-Percent Discount Rate (Billion 2008\$)

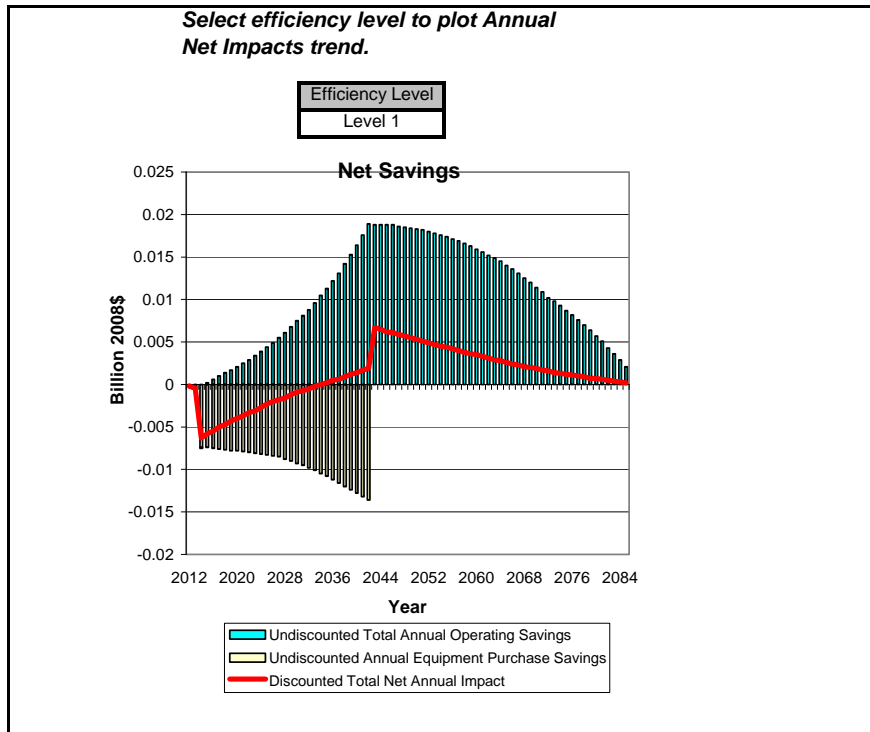


Figure 7-A. 7 National Annual Costs and Savings for Small, Gas-fired, Hot Water, Level 1, Three-Percent Discount Rate

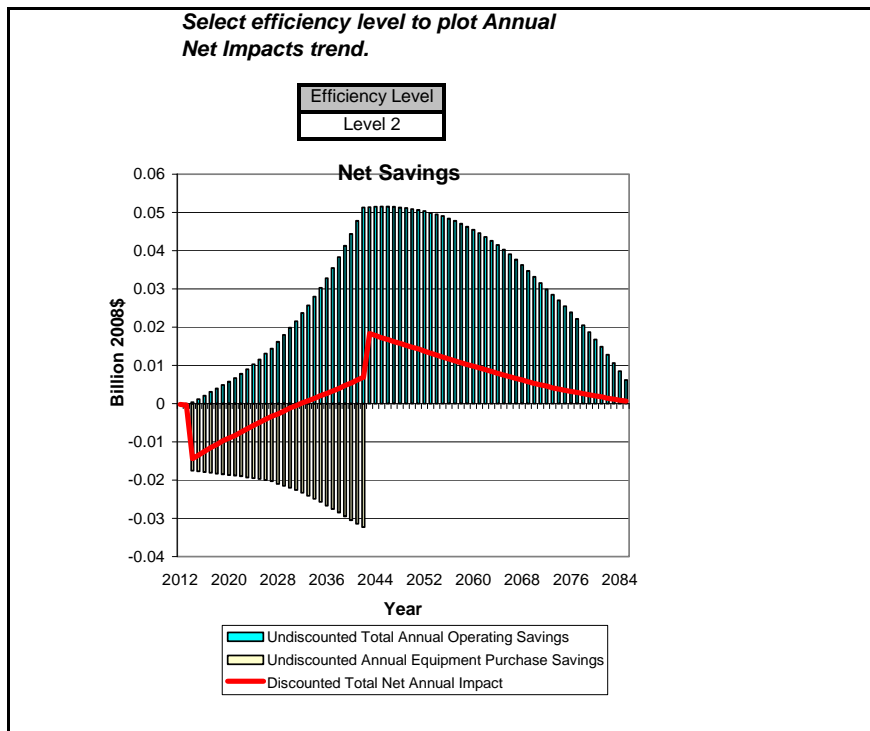


Figure 7-A. 8 National Annual Costs and Savings for Small, Gas-fired, Hot Water, Level 2, Three-Percent Discount Rate

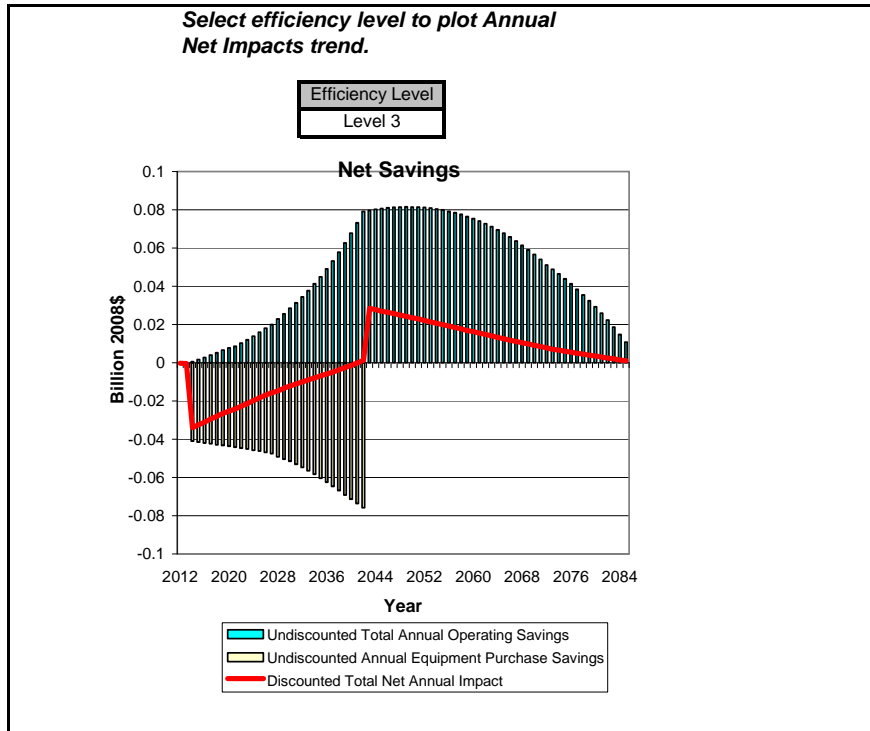


Figure 7-A. 9 National Annual Costs and Savings for Small, Gas-fired, Hot Water, Level 3, Three-Percent Discount Rate

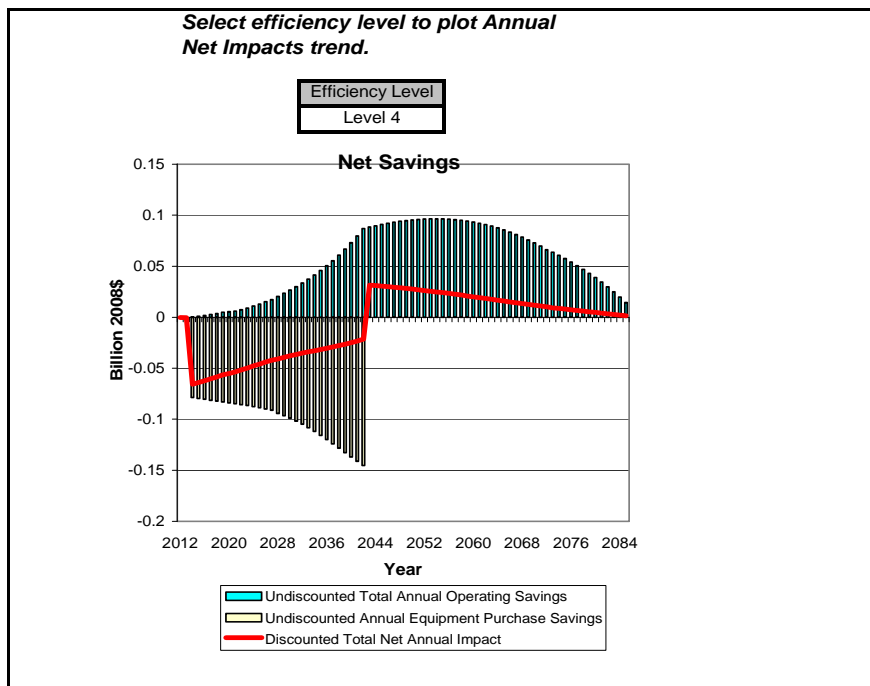


Figure 7-A. 10 National Annual Costs and Savings for Small, Gas-fired, Hot Water, Level 4, Three-Percent Discount Rate

7-A.3.2 SMALL GAS-FIRED STEAM ALL EXCEPT NATURAL DRAFT BOILER

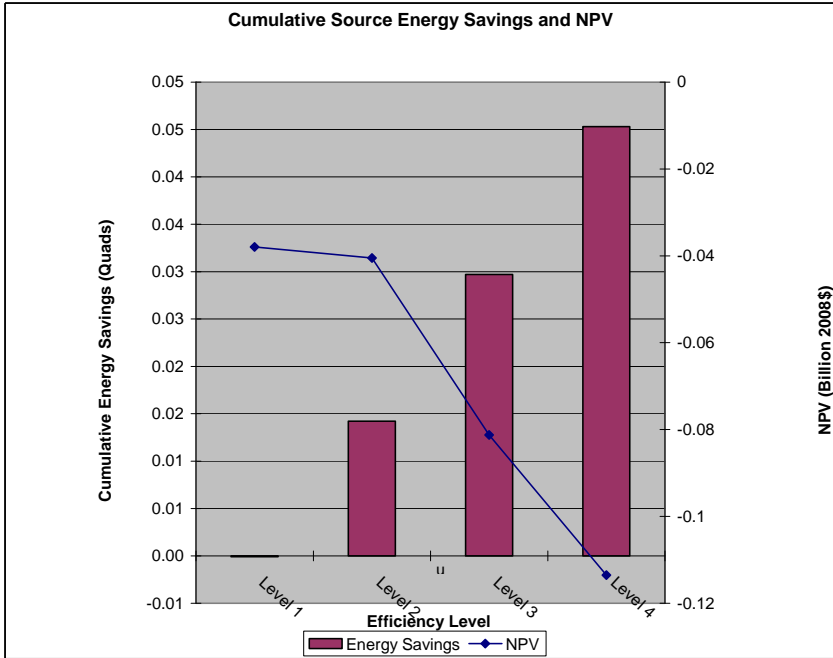


Figure 7-A. 11 Cumulative NPV Results for Small, Gas-fired, Steam, All Except natural Draft Based on a Seven-Percent Discount Rate (Billion 2008\$)

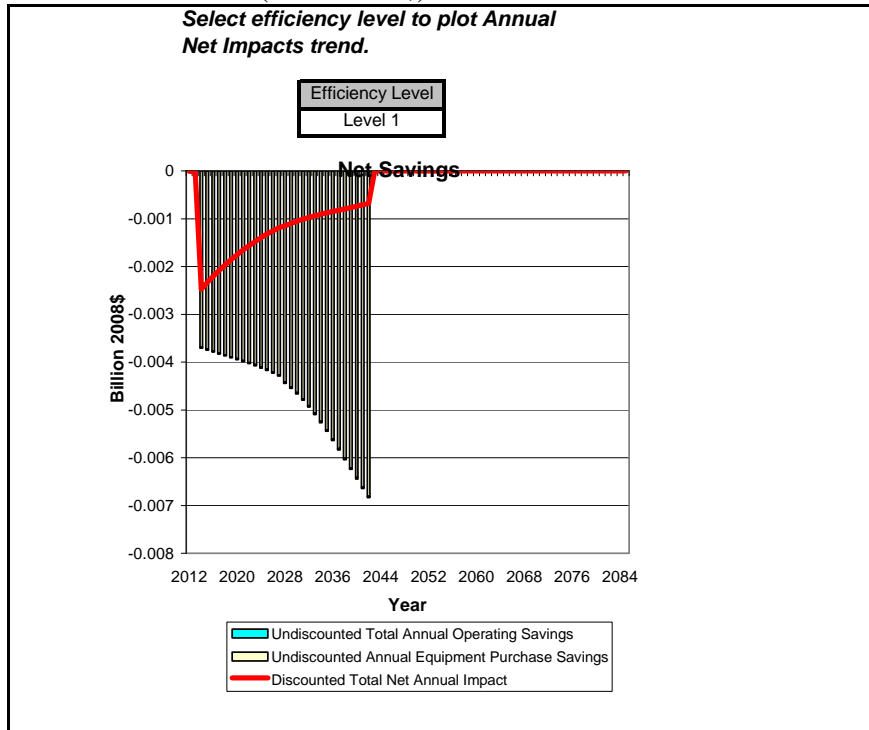


Figure 7-A. 12 National Annual Costs and Savings for Small, Gas-fired, Steam, All Except natural Draft, Level 1, Seven-Percent Discount Rate

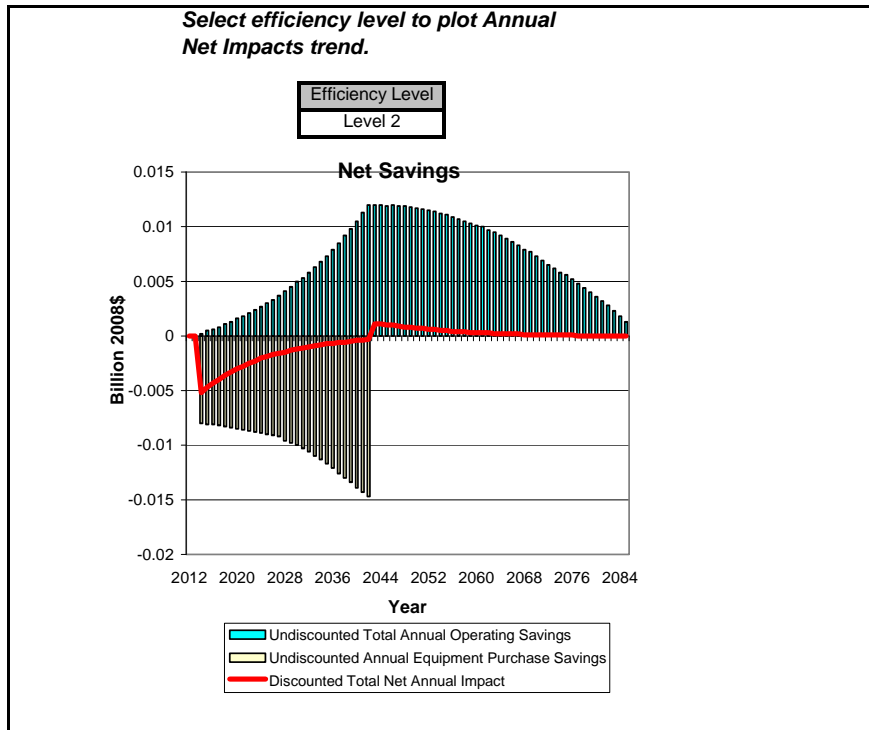


Figure 7-A. 13 National Annual Costs and Savings for Small, Gas-fired, Steam, All Except natural Draft, Level 2, Seven-Percent Discount Rate

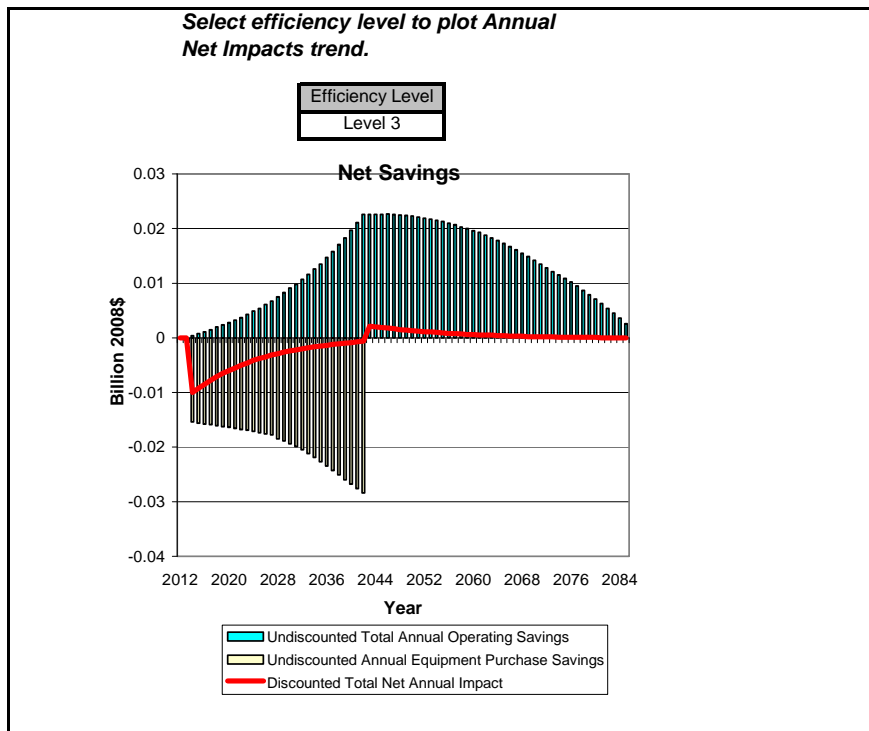


Figure 7-A. 14 National Annual Costs and Savings for Small, Gas-fired, Steam, All Except natural Draft, Level 3, Seven-Percent Discount Rate

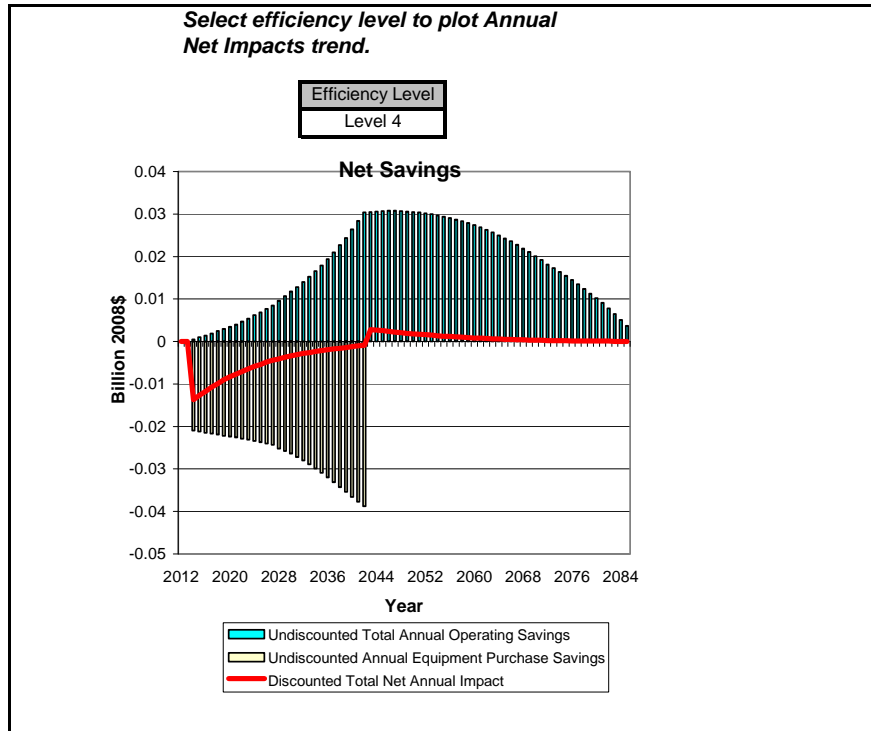


Figure 7-A. 15 National Annual Costs and Savings for Small, Gas-fired, Steam, All Except natural Draft, Level 4, Seven-Percent Discount Rate

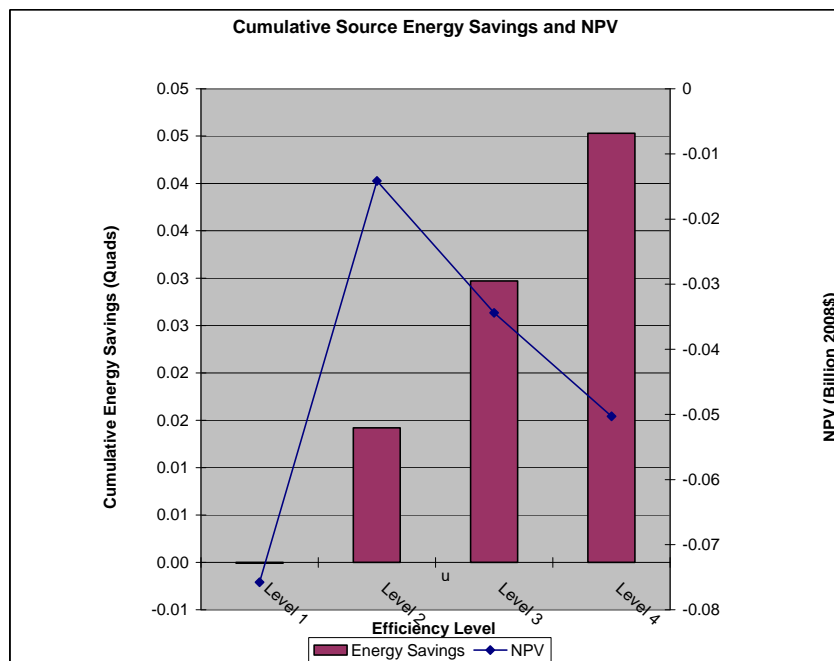


Figure 7-A. 16 Cumulative NPV Results for Small, Gas-fired, Steam, All Except natural Draft Based on a Three-Percent Discount Rate (Billion 2008\$)

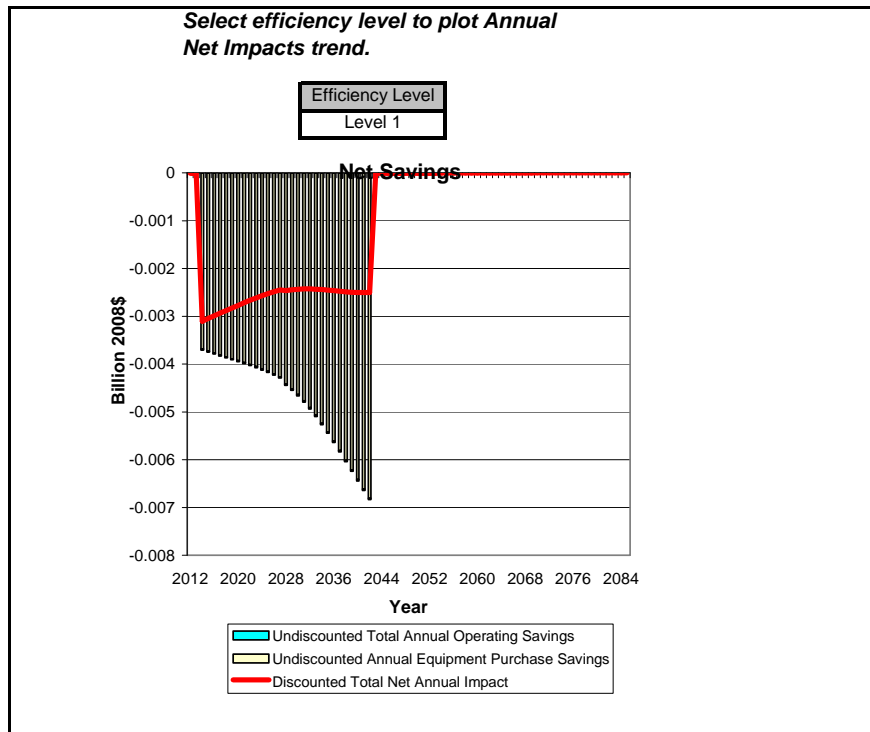


Figure 7-A. 17 National Annual Costs and Savings for Small, Gas-fired, Steam, All Except natural Draft, Level 1, Three-Percent Discount Rate

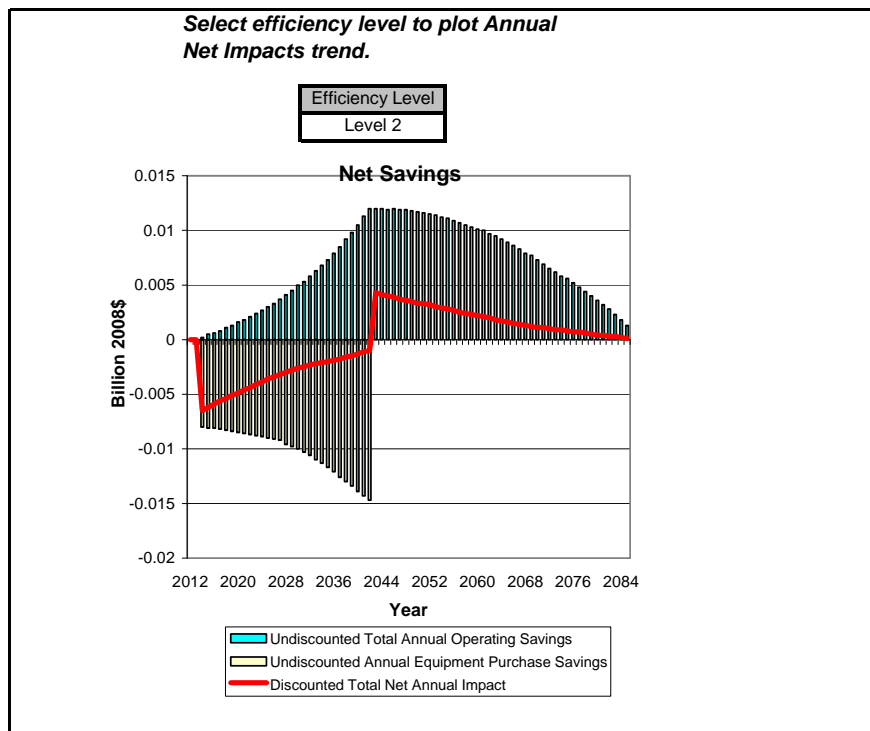


Figure 7-A. 18 National Annual Costs and Savings for Small, Gas-fired, Steam, All Except natural Draft, Level 2, Three-Percent Discount Rate

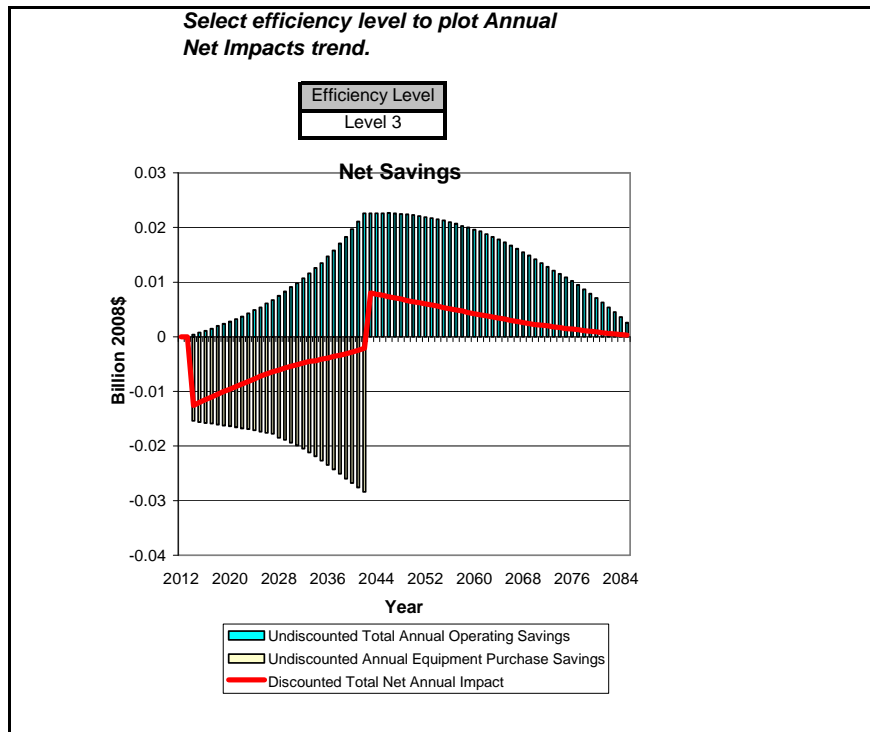


Figure 7-A. 19 National Annual Costs and Savings for Small, Gas-fired, Steam, All Except natural Draft, Level 3, Three-Percent Discount Rate

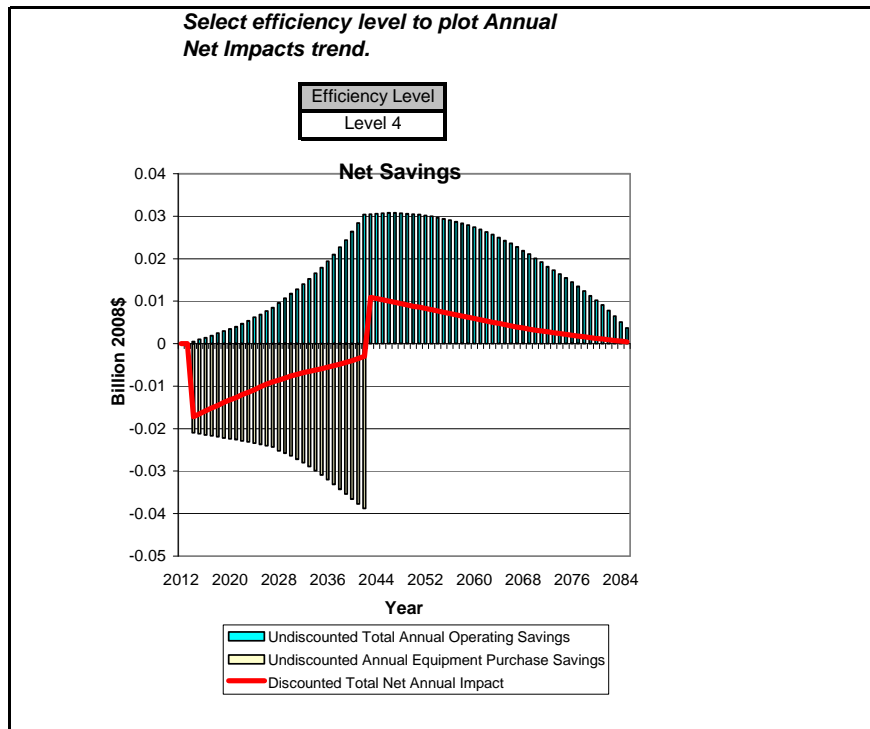


Figure 7-A. 20 National Annual Costs and Savings for Small, Gas-fired, Steam, All Except natural Draft, Level 4, Three-Percent Discount Rate

7-A.3.3 SMALL GAS-FIRED STEAM NATURAL DRAFT BOILER

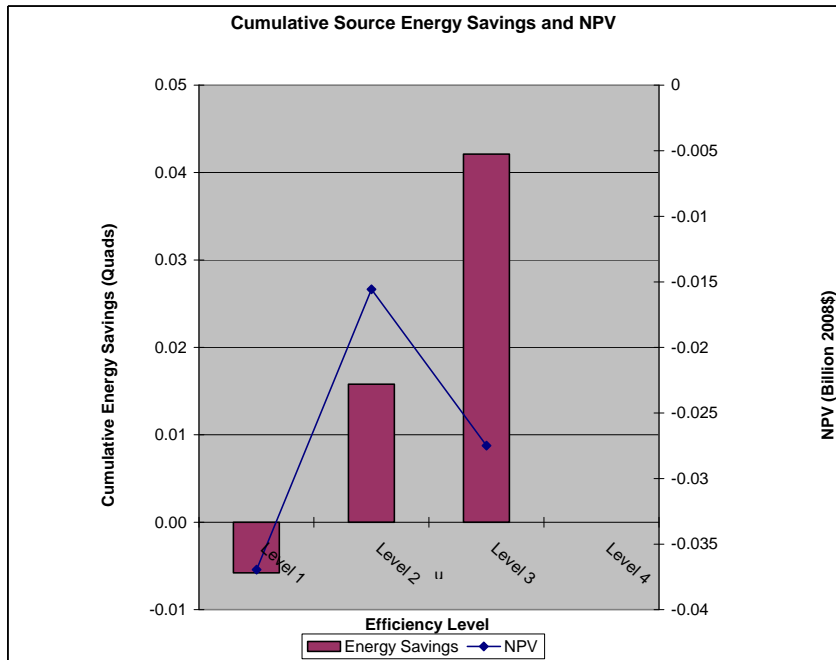


Figure 7-A. 21 Cumulative NPV Results for Small, Gas-fired, Steam, Natural Draft Based on a Seven-Percent Discount Rate (Billion 2008\$)

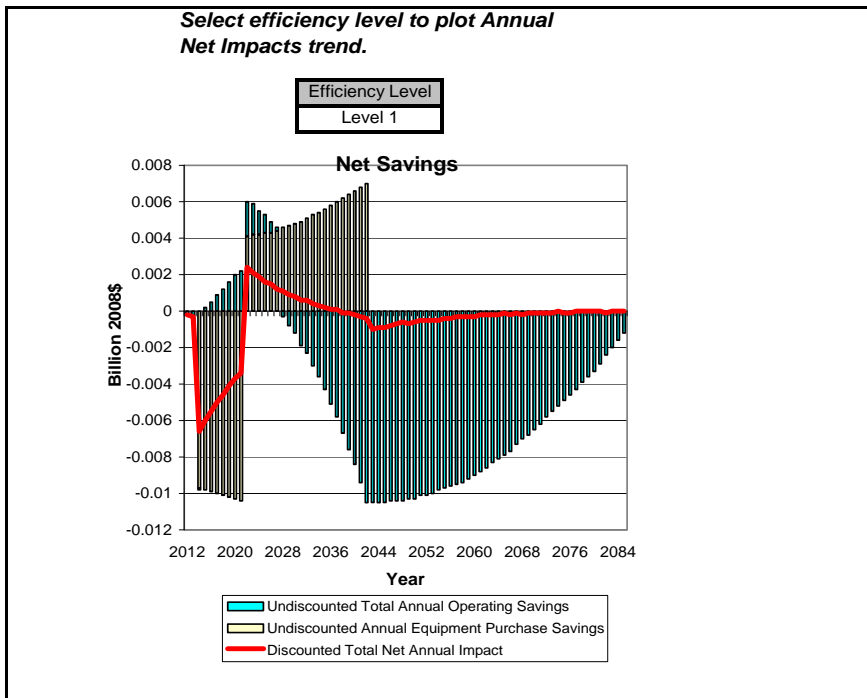


Figure 7-A. 22 National Annual Costs and Savings for Small, Gas-fired, Steam, Natural Draft, Level 1, Seven-Percent Discount Rate

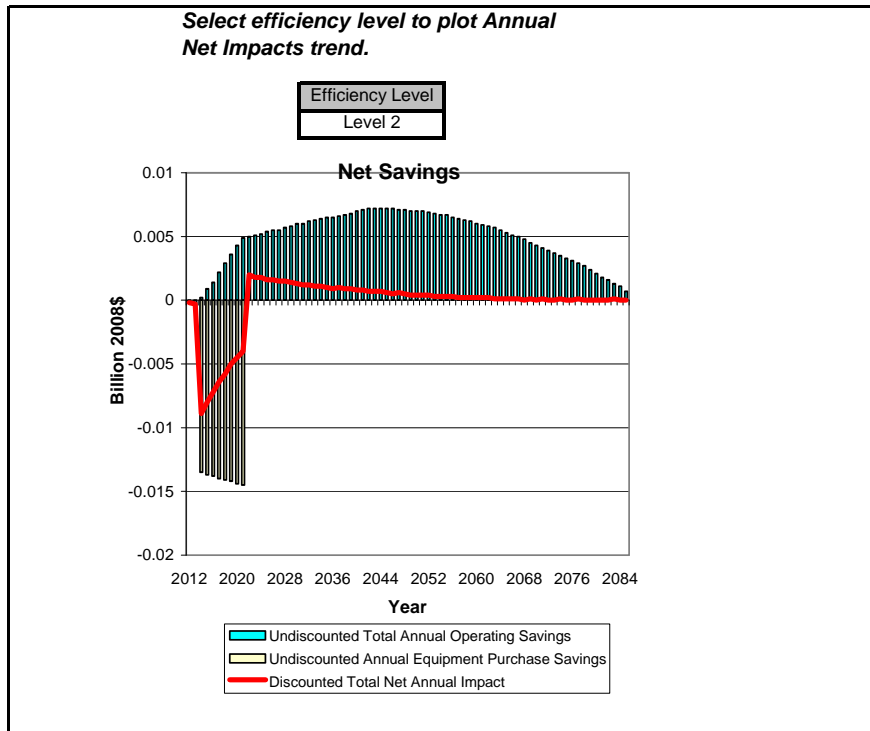


Figure 7-A. 23 National Annual Costs and Savings for Small, Gas-fired, Steam, Natural Draft, Level 2, Seven-Percent Discount Rate

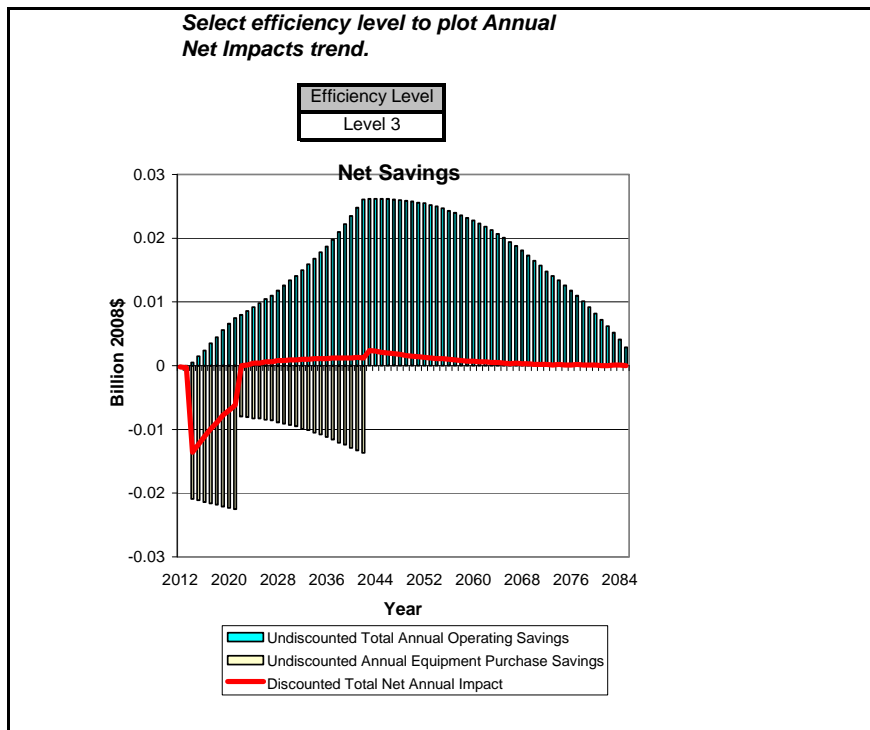


Figure 7-A. 24 National Annual Costs and Savings for Small, Gas-fired, Steam, Natural Draft, Level 3, Seven-Percent Discount Rate

Note: There is no Level 4 for this product class

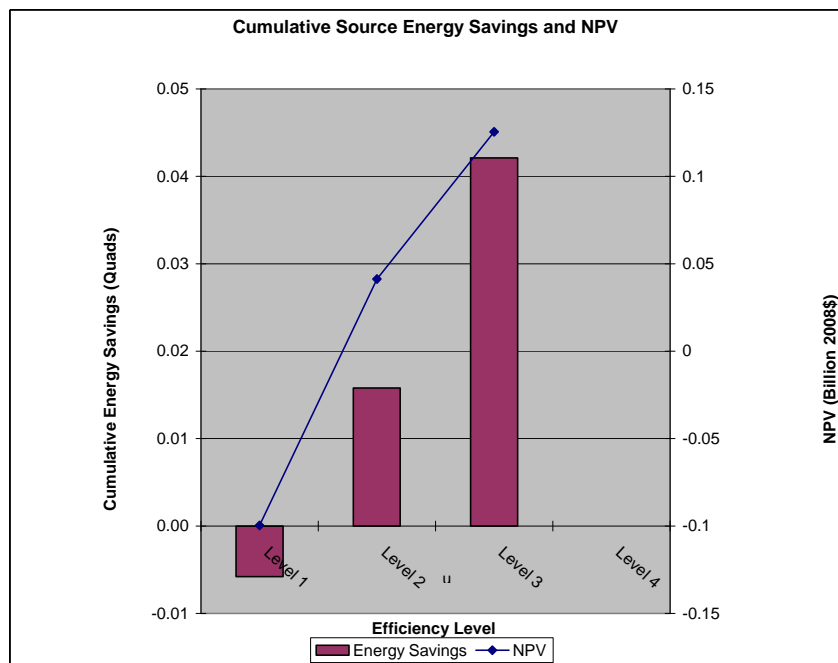


Figure 7-A. 25 Cumulative NPV Results for Small, Gas-fired, Steam, Natural Draft Based on a Three-Percent Discount Rate (Billion 2008\$)

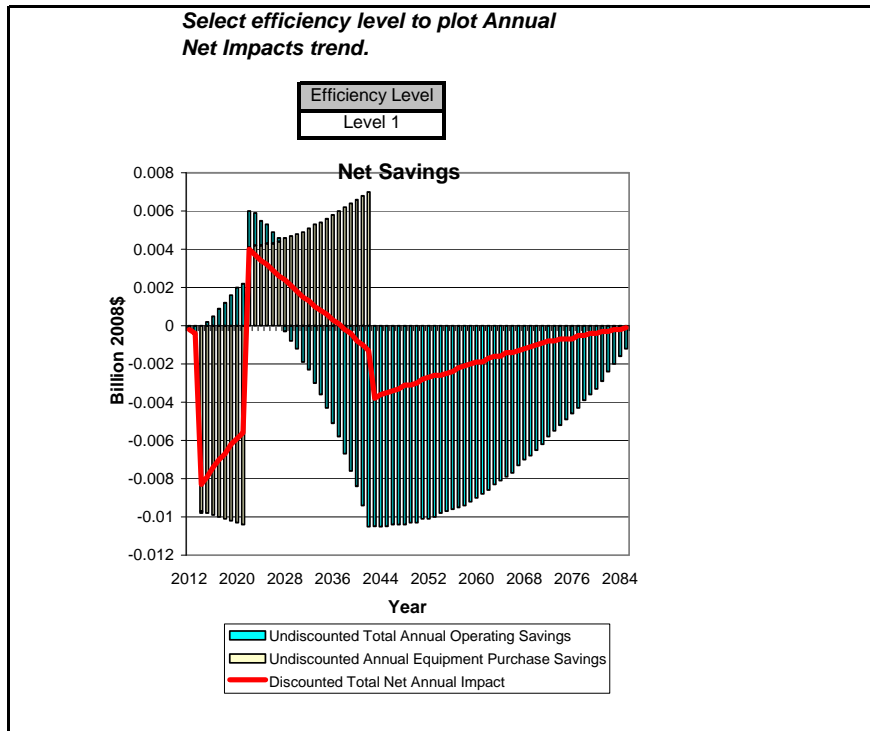


Figure 7-A. 26 National Annual Costs and Savings for Small, Gas-fired, Steam, Natural Draft, Level 1, Three-Percent Discount Rate

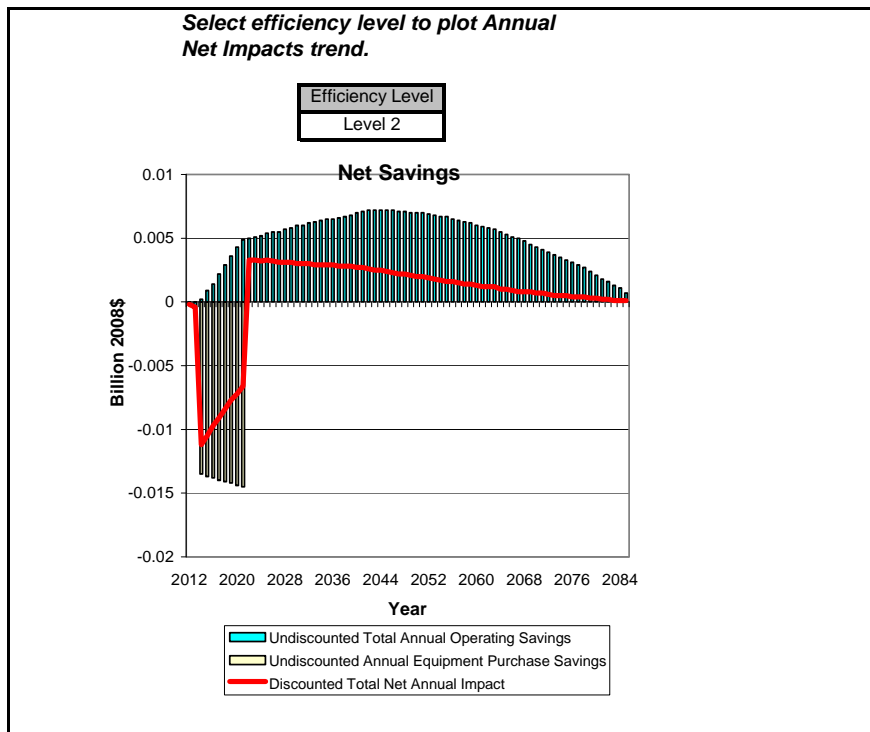


Figure 7-A. 27 National Annual Costs and Savings for Small, Gas-fired, Steam, Natural Draft, Level 2, Three-Percent Discount Rate

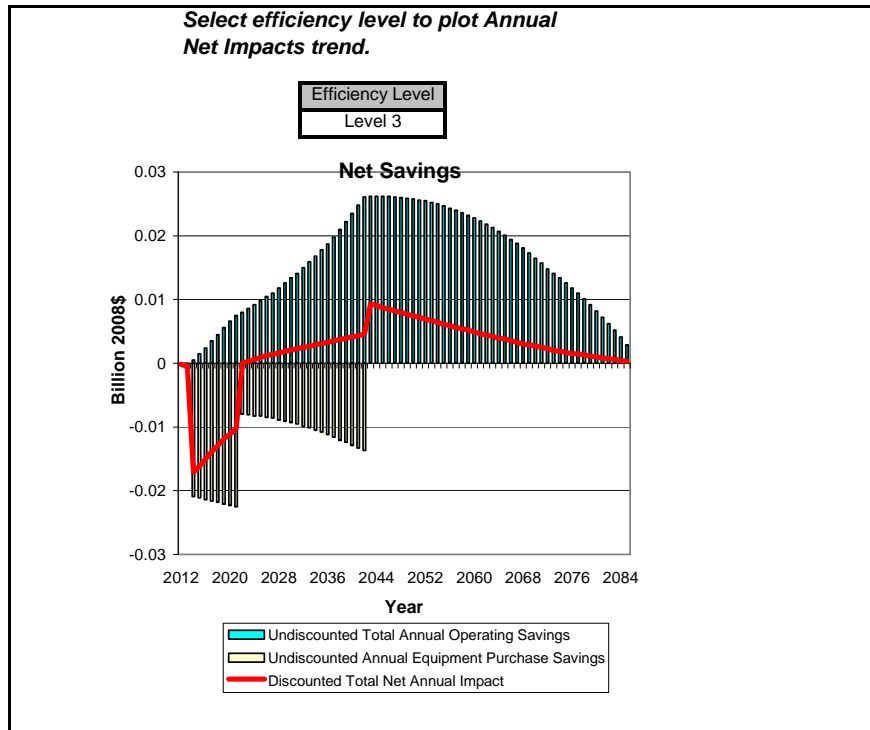


Figure 7-A. 28 National Annual Costs and Savings for Small, Gas-fired, Steam, Natural Draft, Level 3, Three-Percent Discount Rate

Note: There is no Level 4 for this product class

7-A.3.4 SMALL OIL-FIRED HOT WATER BOILER

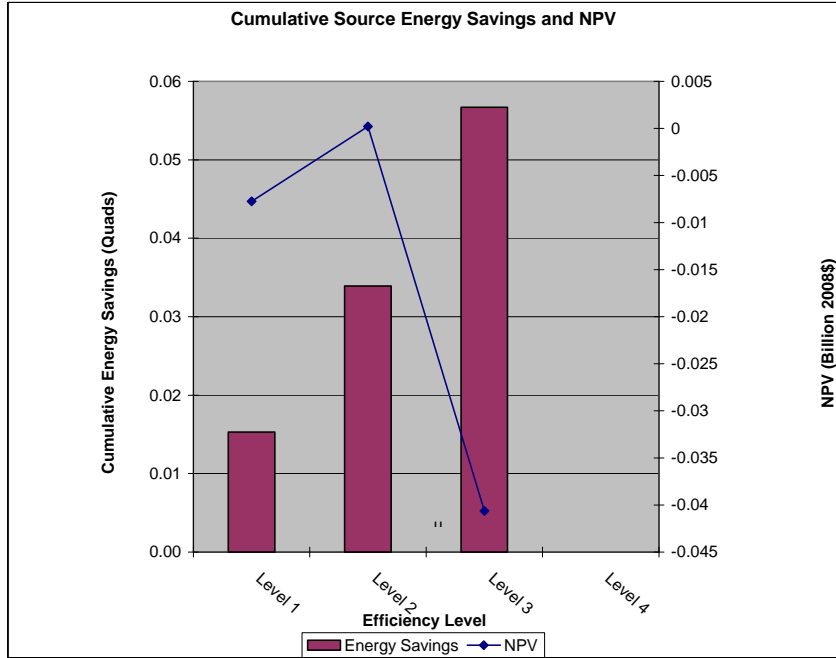


Figure 7-A. 29 Cumulative NPV Results for Small, Oil-fired, Hot Water Based on a Seven-Percent Discount Rate (Billion 2008\$)

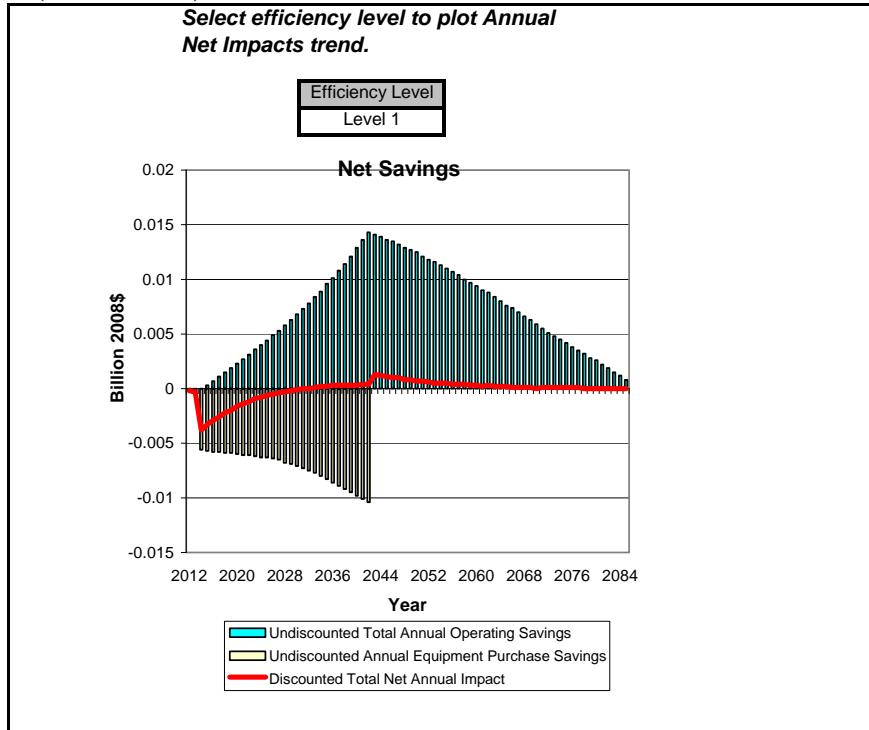


Figure 7-A. 30 National Annual Costs and Savings for Small, Oil-fired, Hot Water, Level 1, Seven-Percent Discount Rate

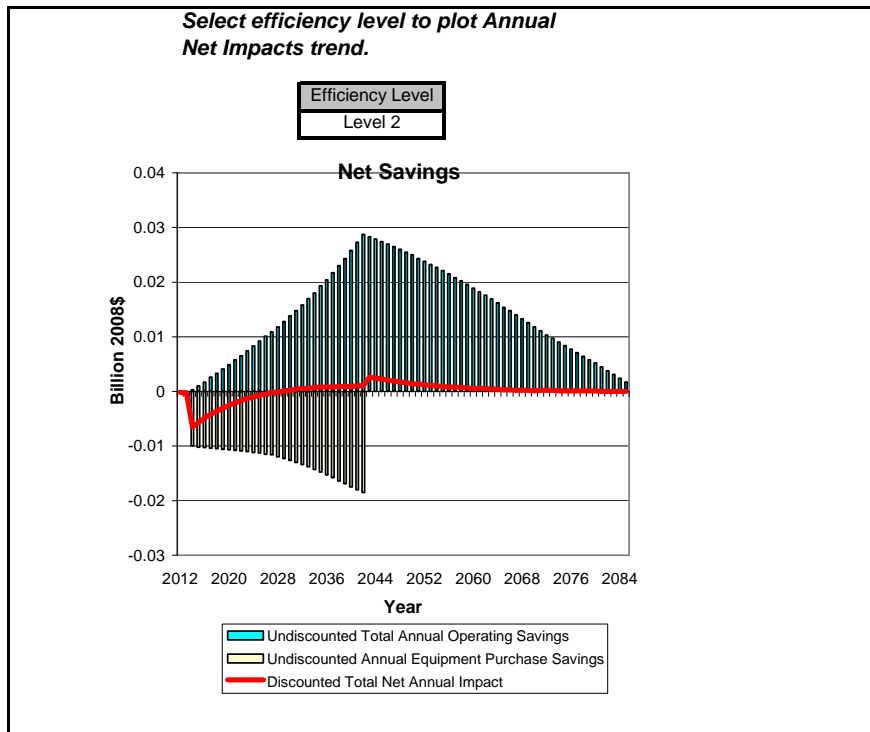


Figure 7-A. 31 National Annual Costs and Savings for Small, Oil-fired, Hot Water, Level 2, Seven-Percent Discount Rate

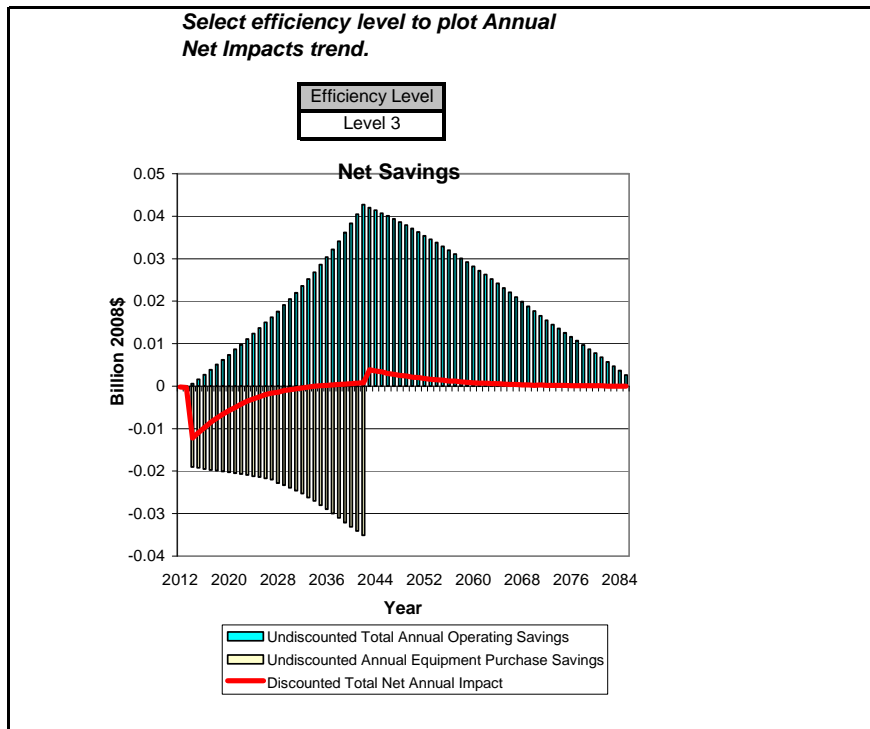


Figure 7-A. 32 National Annual Costs and Savings for Small, Oil-fired, Hot Water, Level 3, Seven-Percent Discount Rate

Note: There is no Level 4 for this product class

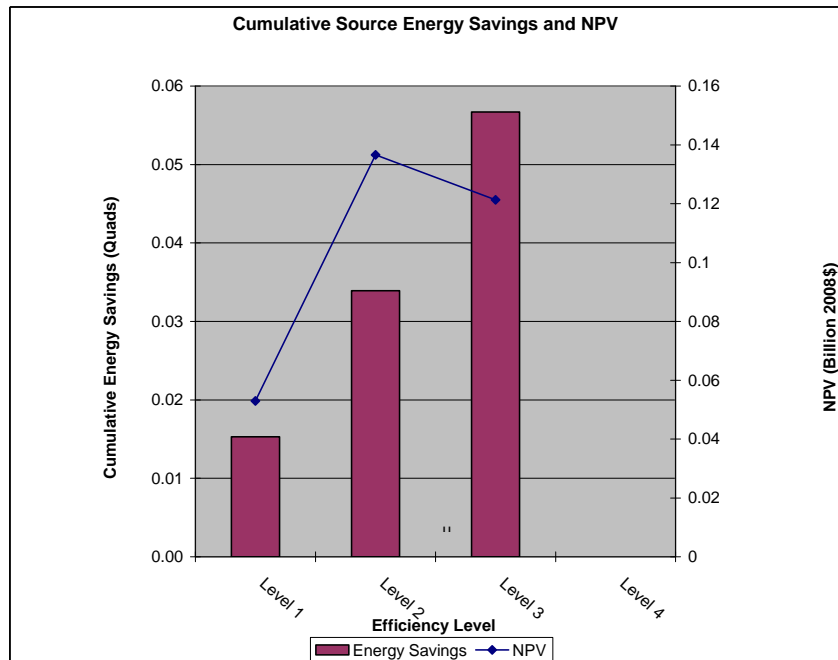


Figure 7-A. 33 Cumulative NPV Results for Small, Oil-fired, Hot Water Based on a Three-Percent Discount Rate (Billion 2008\$)

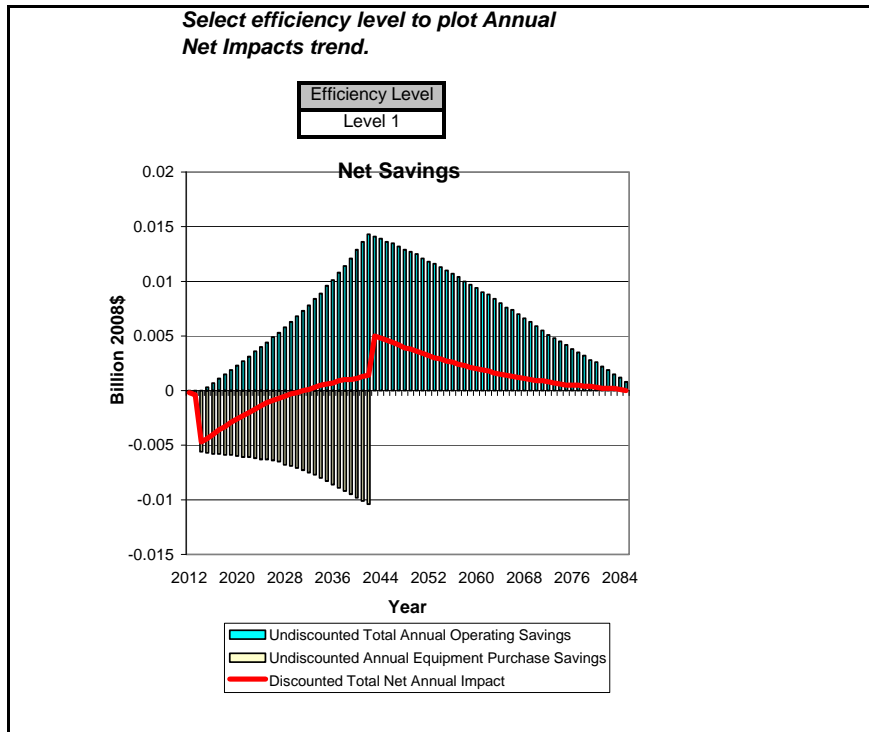


Figure 7-A. 34 National Annual Costs and Savings for Small, Oil-Fired, Hot Water, Level 1, Three-Percent Discount Rate

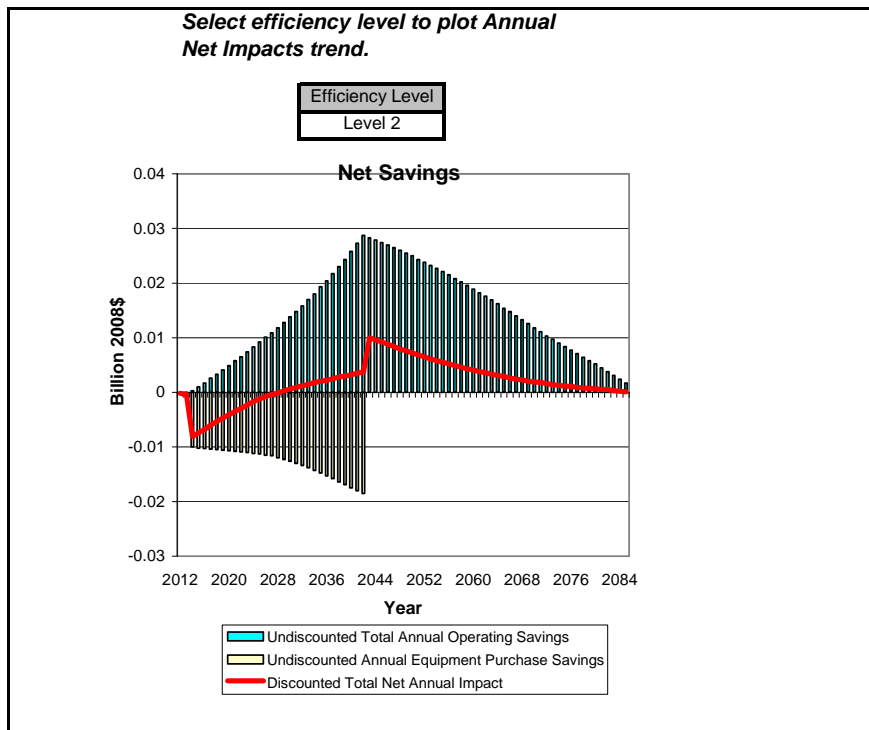


Figure 7-A. 35 National Annual Costs and Savings for Small, Oil-fired, Hot Water, Level 2, Three-Percent Discount Rate

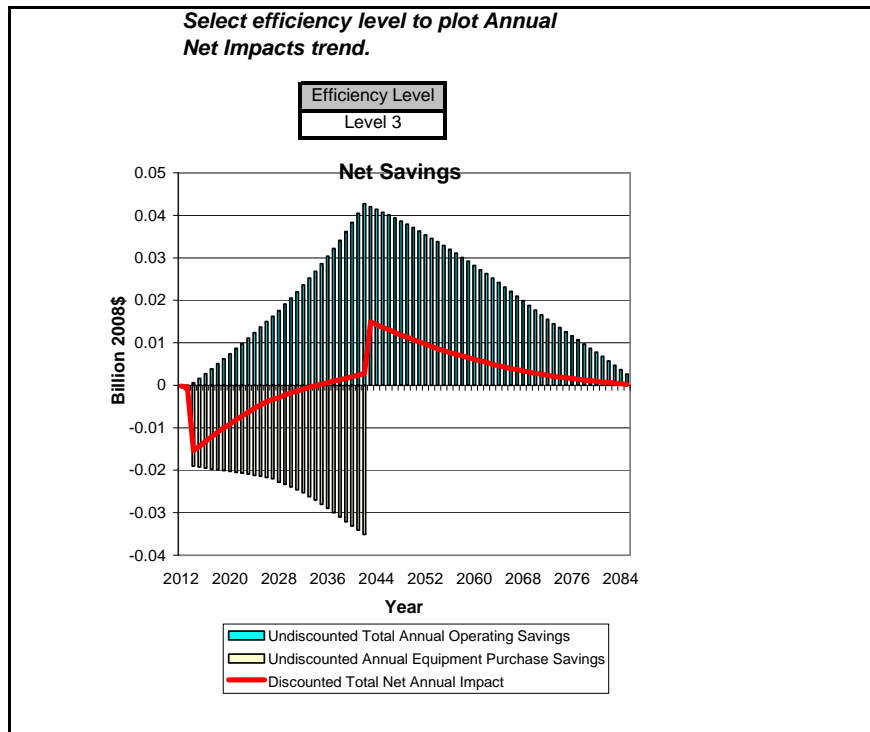


Figure 7-A. 36 National Annual Costs and Savings for Small, Oil-fired, Hot Water, Level 3, Three-Percent Discount Rate

Note: There is no Level 4 for this product class

7-A.3.5 SMALL OIL-FIRED STEAM BOILER

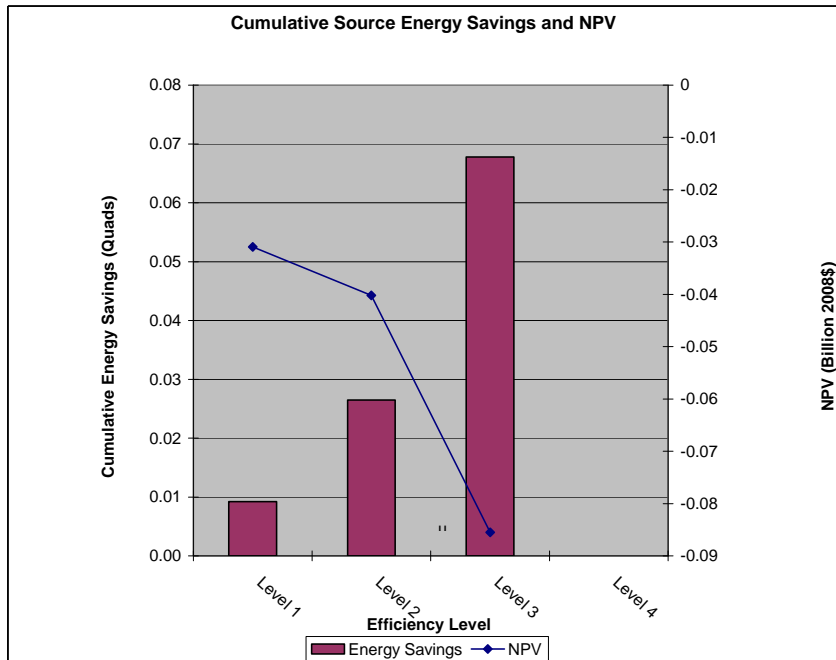


Figure 7-A. 37 Cumulative NPV Results for Small, Oil-fired, Steam Based on a Seven-Percent Discount Rate (Billion 2008\$)

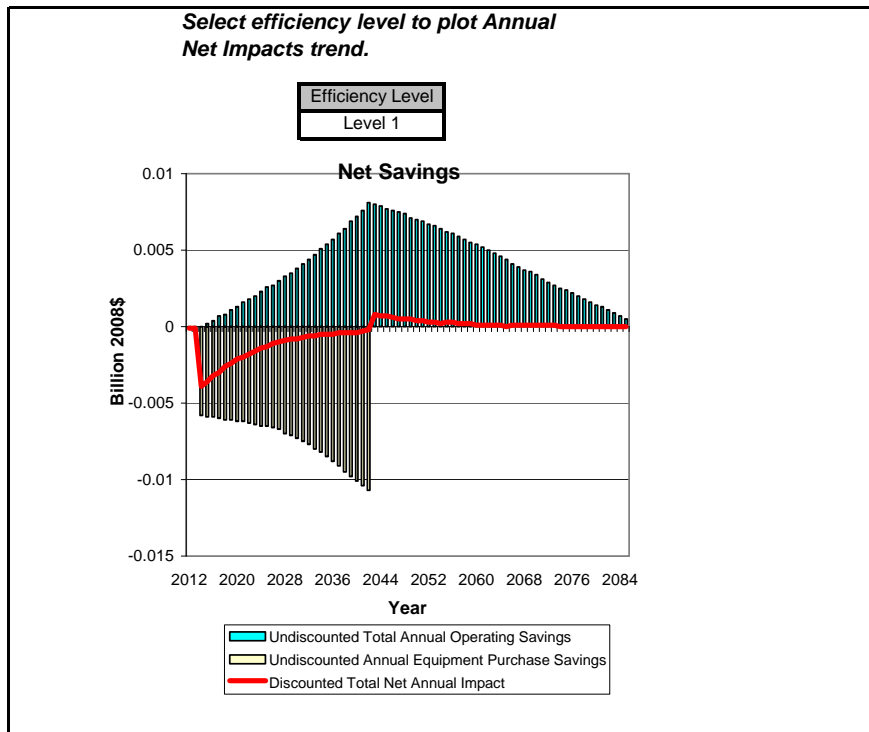


Figure 7-A. 38 National Annual Costs and Savings for Small, Oil-fired, Steam, Level 1, Seven-Percent Discount Rate

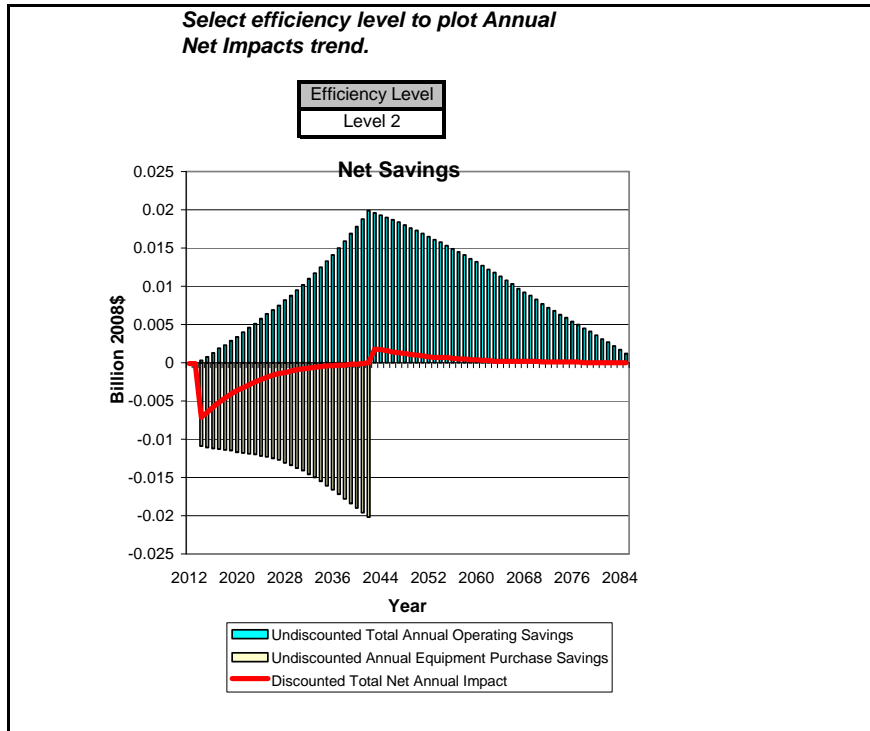


Figure 7-A. 39 National Annual Costs and Savings for Small, Oil-fired, Steam, Level 2, Seven-Percent Discount Rate

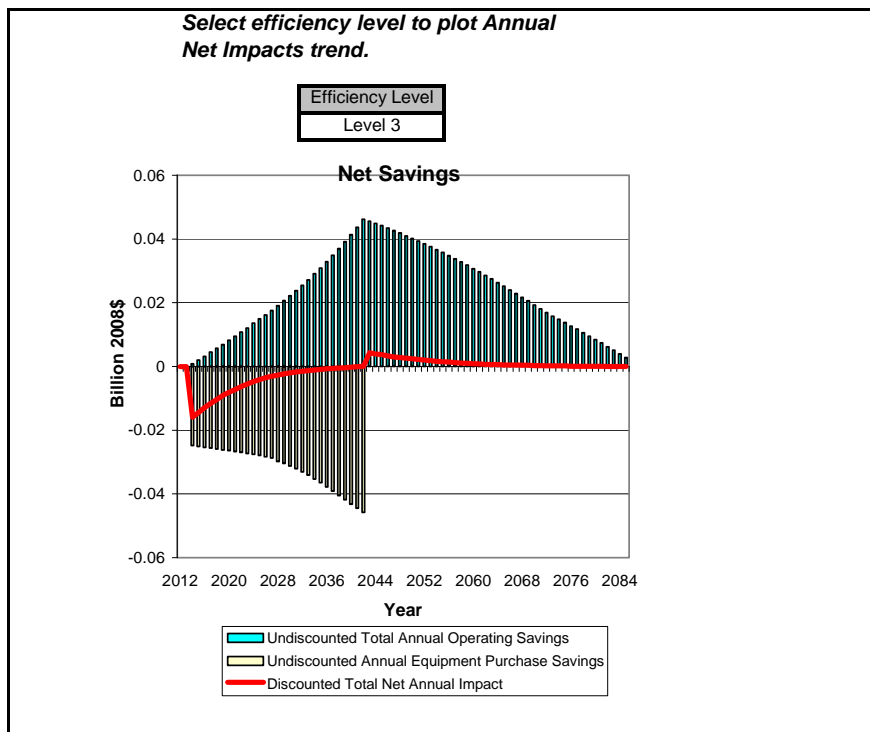


Figure 7-A. 40 National Annual Costs and Savings for Small, Oil-fired, Steam, Level 3, Seven-Percent Discount Rate

Note: There is no Level 4 for this product class

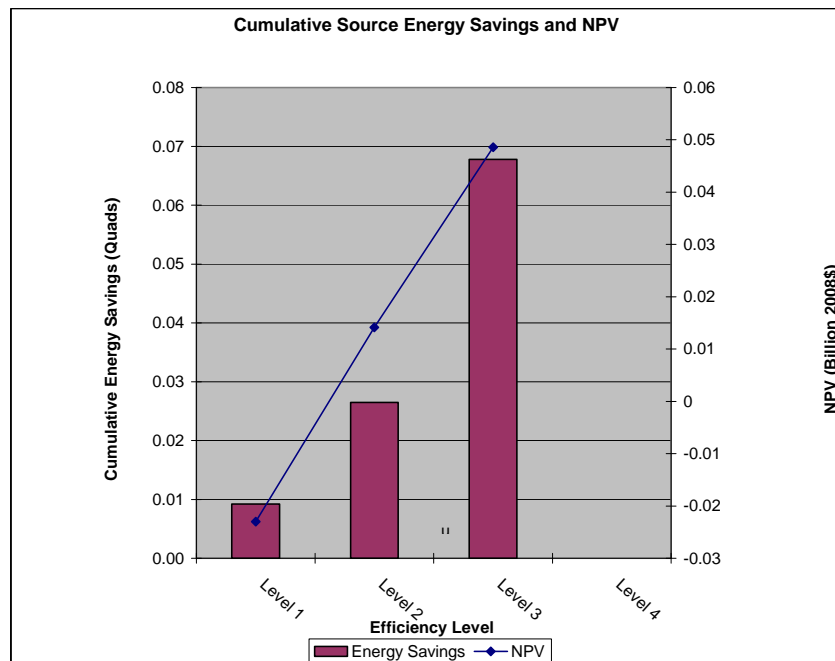


Figure 7-A. 41 Cumulative NPV Results for Small, Oil-fired, Steam Based on a Three-Percent Discount Rate (Billion 2008\$)

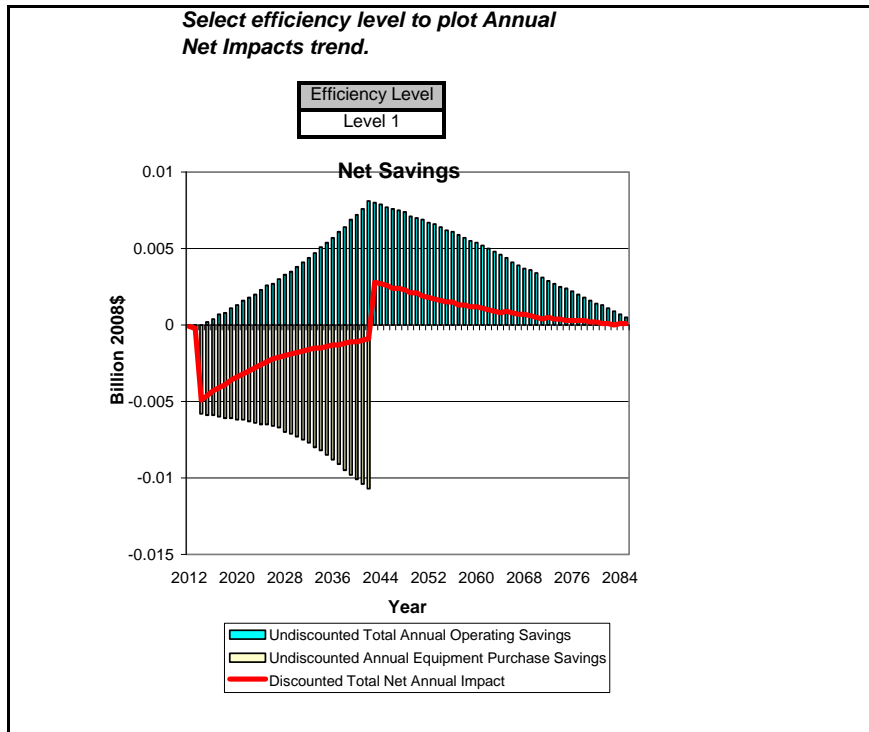


Figure 7-A. 42 National Annual Costs and Savings for Small, Oil-fired, Steam, Level 1, Three-Percent Discount Rate

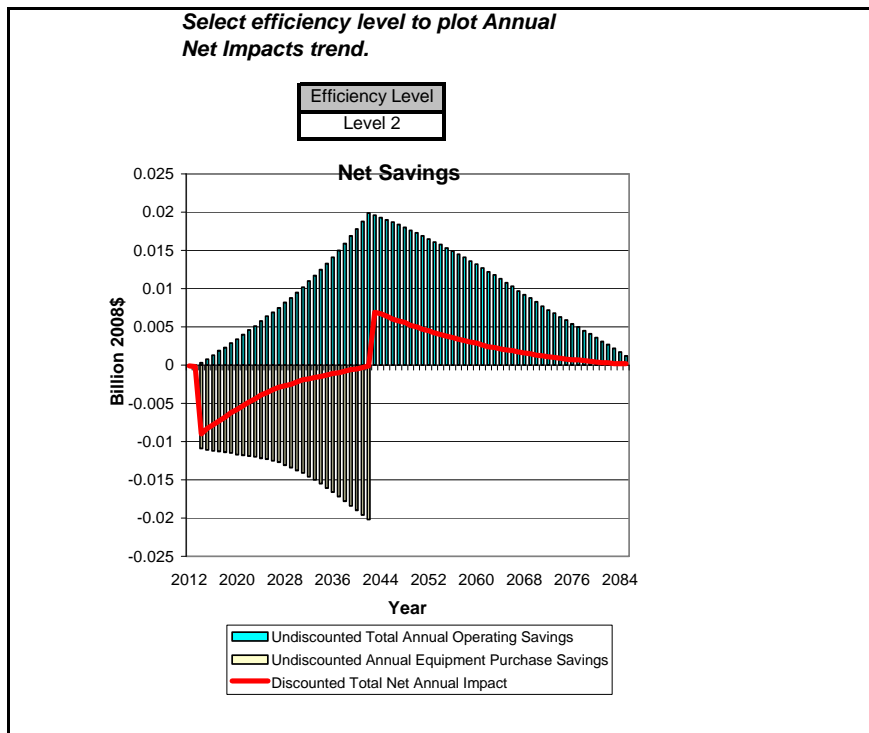


Figure 7-A. 43 National Annual Costs and Savings for Small, Oil-fired, Steam, Level 2, Three-Percent Discount Rate

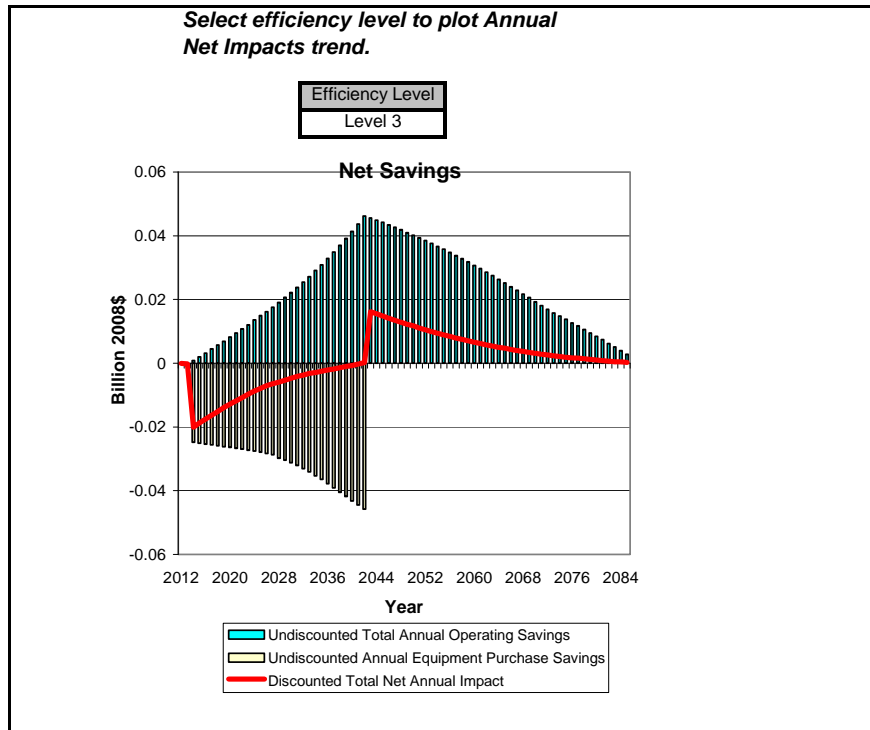


Figure 7-A. 44 National Annual Costs and Savings for Small, Oil-fired, Steam, Level 3, Three-Percent Discount Rate

Note: There is no Level 4 for this product class

7-A.3.6 LARGE GAS-FIRED HOT WATER BOILER

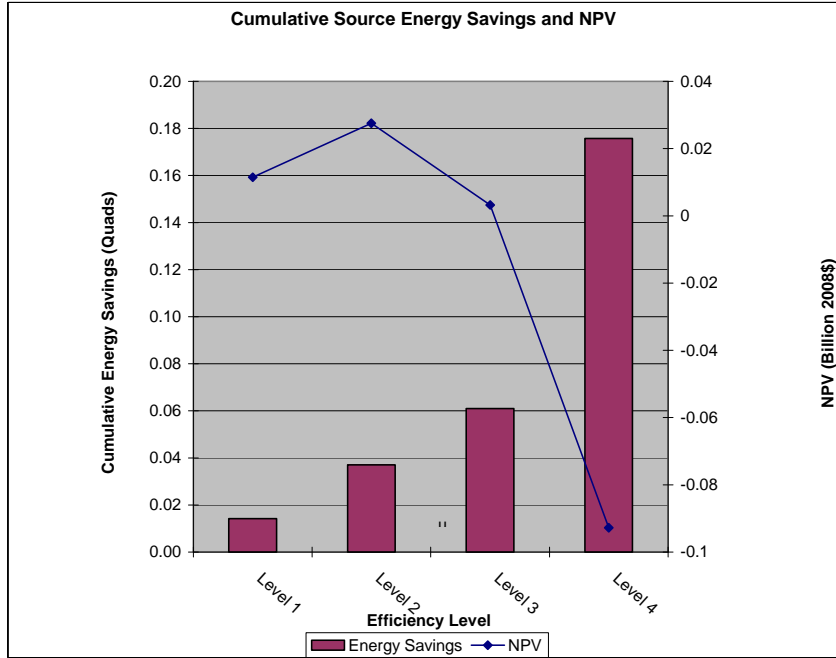


Figure 7-A. 45 Cumulative NPV Results for Large, Gas-fired, Hot Water Based on a Seven-Percent Discount Rate (Billion 2008\$)

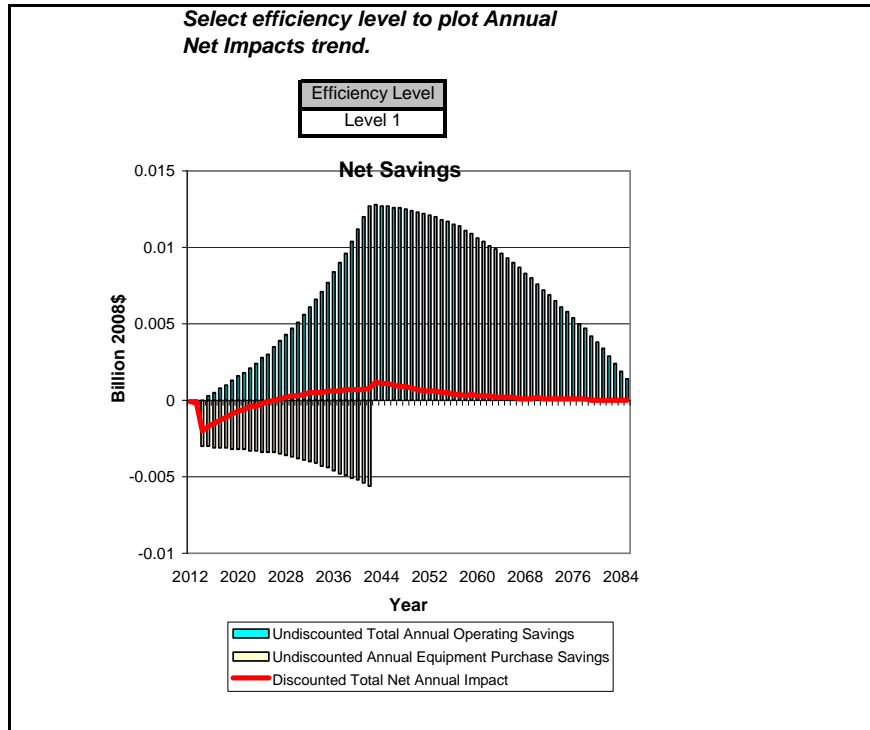


Figure 7-A. 46 National Annual Costs and Savings for Large, Gas-fired, Hot Water, Level 1, Seven-Percent Discount Rate

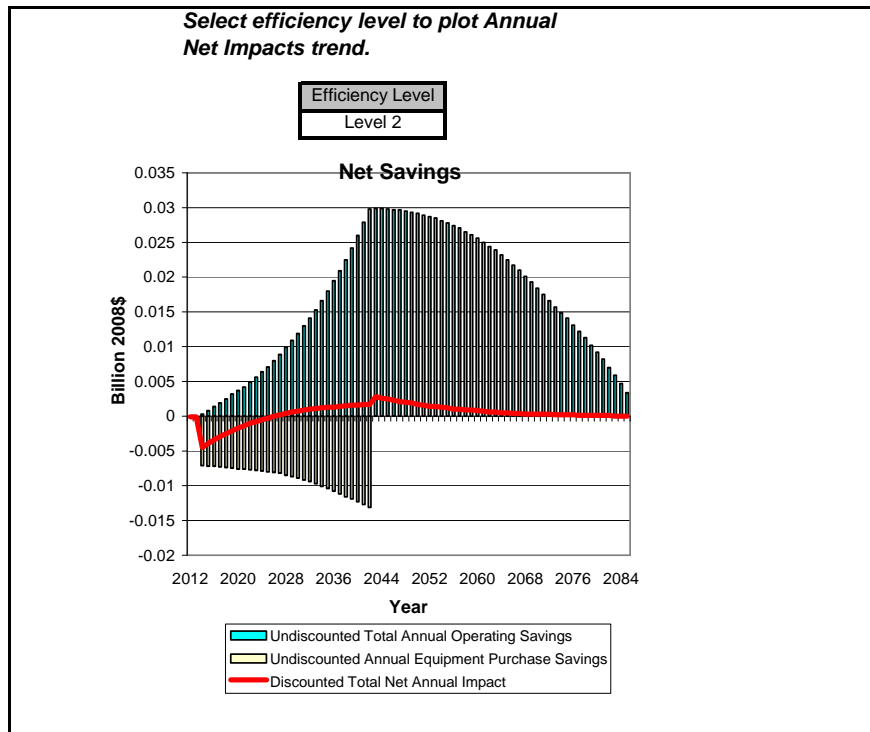


Figure 7-A. 47 National Annual Costs and Savings for Large, Gas-fired, Hot Water, Level 2, Seven-Percent Discount Rate

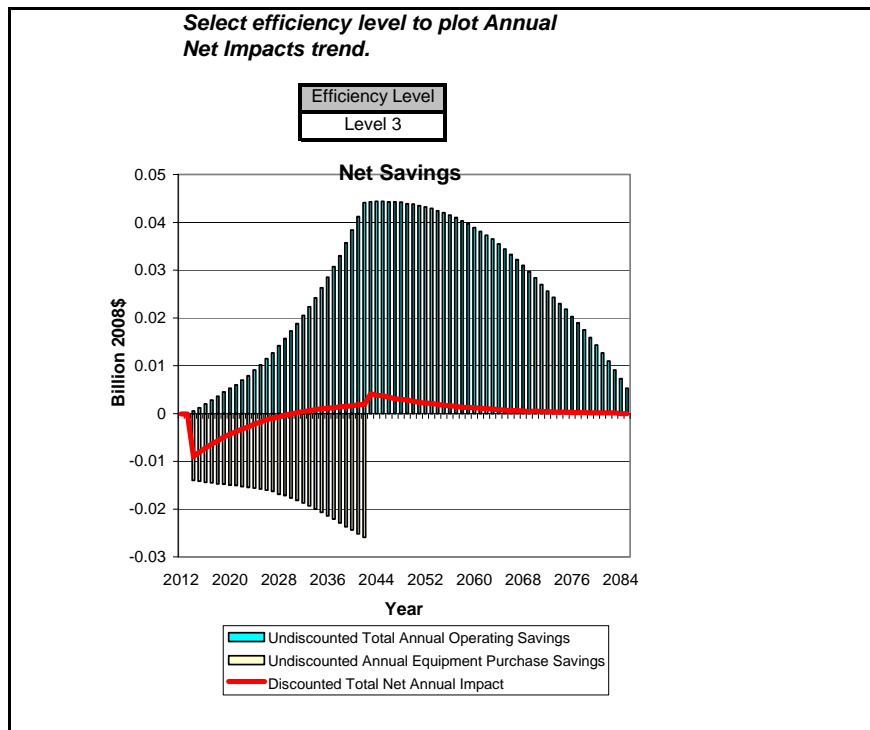


Figure 7-A. 48 National Annual Costs and Savings for Large, Gas-fired, Hot Water, Level 3, Seven-Percent Discount Rate

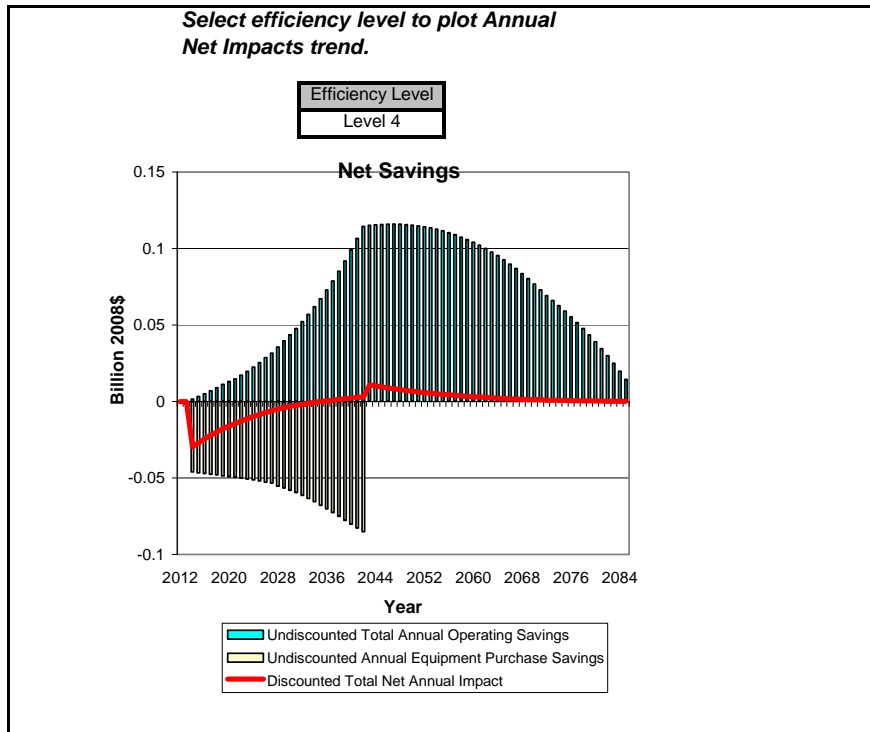


Figure 7-A. 49 National Annual Costs and Savings for Large, Gas-fired, Hot Water, Level 4, Seven-Percent Discount Rate

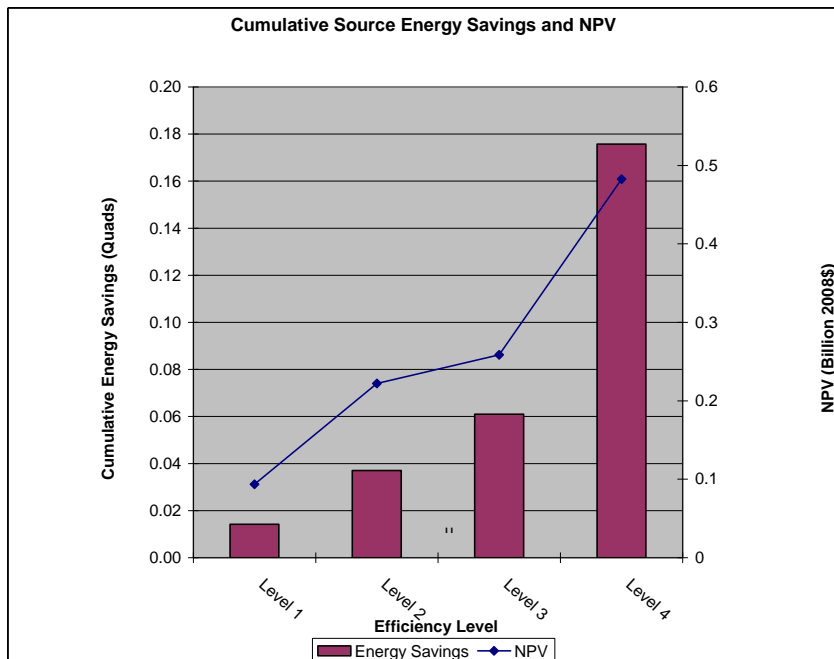


Figure 7-A. 50 Cumulative NPV Results for Large, Gas-fired, Hot Water Based on a Three-Percent Discount Rate (Billion 2008\$)

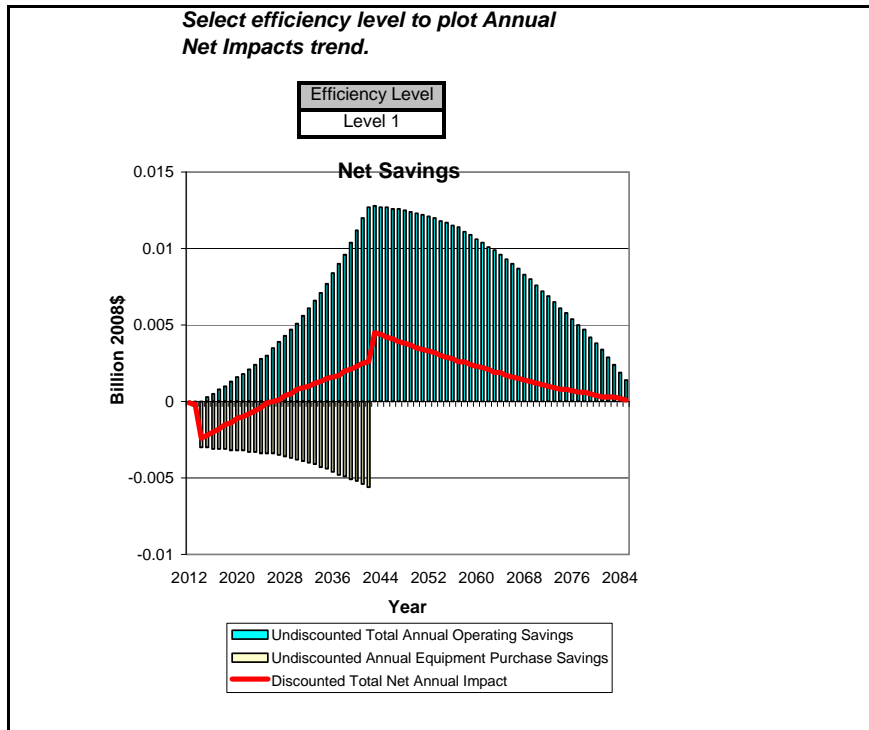


Figure 7-A. 51 National Annual Costs and Savings for Large, Gas-fired, Hot Water, Level 1, Three-Percent Discount Rate

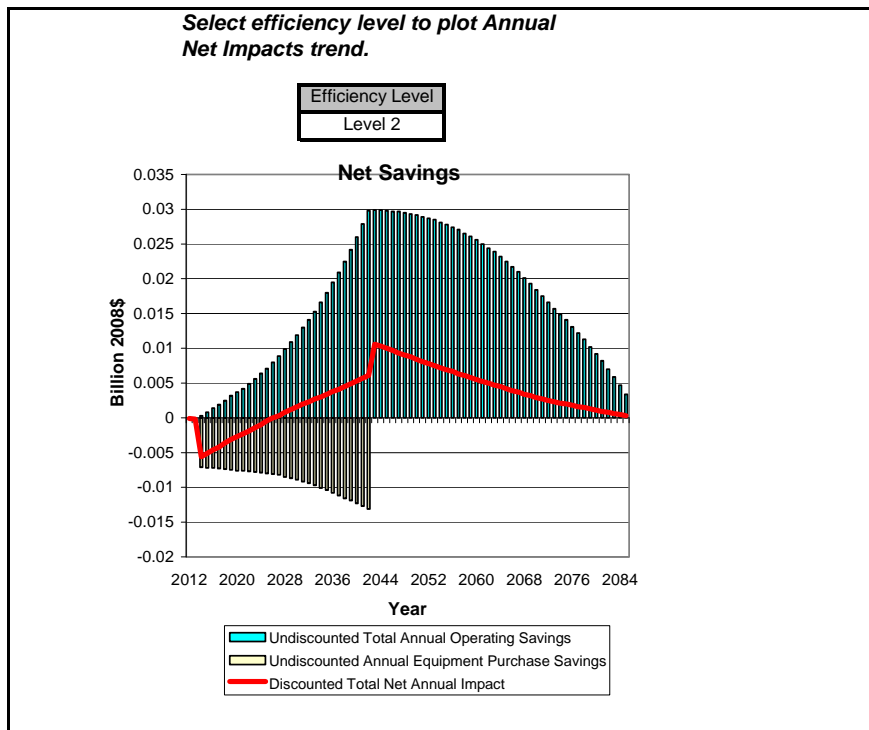


Figure 7-A. 52 National Annual Costs and Savings for Large, Gas-fired, Hot Water, Level 2, Three-Percent Discount Rate

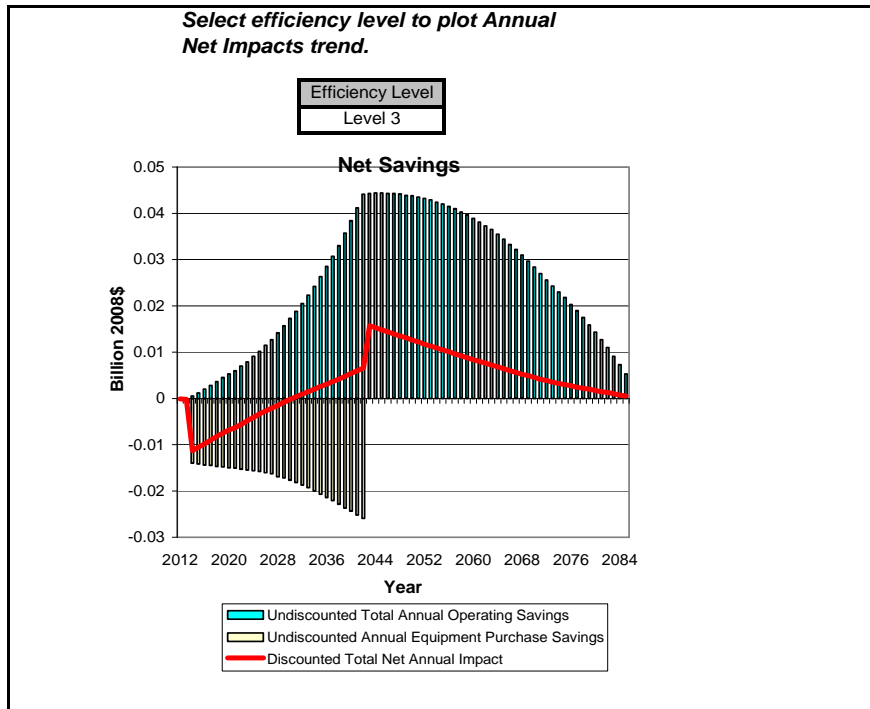


Figure 7-A. 53 National Annual Costs and Savings for Large, Gas-fired, Hot Water, Level 3, Three-Percent Discount Rate

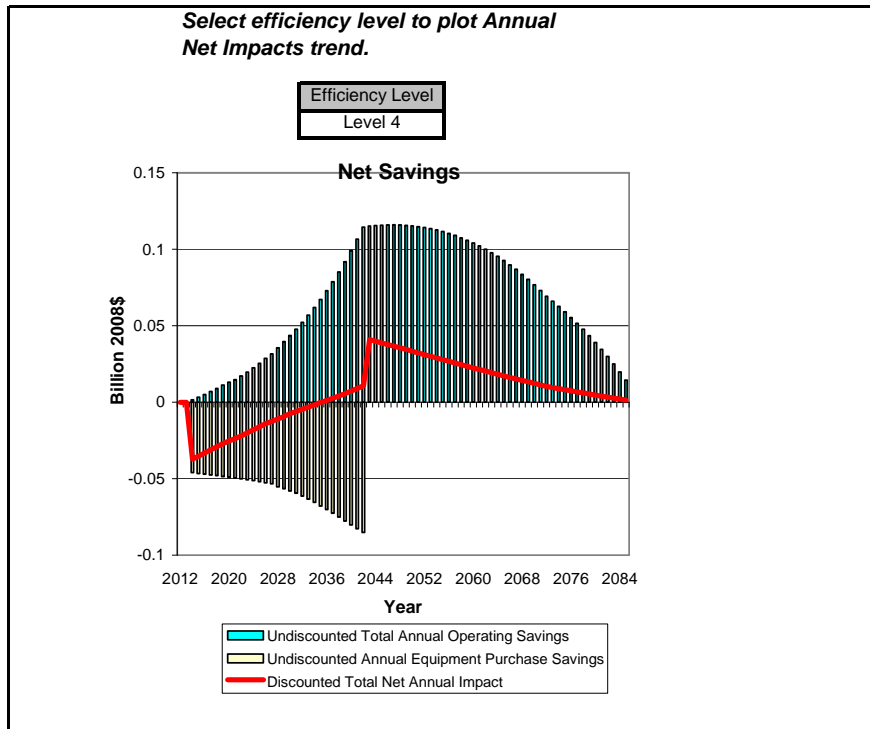


Figure 7-A. 54 National Annual Costs and Savings for Large, Gas-fired, Hot Water, Level 4, Three-Percent Discount Rate

7-A.3.7 LARGE GAS-FIRED STEAM ALL EXCEPT NATURAL DRAFT BOILER

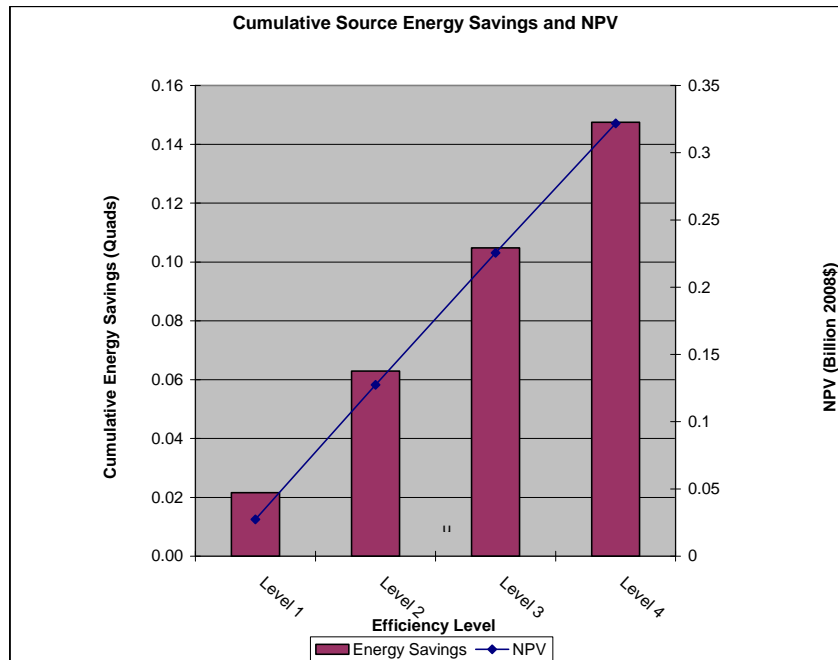


Figure 7-A. 55 Cumulative NPV Results for Large, Gas-fired, Steam, All Except Natural Draft Based on a Seven-Percent Discount Rate (Billion 2008\$)

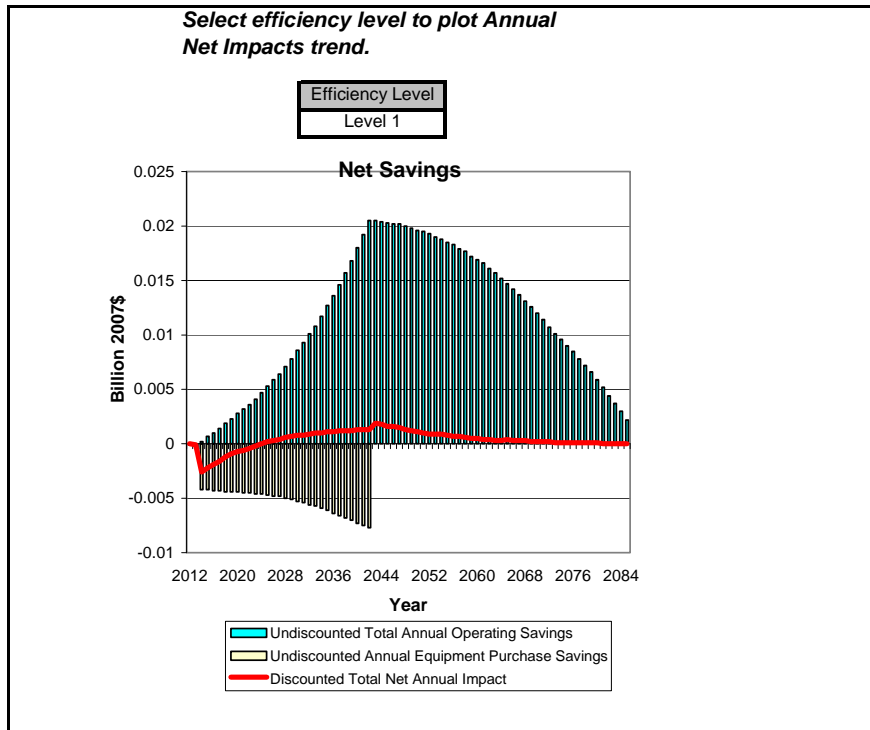


Figure 7-A. 56 National Annual Costs and Savings for Large, Gas-fired, Steam, All Except Natural Draft, Level 1, Seven-Percent Discount Rate

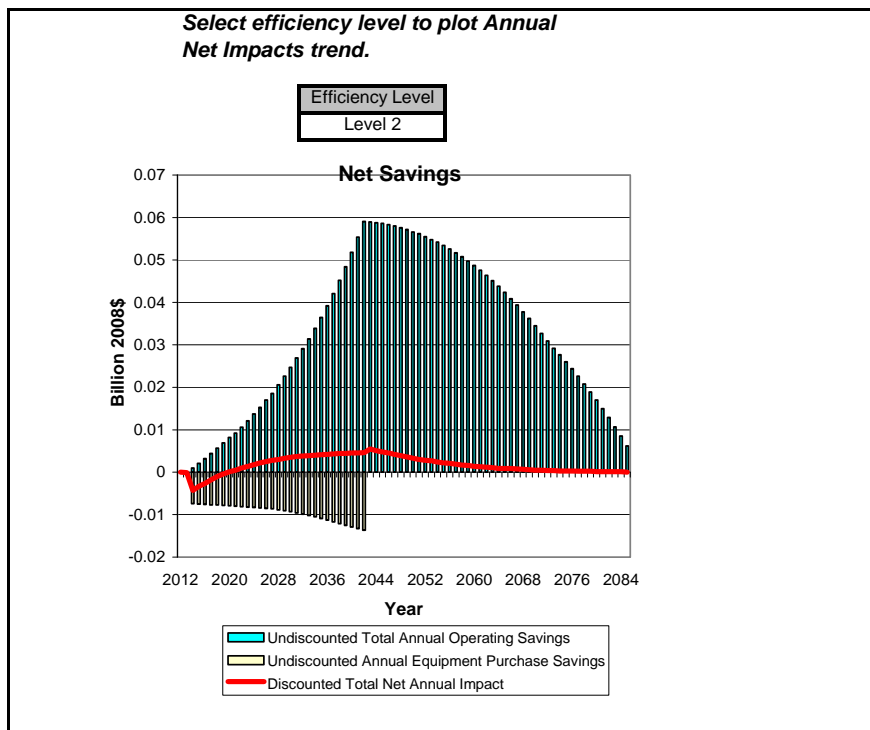


Figure 7-A. 57 National Annual Costs and Savings for Large, Gas-fired, Steam, All Except Natural Draft, Level 2, Seven-Percent Discount Rate

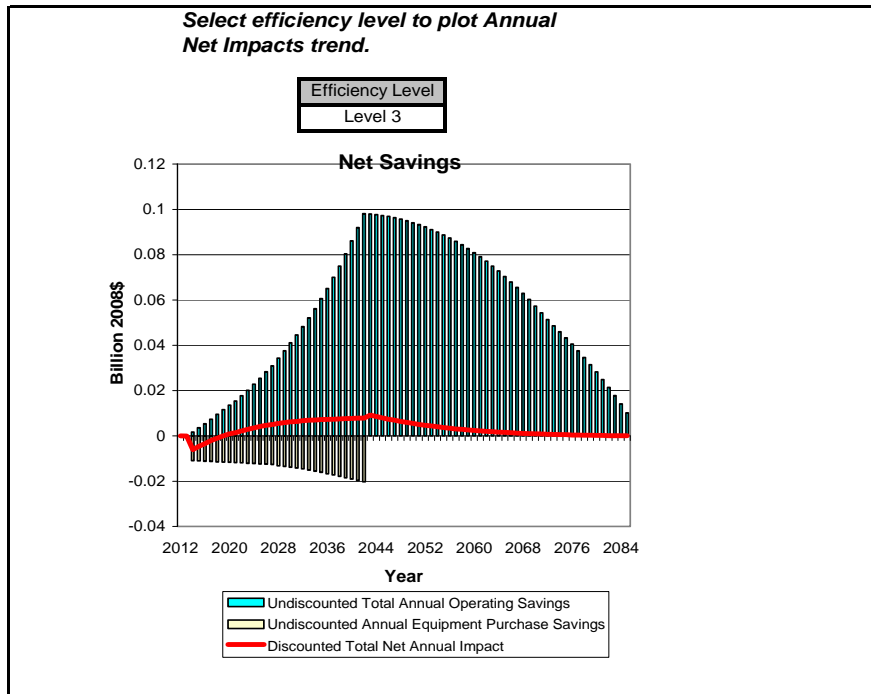


Figure 7-A. 58 National Annual Costs and Savings for Large, Gas-fired, Steam, All Except Natural Draft, Level 3, Seven-Percent Discount Rate

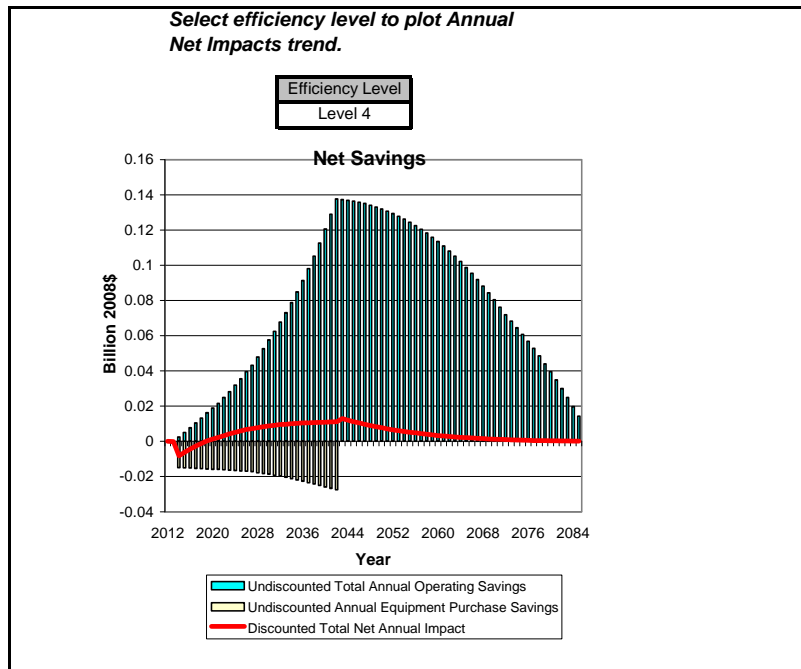


Figure 7-A. 59 National Annual Costs and Savings for Large, Gas-fired, Steam, All Except Natural Draft, Level 4, Seven-Percent Discount Rate

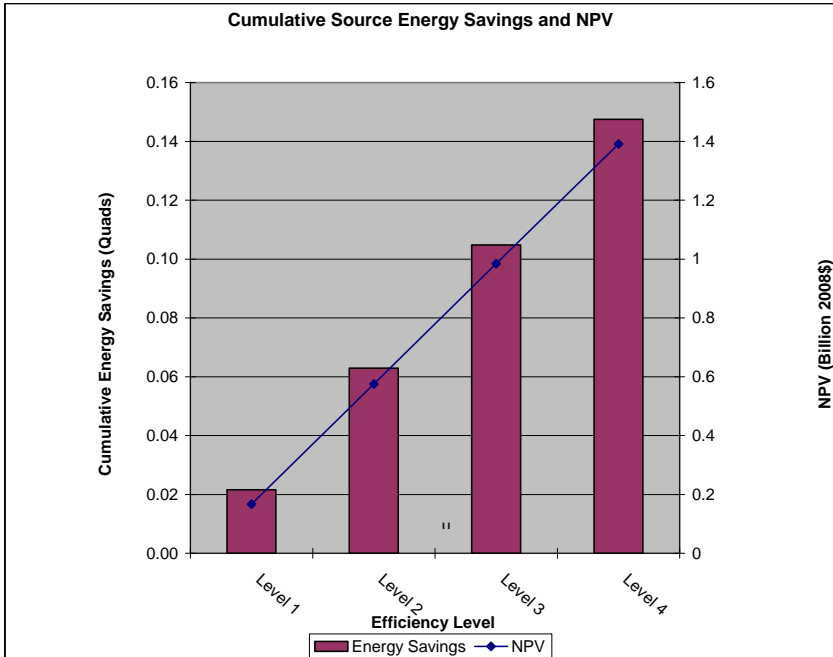


Figure 7-A. 60 Cumulative NPV Results for Large, Gas-fired, Steam, All Except Natural Draft Based on a Three-Percent Discount Rate (Billion 2008\$)

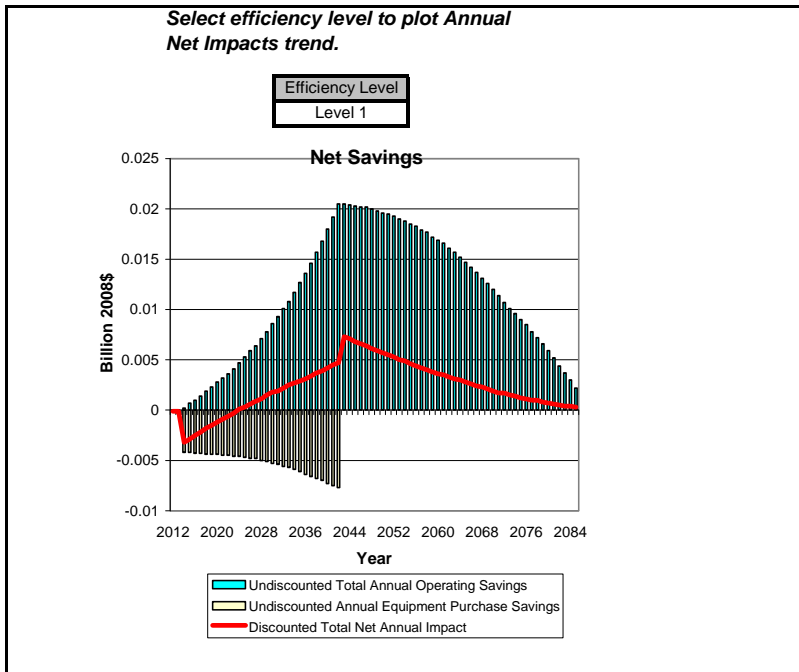


Figure 7-A. 61 National Annual Costs and Savings for Large, Gas-fired, Steam, All Except Natural Draft, Level 1, Three-Percent Discount Rate

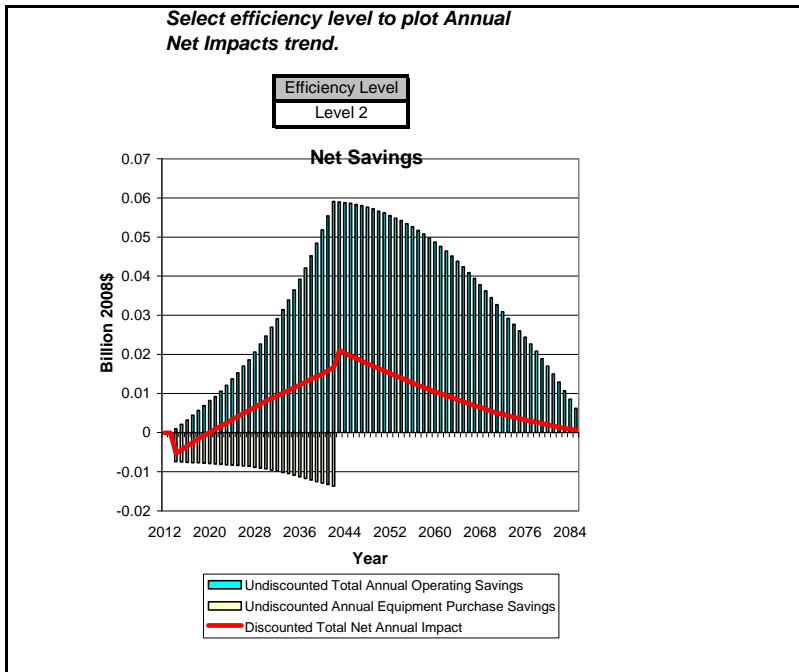


Figure 7-A. 62 National Annual Costs and Savings for Large, Gas-fired, Steam, All Except Natural Draft, Level 2, Three-Percent Discount Rate

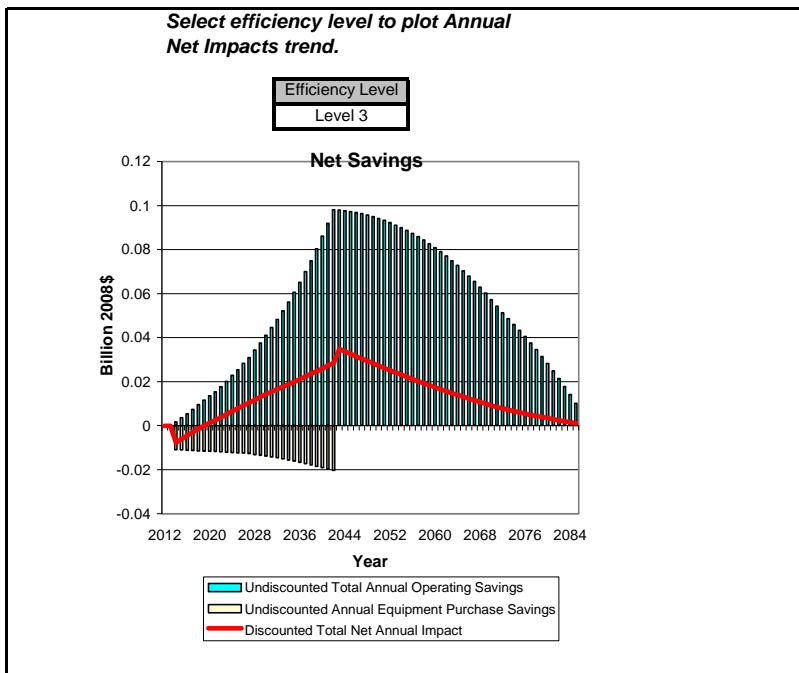


Figure 7-A. 63 National Annual Costs and Savings for Large, Gas-fired, Steam, All Except Natural Draft, Level 3, Three-Percent Discount Rate

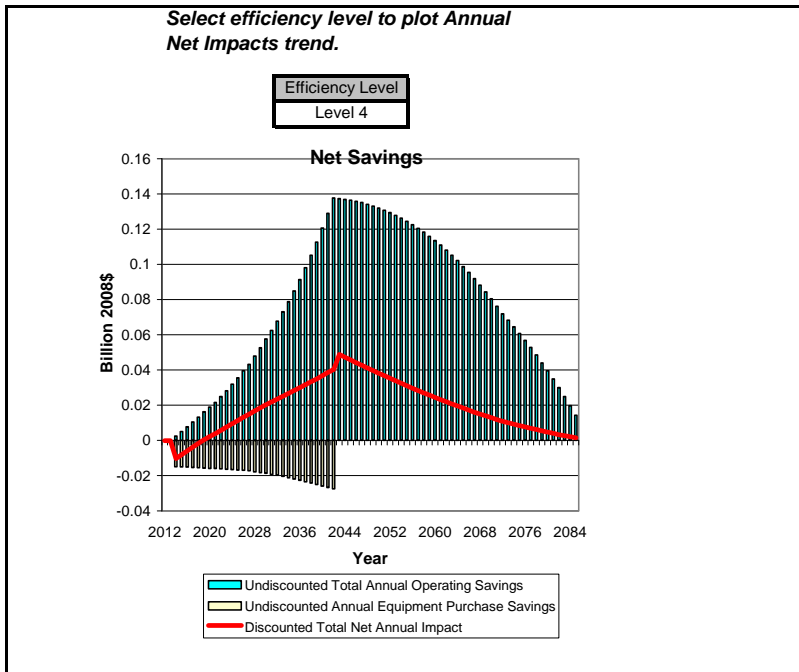


Figure 7-A. 64 National Annual Costs and Savings for Large, Gas-fired, Steam, All Except Natural Draft, Level 4, Three-Percent Discount Rate

7-A.3.8 LARGE GAS-FIRED STEAM NATURAL DRAFT BOILER

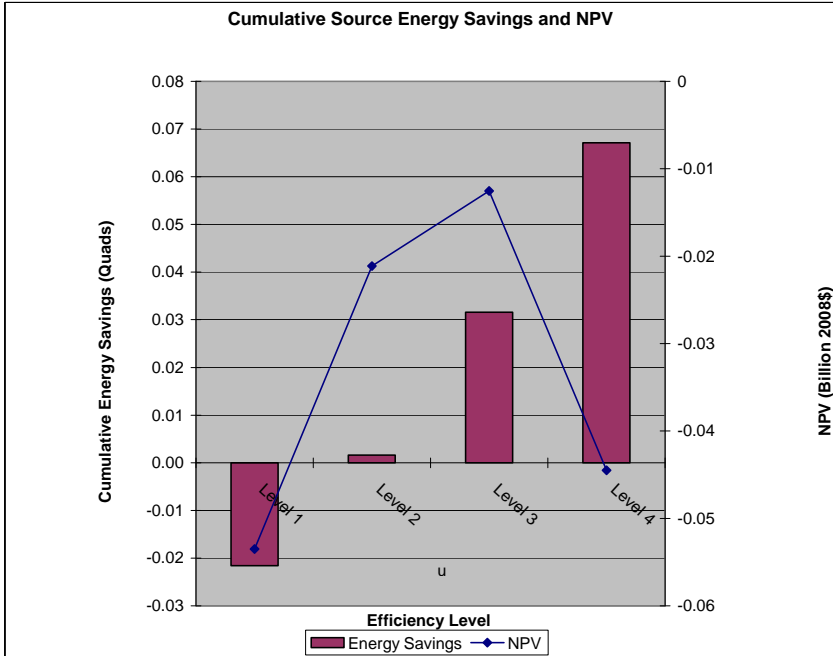


Figure 7-A. 65 Cumulative NPV Results for Large, Gas-fired, Steam, Natural Draft Based on a Seven-Percent Discount Rate (Billion 2008\$)

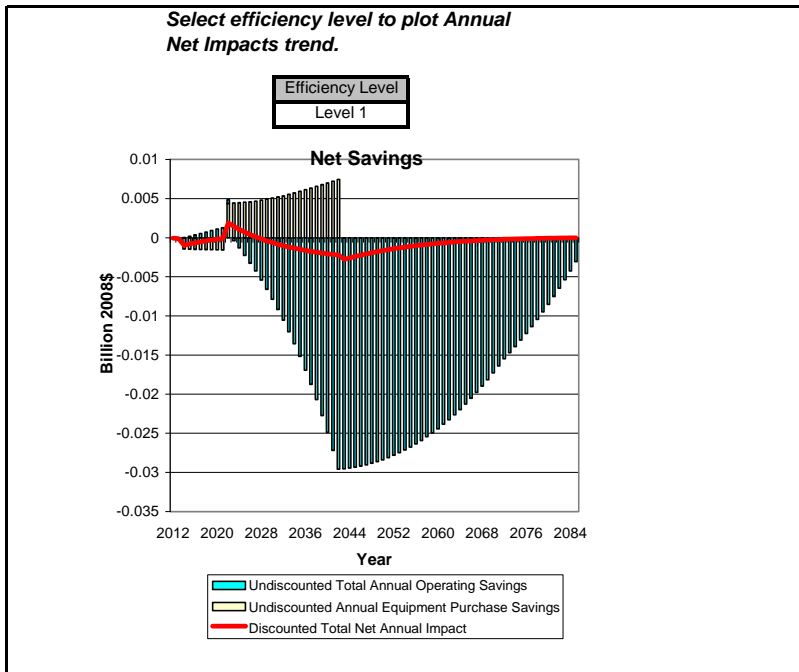


Figure 7-A. 66 National Annual Costs and Savings for Large, Gas-fired, Steam, Natural Draft, Level 1, Seven-Percent Discount Rate

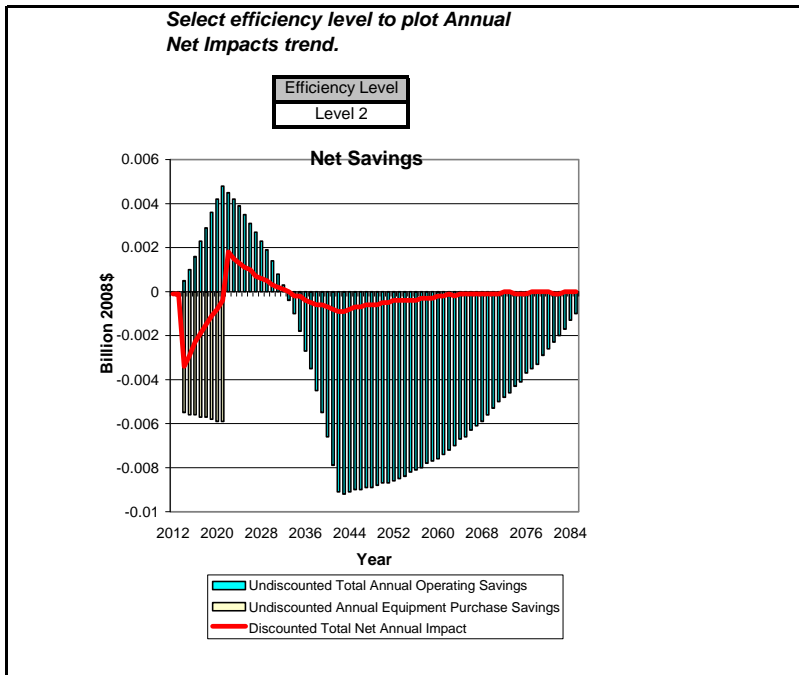


Figure 7-A. 67 National Annual Costs and Savings for Large, Gas-fired, Steam, Natural Draft, Level 2, Seven-Percent Discount Rate

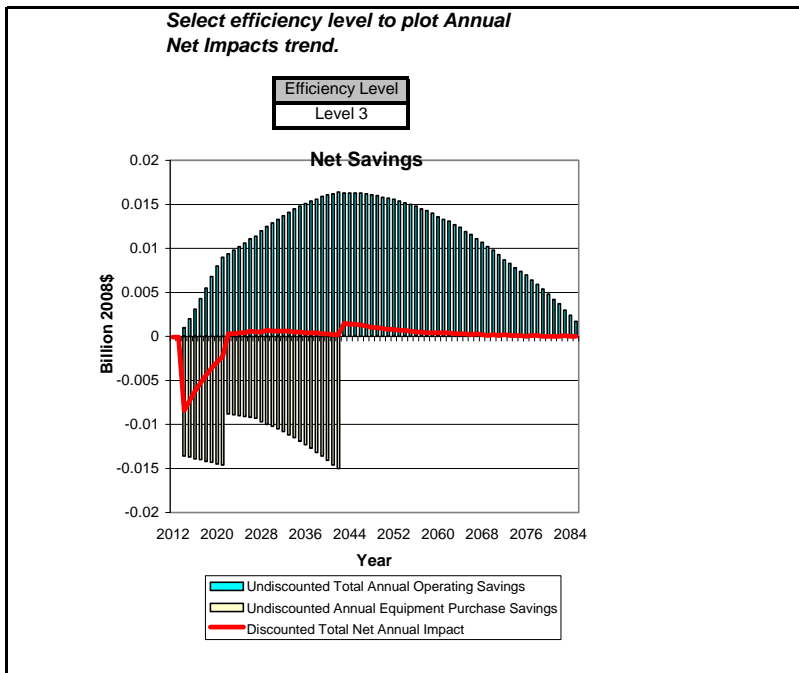


Figure 7-A. 68 National Annual Costs and Savings for Large, Gas-fired, Steam, Natural Draft, Level 3, Seven-Percent Discount Rate

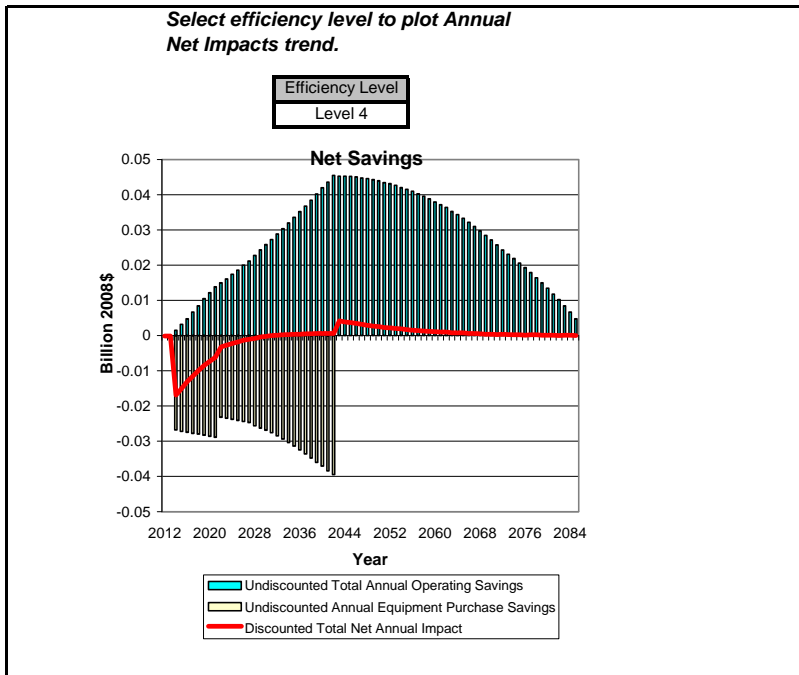


Figure 7-A. 69 National Annual Costs and Savings for Large, Gas-fired, Steam, Natural Draft, Level 4, Seven-Percent Discount Rate

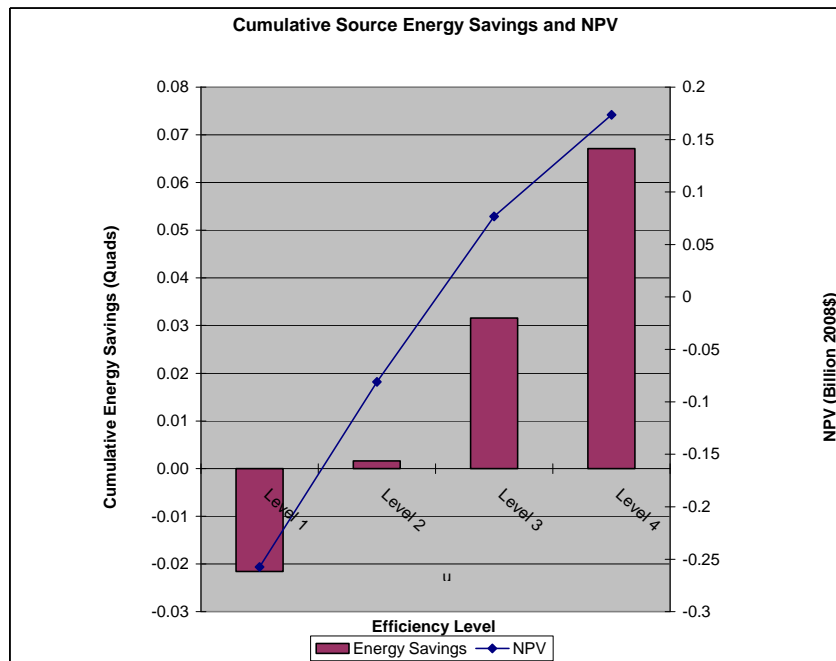


Figure 7-A. 70 Cumulative NPV Results for Large, Gas-fired, Steam, Natural Draft Based on a Three-Percent Discount Rate (Billion 2008\$)

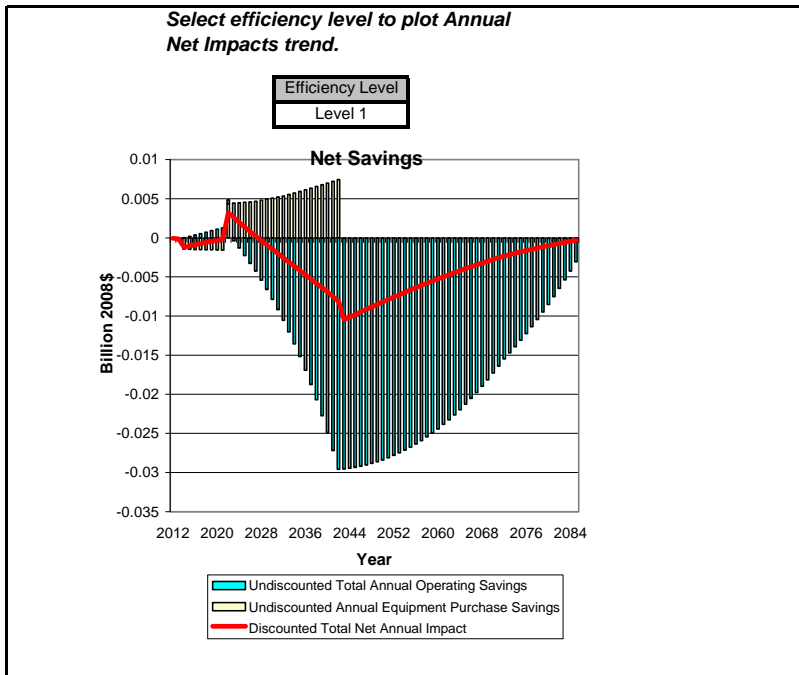


Figure 7-A. 71 National Annual Costs and Savings for Large, Gas-fired, Steam, Natural Draft, Level 1, Three-Percent Discount Rate

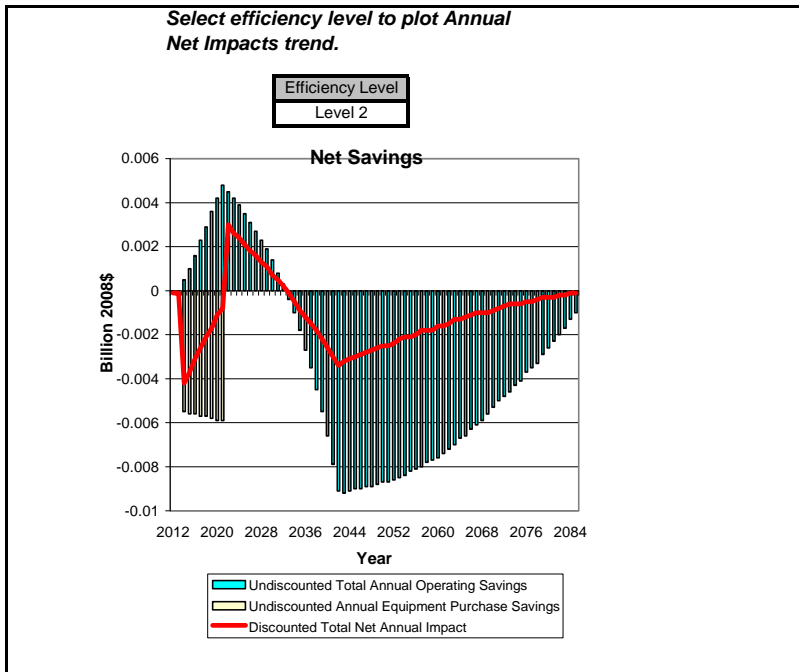


Figure 7-A. 72 National Annual Costs and Savings for Large, Gas-fired, Steam, Natural Draft, Level 2, Three-Percent Discount Rate

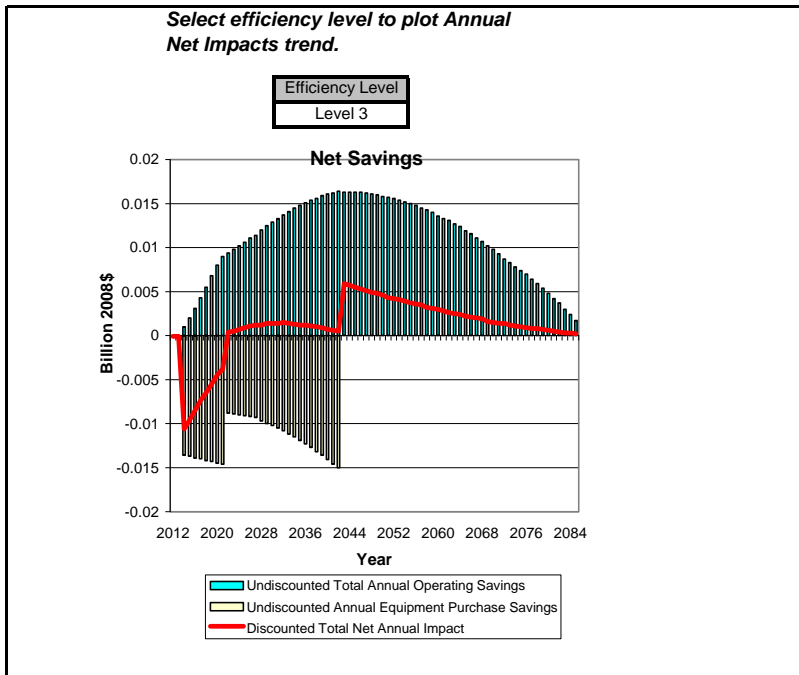


Figure 7-A. 73 National Annual Costs and Savings for Large, Gas-fired, Steam, Natural Draft, Level 3, Three-Percent Discount Rate

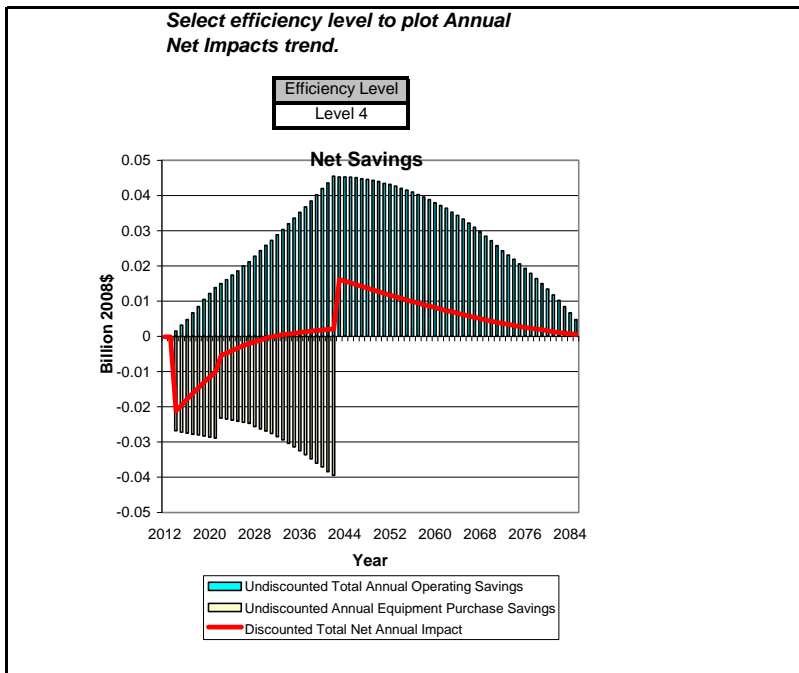


Figure 7-A. 74 National Annual Costs and Savings for Large, Gas-fired, Steam, Natural Draft, Level 4, Three-Percent Discount Rate

7-A.3.9 LARGE OIL-FIRED HOT WATER BOILER

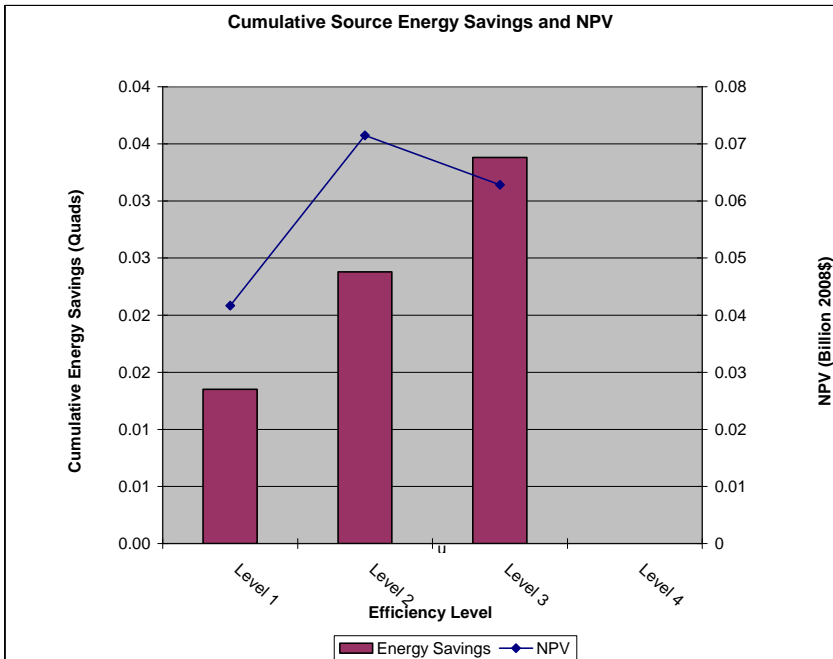


Figure 7-A. 75 Cumulative NPV Results for Large, Oil-fired, Hot Water Based on a Seven-Percent Discount Rate (Billion 2008\$)

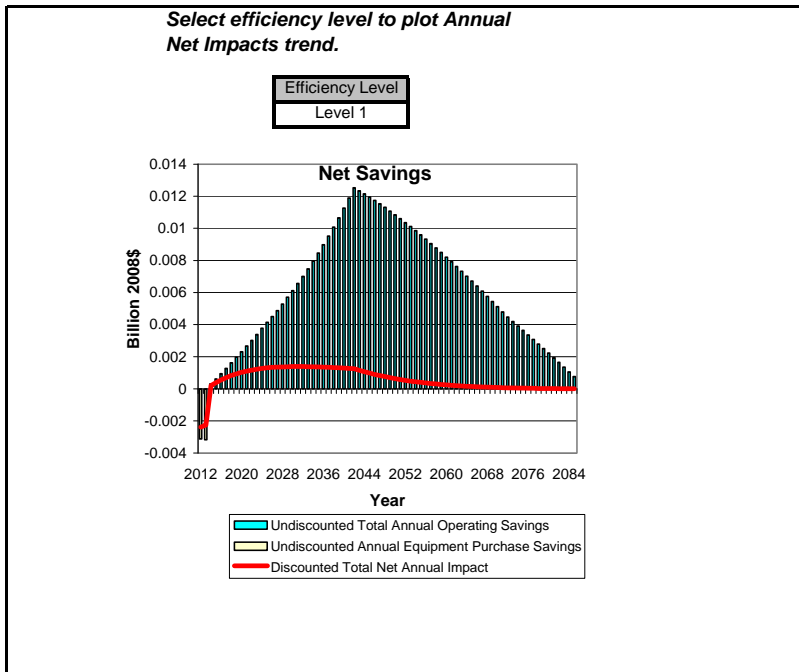


Figure 7-A. 76 National Annual Costs and Savings for Large, Oil-fired, Hot Water, Level 1, Seven-Percent Discount Rate

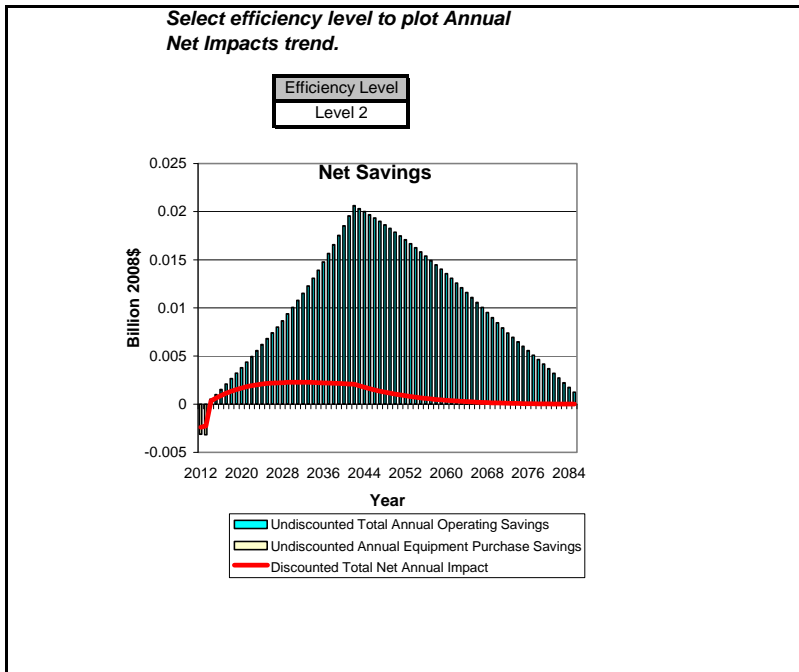


Figure 7-A. 77 National Annual Costs and Savings for Large, Oil-fired, Hot Water, Level 2, Seven-Percent Discount Rate

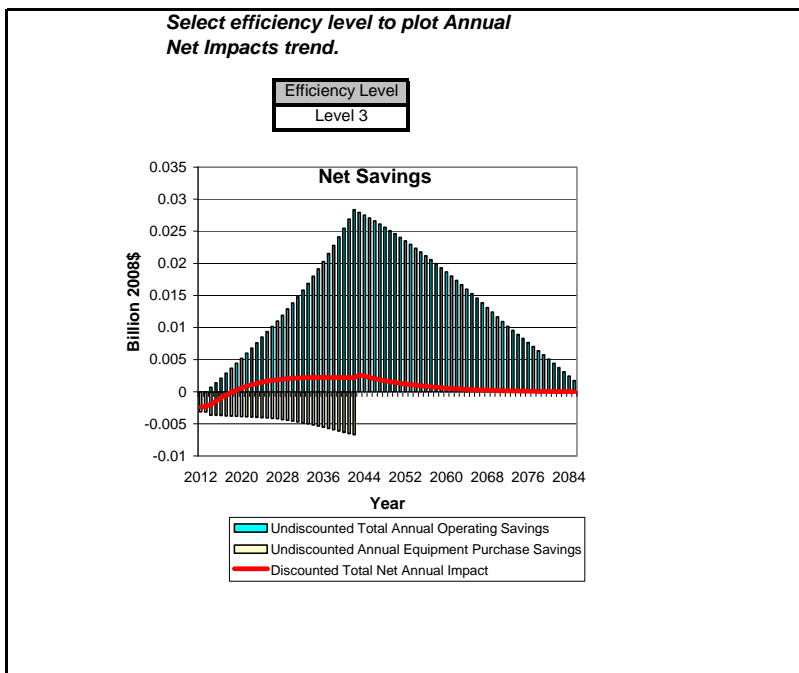


Figure 7-A. 78 National Annual Costs and Savings for Large, Oil-fired, Hot Water, Level 3, Seven-Percent Discount Rate

Note: There is no Level 4 for this product class

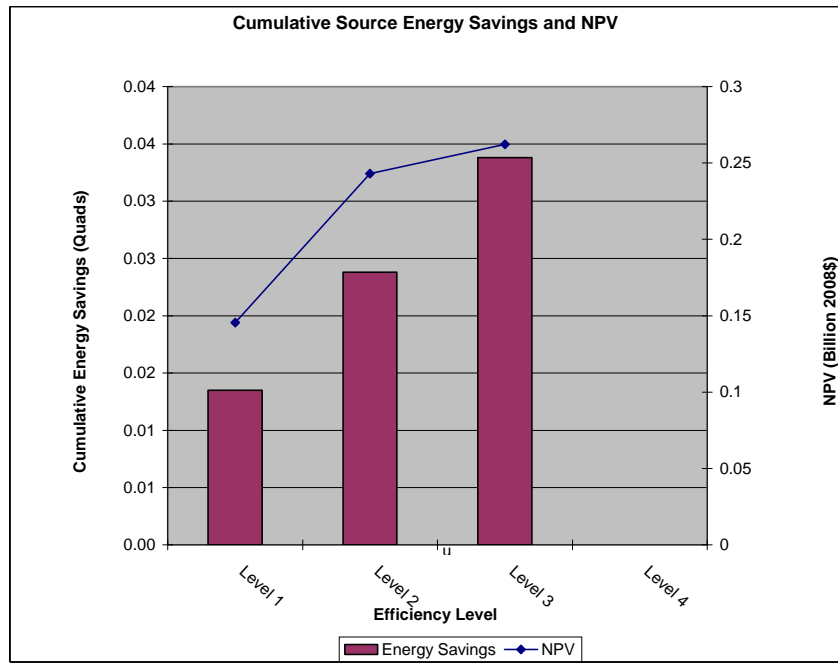


Figure 7-A. 79 Cumulative NPV Results for Large, Oil-fired, Hot Water Based on a Three-Percent Discount Rate (Billion 2008\$), Three-Percent Discount Rate

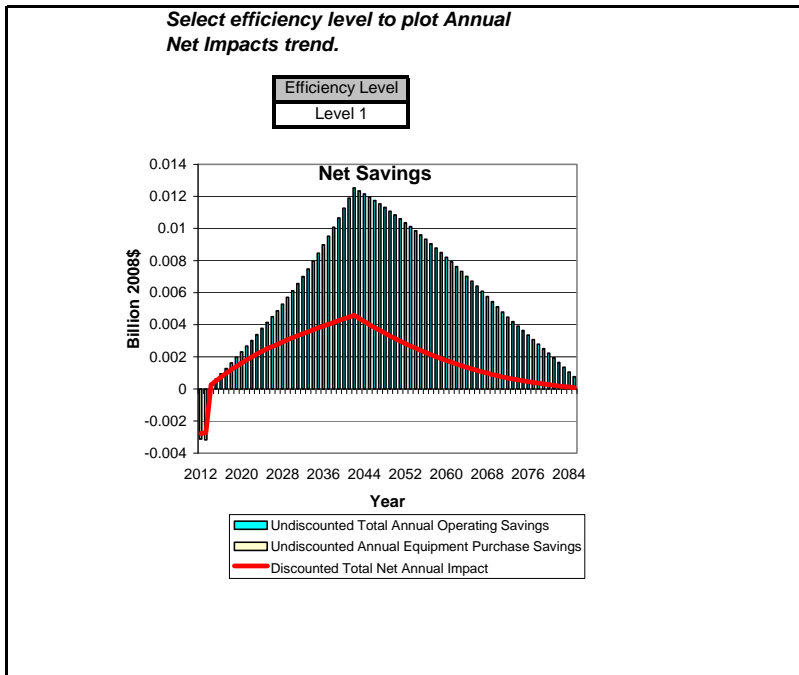


Figure 7-A. 80 National Annual Costs and Savings for Large, Oil-fired, Hot Water, Level 1, Three-Percent Discount Rate

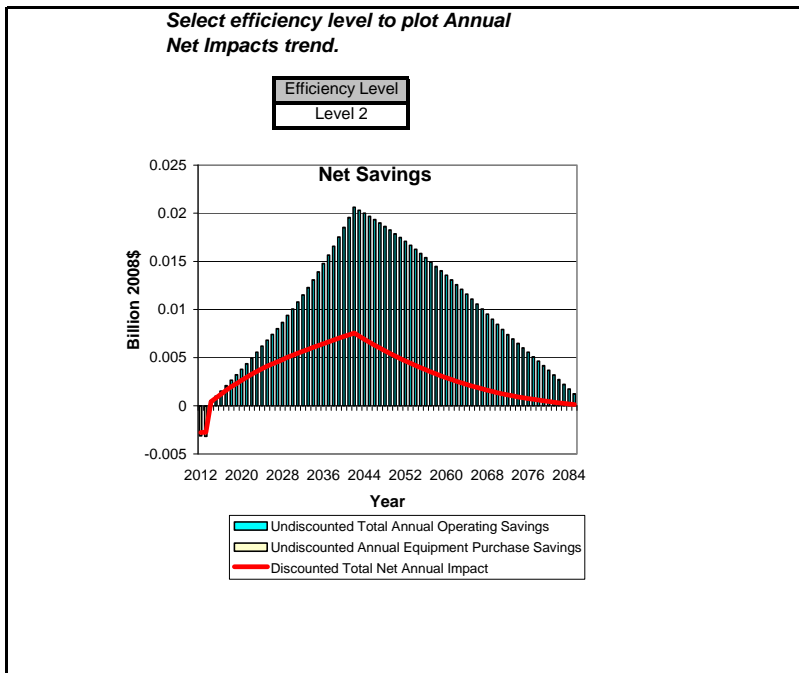


Figure 7-A. 81 National Annual Costs and Savings for Large, Oil-fired, Hot Water, Level 2, Three-Percent Discount Rate

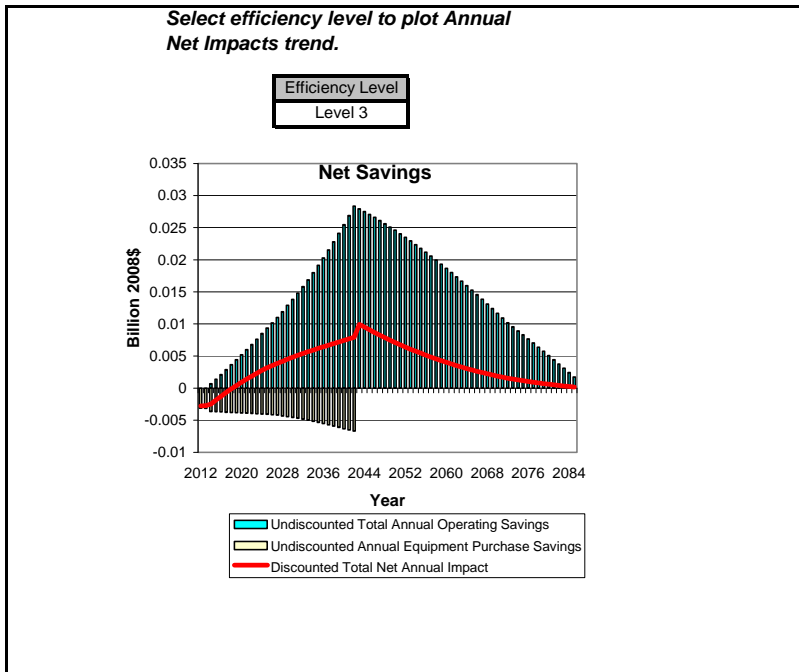


Figure 7-A. 82 National Annual Costs and Savings for Large, Oil-fired, Hot Water, Level 3, Three-Percent Discount Rate

Note: There is no Level 4 for this product class

7-A.3.10 LARGE OIL-FIRED STEAM BOILER

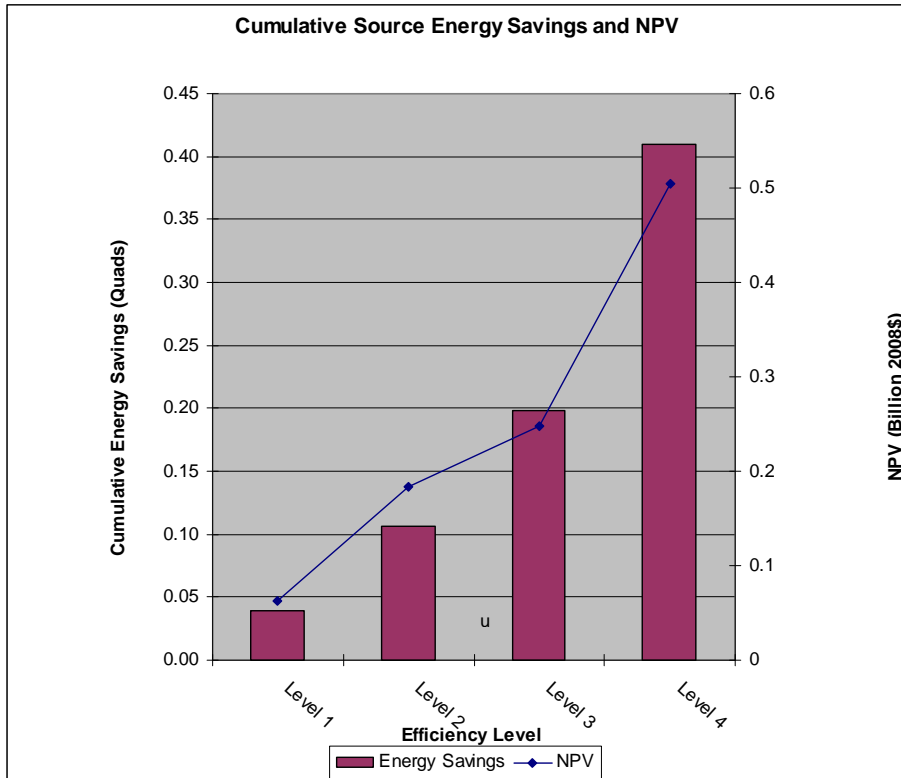


Figure 7-A. 83 Cumulative NPV Results for Large, Oil-fired, Steam Based on a Seven-Percent discount Rate (Billion 2008\$)

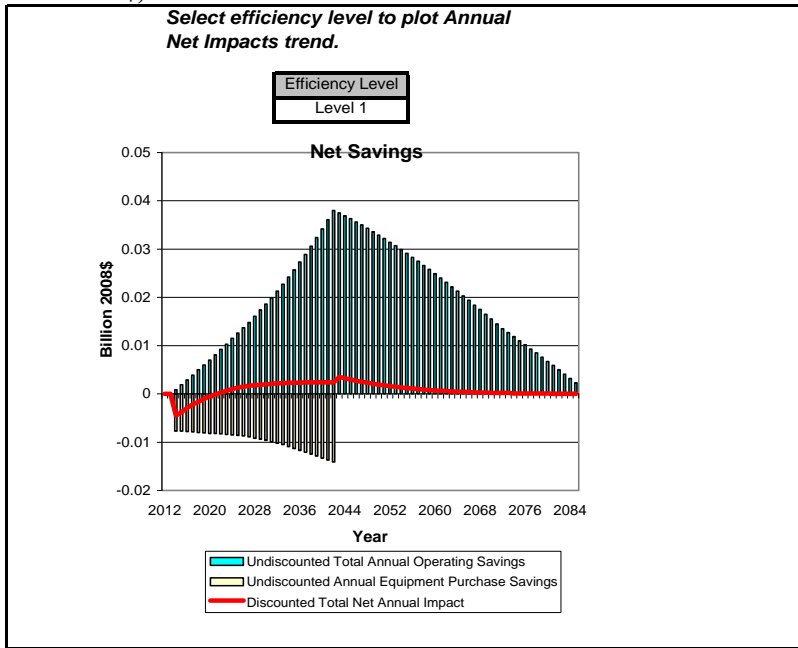


Figure 7-A. 84 National Annual Costs and Savings for Large, Oil-fired, Steam, Level 1, Seven-Percent Discount Rate

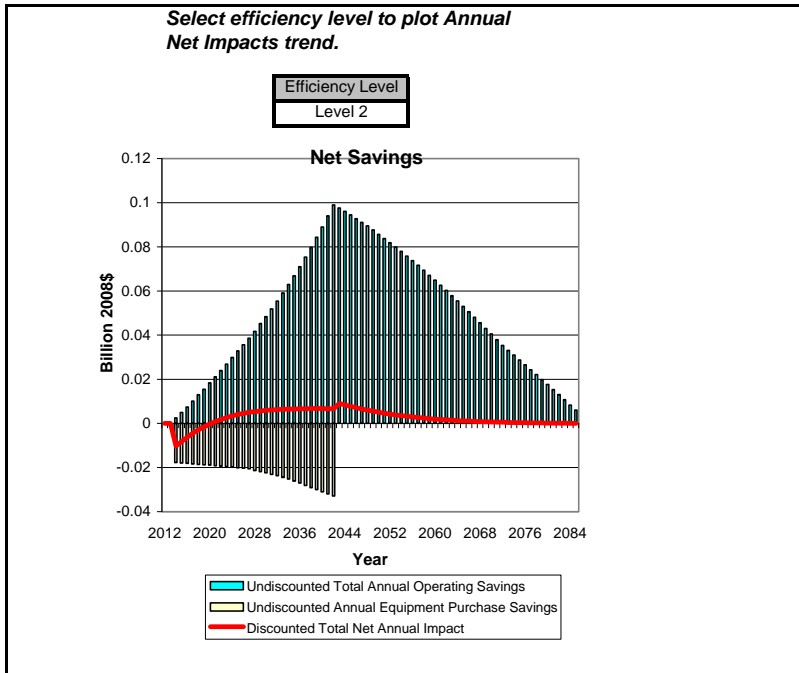


Figure 7-A. 85 National Annual Costs and Savings for Large, Oil-fired, Steam, Level 2, Seven-Percent Discount Rate

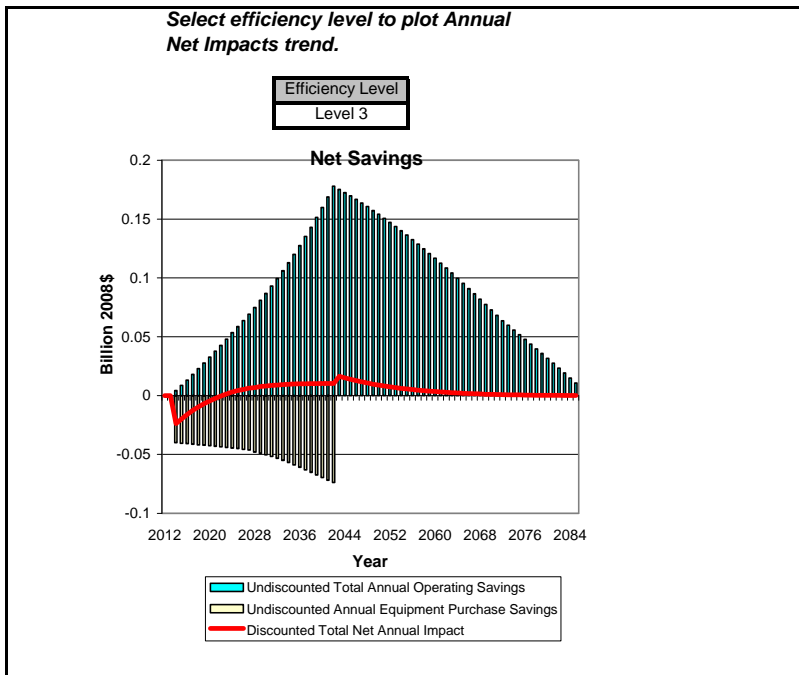


Figure 7-A. 86 National Annual Costs and Savings for Large, Oil-fired, Steam, Level 3, Seven-Percent Discount Rate

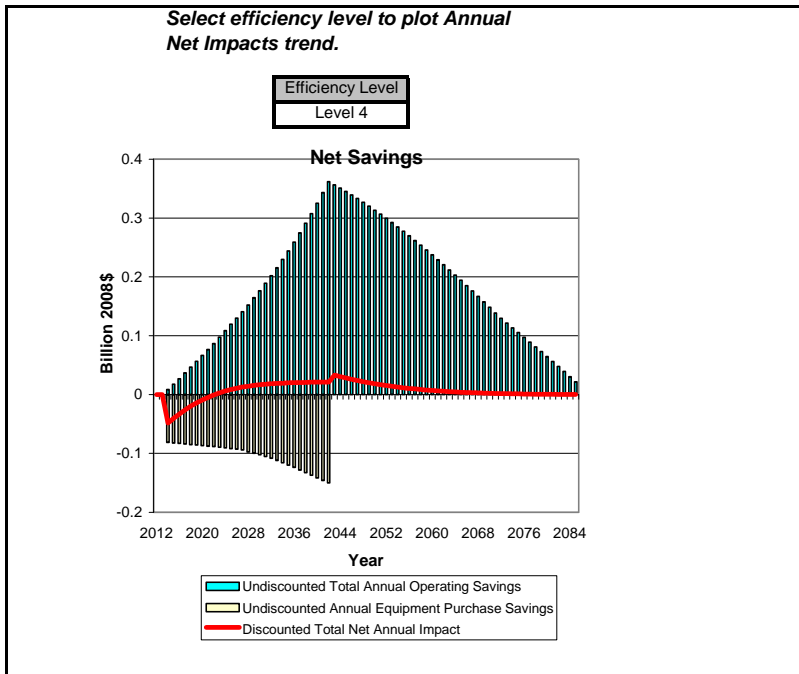


Figure 7-A. 87 National Annual Costs and Savings for Large, Oil-fired, Steam, Level 4, Seven-Percent Discount Rate

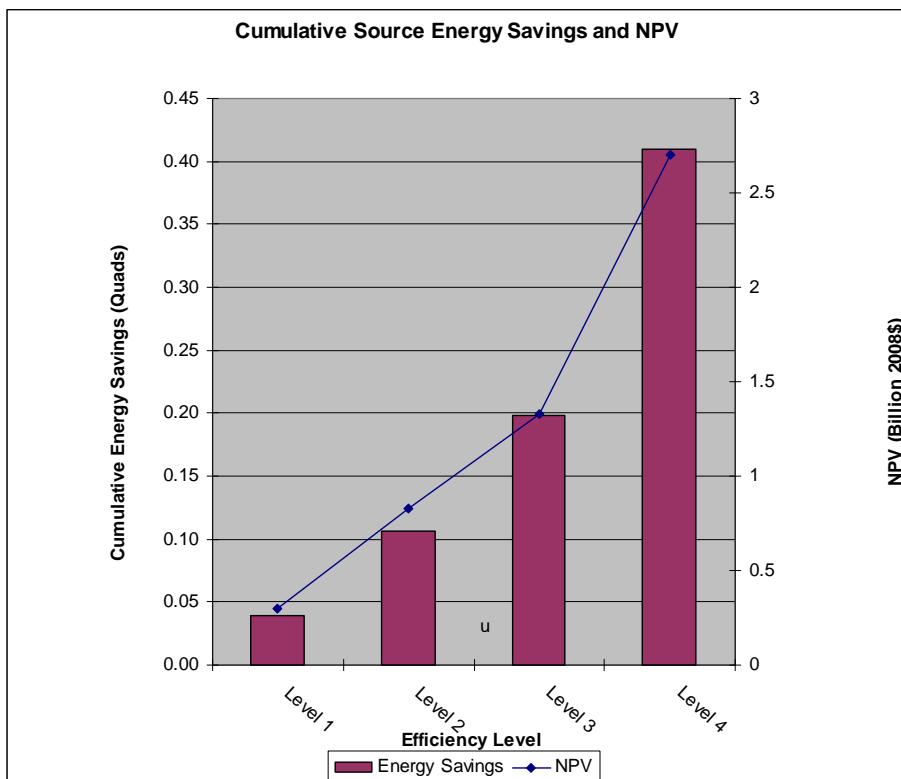


Figure 7-A. 88 Cumulative NPV Results for Large, Oil-fired, Steam Based on a Three-Percent Discount Rate (Billion 2008\$)

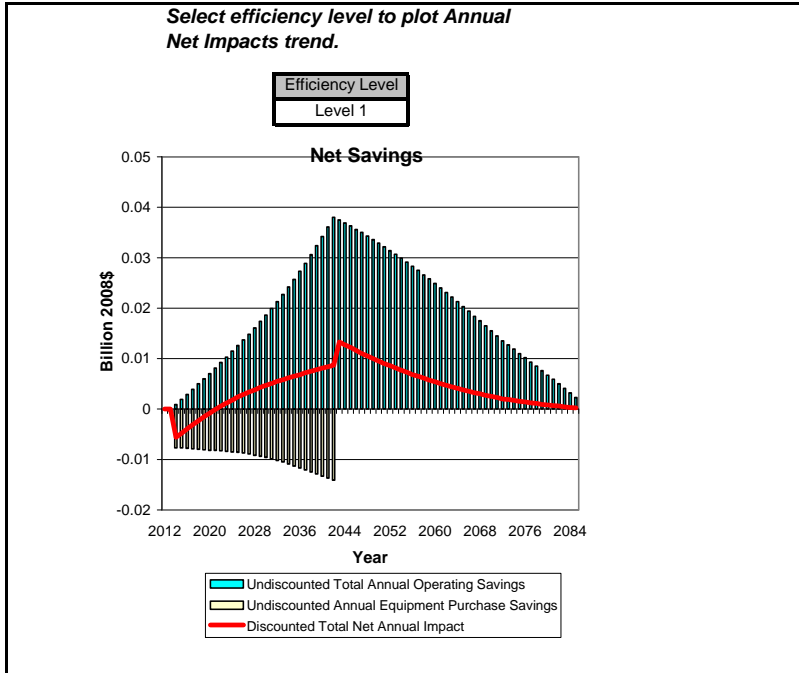


Figure 7-A. 89 National Annual Costs and Savings for Large, Oil-fired, Steam, Level 1, Three-Percent Discount Rate

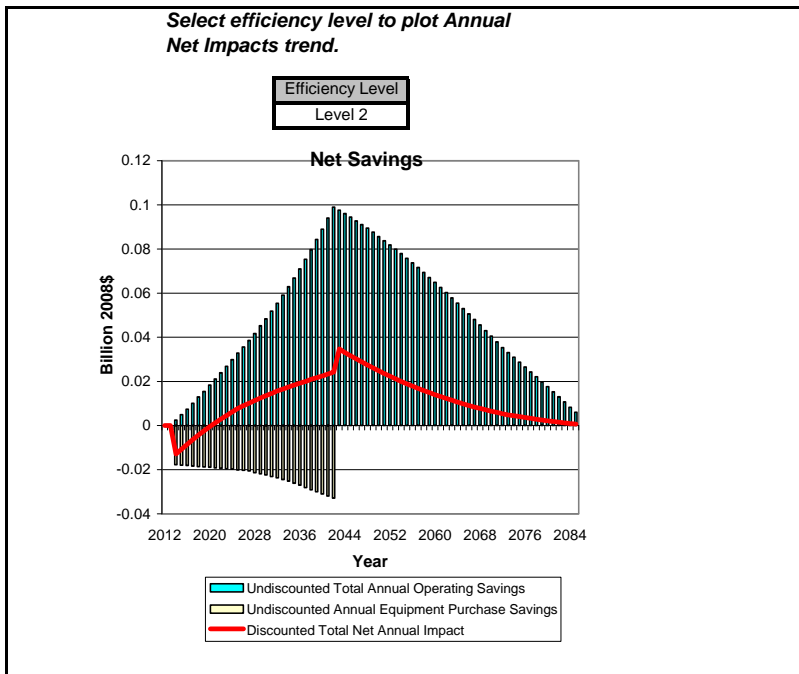


Figure 7-A. 90 National Annual Costs and Savings for Large, Oil-fired, Steam, Level 2, Three-Percent Discount Rate

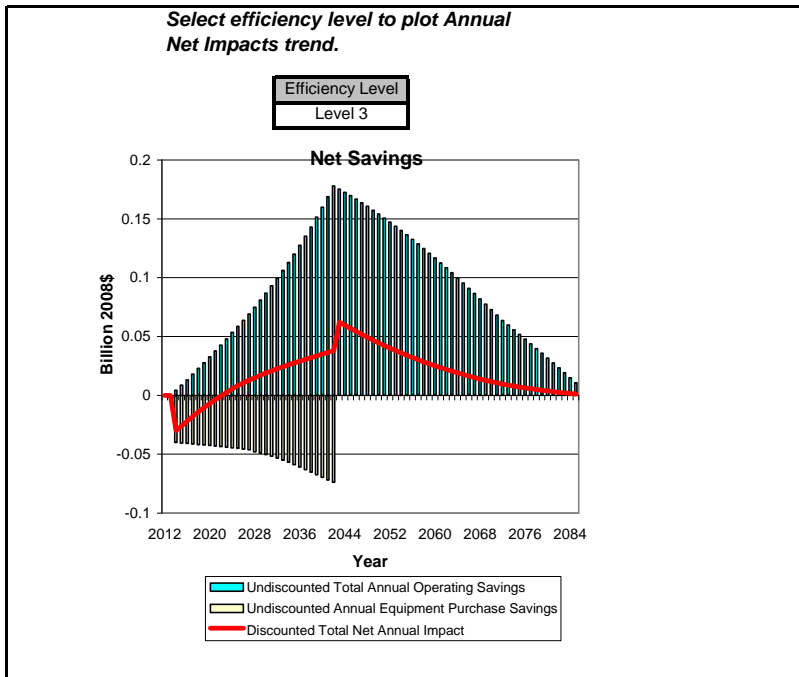


Figure 7-A. 91 National Annual Costs and Savings for Large, Oil-fired, Steam, Level 3, Three-Percent Discount Rate

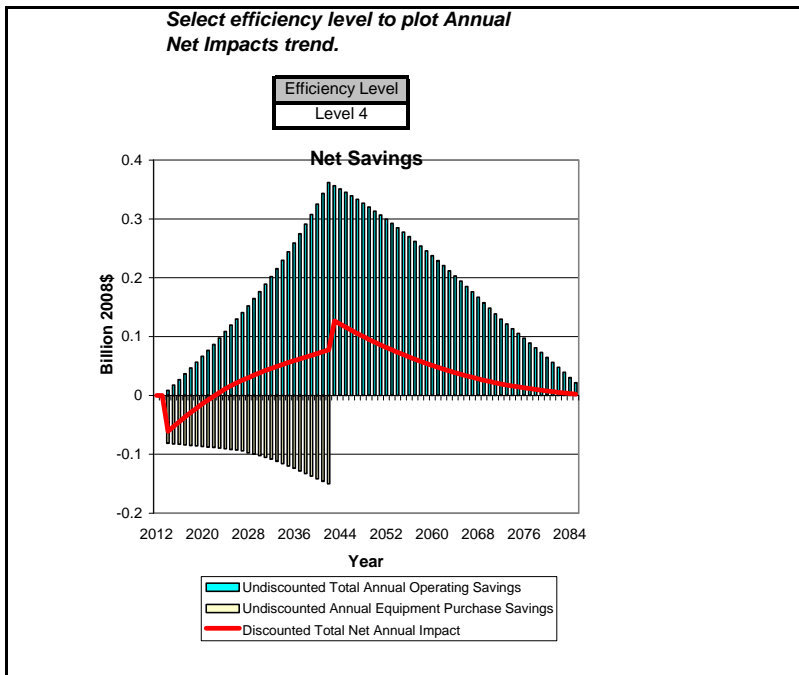


Figure 7-A. 92 National Annual Costs and Savings for Large, Oil-fired, Steam, Level 4, Three-Percent Discount Rate