APPENDIX U. ALTERNATIVE "MAX TECH" SCENARIO AND ITS IMPACT ON NATIONAL ENERGY SAVINGS AND NET PRESENT VALUE

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APPENDIX U. ALTERNATIVE "MAX TECH" SCENARIO AND ITS IMPACT ON NATIONAL ENERGY SAVINGS AND NET PRESENT VALUE

U.1 INTRODUCTION

The maximum technologically feasible design (i.e., "max tech") as established by the engineering analysis (Chapter 5) is 12.0 EER. The national energy savings (NES) and the net present value (NPV) for various candidate standard levels as presented in Chapter 10 were based on a "max tech" energy efficiency ratio (EER) of 12.0. This appendix explores how sensitive the NES and NPV are to an alternative "max tech" scenario. The alternative "max tech" scenario allows the "max tech" design to be 2 EER rating points higher than the prospective standard level and is referred to as the "2+ EER" scenario.

U.2 STANDARDS CASE EFFICIENCY TRENDS

The 2+ EER "max tech" scenario impacts the forecasted standards case efficiency trends. This in turn impacts the determination of the key inputs to the NES and NPV calculation (i.e., annual energy consumption per unit, total annual installed cost, and total annual operating cost savings).

Under the ASHRAE/IESNA Standard 90.1-1999 and 10.0 EER candidate standard levels, the forecasted efficiency trend remains unchanged under the 2+ EER case as the "max tech" design remains at 12.0 EER. But under all other candidate standard levels, the forecasted efficiency trends are impacted as the "max tech" design is greater than 12.0 EER (i.e., 12.5 EER for the 10.5 EER candidate standard level, 13.0 EER for the 11.0 EER candidate standard level, 13.5 EER for the 11.5 EER candidate standard level, and 14.0 EER for the 12.0 EER candidate standard level).

Tables U.2.1 and U.2.2 show the shipment-weighted efficiencies for the standards case efficiency trends under the 2+ EER "max tech" scenario for the ≥65,000 Btu/h to <135,000 Btu/h and ≥135,000 Btu/h to <240,000 Btu/h equipment class es, respectively. The efficiency trends under the 12 EER "max tech" case, which are presented in Chapter 10, Section 10.2.2.1 and Appendix S, are also presented here to show how the 2+ EER trends compare. Note that the assumed effective date of new standards is 2008 for all standards cases with the exception of the ASHRAE 90.1-1999 standards case where the effective date is 2004.

As shown in Tables U.2.1 and U.2.2, only the shipment-weighted efficiencies under the 11.5 EER and 12.0 EER standards cases are significantly impacted by the change in the "max tech" scenario, with the 12.0 EER standards case having the most dramatic change. Even in the 12 EER standards cases, the shipment-weighted efficiencies never exceed 13 EER because few shipments are actually projected to occur beyond 13 EER.

Table U.2.1 ≥65,000 Btu/h to <135,000 Btu/h: Forecasted Shipment-Weighted Efficiencies

	12 EER Max Tech					2+ EER Max Tech				
Year	ASHRAE	10.5 EER	11.0 EER	11.5 EER	12.0 EER	ASHRAE	10.5 EER	11.0 EER	11.5 EER	12.0 EER
2004	10.43	10.11	10.11	10.11	10.11	10.43	10.11	10.11	10.11	10.11
2005	10.46	10.14	10.14	10.14	10.14	10.46	10.14	10.14	10.14	10.14
2006	10.49	10.17	10.17	10.17	10.17	10.49	10.17	10.17	10.17	10.17
2007	10.52	10.21	10.21	10.21	10.21	10.52	10.21	10.21	10.21	10.21
2008	10.55	10.70	11.10	11.54	12.00	10.55	10.70	11.10	11.54	12.03
2009	10.59	10.73	11.13	11.57	12.00	10.59	10.73	11.13	11.58	12.06
2010	10.62	10.76	11.16	11.61	12.00	10.62	10.77	11.16	11.61	12.09
2011	10.65	10.80	11.19	11.64	12.00	10.65	10.80	11.20	11.64	12.13
2012	10.68	10.83	11.23	11.67	12.00	10.68	10.83	11.23	11.67	12.16
2013	10.71	10.86	11.26	11.70	12.00	10.71	10.86	11.26	11.70	12.19
2014	10.75	10.89	11.29	11.73	12.00	10.75	10.90	11.29	11.74	12.22
2015	10.78	10.92	11.32	11.77	12.00	10.78	10.93	11.33	11.77	12.26
2016	10.81	10.96	11.35	11.80	12.00	10.81	10.96	11.36	11.80	12.29
2017	10.84	10.99	11.38	11.83	12.00	10.84	10.99	11.39	11.83	12.32
2018	10.87	11.02	11.42	11.86	12.00	10.87	11.03	11.42	11.87	12.35
2019	10.90	11.05	11.45	11.89	12.00	10.90	11.06	11.46	11.90	12.39
2020	10.93	11.08	11.48	11.92	12.00	10.93	11.09	11.49	11.93	12.42
2021	10.96	11.11	11.51	11.95	12.00	10.96	11.12	11.52	11.96	12.45
2022	11.00	11.14	11.54	11.98	12.00	11.00	11.15	11.55	12.00	12.48
2023	11.03	11.17	11.57	12.00	12.00	11.03	11.19	11.59	12.03	12.52
2024	11.06	11.20	11.60	12.00	12.00	11.06	11.22	11.62	12.06	12.55
2025	11.09	11.23	11.63	12.00	12.00	11.09	11.25	11.65	12.09	12.58
2026	11.11	11.26	11.66	12.00	12.00	11.11	11.28	11.68	12.13	12.61
2027	11.14	11.29	11.69	12.00	12.00	11.14	11.32	11.72	12.16	12.64
2028	11.17	11.32	11.72	12.00	12.00	11.17	11.35	11.75	12.19	12.68
2029	11.20	11.35	11.75	12.00	12.00	11.20	11.38	11.78	12.22	12.71
2030	11.23	11.38	11.78	12.00	12.00	11.23	11.41	11.81	12.26	12.74
2031	11.26	11.41	11.80	12.00	12.00	11.26	11.44	11.84	12.29	12.77
2032	11.29	11.44	11.83	12.00	12.00	11.29	11.48	11.88	12.32	12.81
2033	11.32	11.46	11.86	12.00	12.00	11.32	11.51	11.91	12.35	12.84
2034	11.35	11.49	11.89	12.00	12.00	11.35	11.54	11.94	12.39	12.87
2035	11.37	11.52	11.92	12.00	12.00	11.37	11.57	11.97	12.42	12.90

Table U.2.2 ≥135,000 Btu/h to <240,000 Btu/h: Forecasted Shipment-Weighted Efficiencies

	12 EER Max Tech						2+ EER Max Tech					
Year	ASHRAE	10.0 EER	10.5 EER	11.0 EER	11.5 EER	12.0 EER	ASHRAE	10.0 EER	10.5 EER	11.0 EER	11.5 EER	12.0 EER
2004	10.02	9.77	9.77	9.77	9.77	9.77	10.02	9.77	9.77	9.77	9.77	9.77
2005	10.05	9.81	9.81	9.81	9.81	9.81	10.05	9.81	9.81	9.81	9.81	9.81
2006	10.08	9.84	9.84	9.84	9.84	9.84	10.08	9.84	9.84	9.84	9.84	9.84
2007	10.12	9.87	9.87	9.87	9.87	9.87	10.11	9.87	9.87	9.87	9.87	9.87
2008	10.15	10.34	10.67	11.08	11.53	12.00	10.15	10.34	10.67	11.08	11.53	12.03
2009	10.18	10.37	10.70	11.11	11.57	12.00	10.18	10.37	10.70	11.11	11.57	12.06
2010	10.21	10.40	10.73	11.15	11.60	12.00	10.21	10.40	10.73	11.15	11.60	12.09
2011	10.25	10.44	10.76	11.18	11.63	12.00	10.24	10.44	10.76	11.18	11.63	12.12
2012	10.28	10.47	10.80	11.21	11.66	12.00	10.28	10.47	10.80	11.21	11.66	12.16
2013	10.31	10.50	10.83	11.24	11.70	12.00	10.31	10.50	10.83	11.24	11.70	12.19
2014	10.34	10.53	10.86	11.28	11.73	12.00	10.34	10.53	10.86	11.28	11.73	12.22
2015	10.38	10.57	10.89	11.31	11.76	12.00	10.37	10.57	10.89	11.31	11.76	12.25
2016	10.41	10.60	10.93	11.34	11.79	12.00	10.41	10.60	10.93	11.34	11.79	12.29
2017	10.44	10.63	10.96	11.37	11.83	12.00	10.44	10.63	10.96	11.37	11.83	12.32
2018	10.47	10.66	10.99	11.40	11.86	12.00	10.47	10.66	10.99	11.41	11.86	12.35
2019	10.50	10.69	11.02	11.43	11.89	12.00	10.50	10.69	11.02	11.44	11.89	12.38
2020	10.53	10.72	11.05	11.47	11.92	12.00	10.53	10.72	11.06	11.47	11.92	12.42
2021	10.56	10.76	11.08	11.50	11.95	12.00	10.56	10.76	11.09	11.50	11.96	12.45
2022	10.60	10.79	11.11	11.53	11.98	12.00	10.59	10.79	11.12	11.54	11.99	12.48
2023	10.63	10.82	11.15	11.56	12.00	12.00	10.63	10.82	11.15	11.57	12.02	12.51
2024	10.66	10.85	11.18	11.59	12.00	12.00	10.66	10.85	11.19	11.60	12.05	12.55
2025	10.69	10.88	11.21	11.62	12.00	12.00	10.69	10.88	11.22	11.63	12.09	12.58
2026	10.72	10.91	11.24	11.65	12.00	12.00	10.72	10.91	11.25	11.66	12.12	12.61
2027	10.75	10.94	11.27	11.68	12.00	12.00	10.75	10.94	11.28	11.70	12.15	12.64
2028	10.78	10.97	11.30	11.71	12.00	12.00	10.78	10.97	11.32	11.73	12.18	12.68
2029	10.81	11.00	11.33	11.74	12.00	12.00	10.81	11.00	11.35	11.76	12.22	12.71
2030	10.84	11.03	11.36	11.77	12.00	12.00	10.84	11.03	11.38	11.79	12.25	12.74
2031	10.87	11.06	11.39	11.80	12.00	12.00	10.87	11.06	11.41	11.83	12.28	12.77
2032	10.90	11.09	11.42	11.83	12.00	12.00	10.90	11.09	11.45	11.86	12.31	12.81
2033	10.93	11.12	11.44	11.86	12.00	12.00	10.92	11.12	11.48	11.89	12.35	12.84
2034	10.95	11.15	11.47	11.89	12.00	12.00	10.95	11.15	11.51	11.92	12.38	12.87
2035	10.98	11.17	11.50	11.92	12.00	12.00	10.98	11.17	11.54	11.96	12.41	12.90

U.3 NES AND NPV RESULTS

Table U.3.1 shows the impact of the 2+ EER "max tech" scenario on the NES of the ≥65,000 Btu/h to <135,000 Btu/h and ≥135,000 Btu/h to <240,000 Btu/h equipment classes. As noted in the discussion of the efficiency trends, although the 2+ EER "max tech" design allows for efficiencies of greater than 12.0 EER to occur, shipments of equipment greater than 12.0 EER are gradually phased so that the trends are not dramatically different than those developed with a 12 EER "max tech" scenario. As a result, only the NES results for the 12.0 EER candidate standard levels are significantly different from those results based on the 12 EER "max tech" scenario. In Table U.3.1, both the 12 EER and 2+ EER "max tech" scenarios are presented to show the difference in the NES results based on the differing set of "max tech" assumptions. Figures U.3.1 and U.3.2 graphically compare the NES results from the 12 EER and 2+ EER "max tech" scenarios for the ≥65,000 Btu/h to <135,000 Btu/h and ≥135,000 Btu/h to <240,000 Btu/h equipment classes, respectively.

Table U.3.1 Comparison of Cumulative National Energy Savings between Max Tech Cases for Commercial Unitary Air Conditioners

		≥65,000 Btu/h to <135,00 Btu/h		≥135,000 Btu/h to <240,000Btu/h	
Candidate Standard Level	**Effective Date**	**12 EER Max Tech NES** (Quads)	**2+ EER Max Tech NES** (Quads)	**12 EER Max Tech NES** (Quads)	**2+ EER Max Tech NES** (Quads)
ASHRAE 90.1-1999	2004	0.31	0.31	0.20	0.23
10.0 EER	2008	-	-	0.31	0.31
10.5 EER	2008	0.39	0.40	0.53	0.54
11.0 EER	2008	0.70	0.71	0.79	0.79
11.5 EER	2008	0.98	1.03	1.02	1.05
12.0 EER	2008	1.08	1.33	1.09	1.30

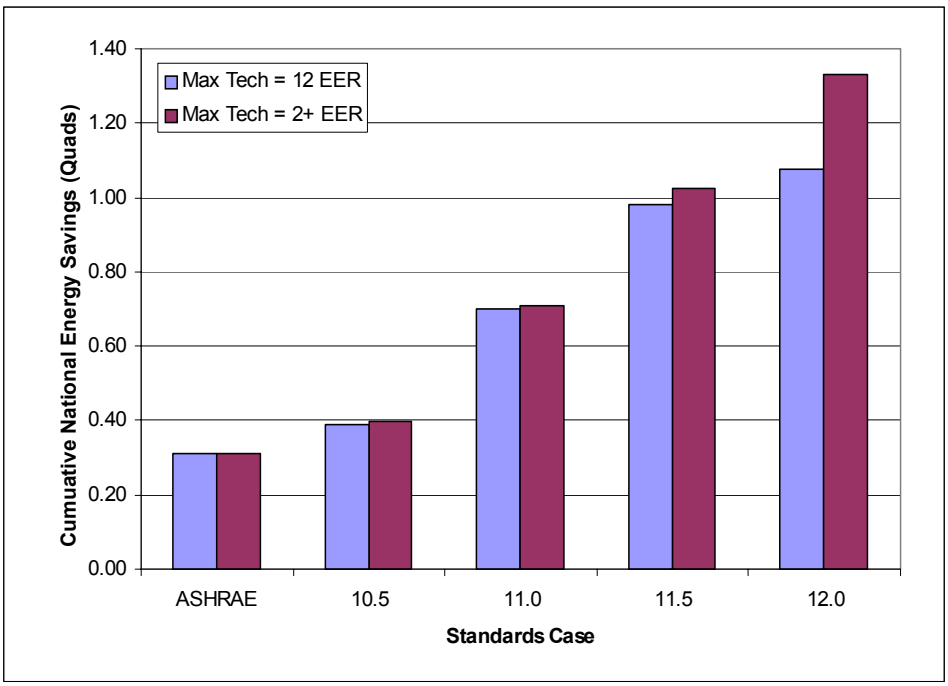

Figure U.3.1 ≥65,000 Btu/h to <135,000 Btu/h: Comparison of Cumulative National Energy Savings between Max Tech Cases

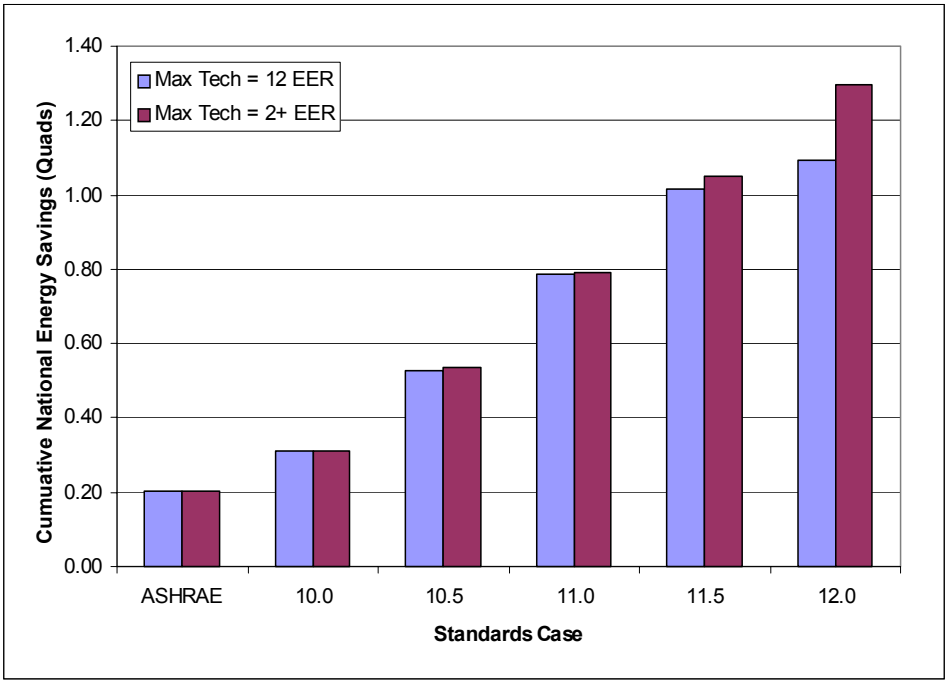

Figure U.3.2 ≥135,000 Btu/h to <240,000 Btu/h: Comparison of Cumulative National Energy Savings between Max Tech Cases

Table U.3.2 shows the impact of the 2+ EER "max tech" scenario on the NPV of the ≥65,000 Btu/h to <135,000 Btu/h and ≥135,000 Btu/h to <240,000 Btu/h equipment classes. As with the NES results, only the NPV results for the 12.0 EER candidate standard levels are significantly different from those results based on the 12 EER "max tech" scenario. But as opposed to the NES results where the 2+ EER "max tech" scenario yields greater energy savings for the 12.0 EER standards case, the 2+ EER "max tech" scenario yields a lower NPV than the 12 EER "max tech" scenario. Although the 2+ EER "max tech" scenario for the 12.0 EER standards case yields greater bill savings to the Nation, it is offset by the much higher equipment costs that are incurred. Figures U.3.1 and U.3.2 graphically compare the NPV results from the 12 EER and 2+ EER "max tech" scenarios for the ≥65,000 Btu/h to <135,000 Btu/h and ≥135,000 Btu/h to <240,000 Btu/h equipment classes, respectively.

Table U.3.2 Comparison of Cumulative NPV result between Max Tech Cases for Commercial Unitary Air Conditioners based on a 7 percent Discount Rate (billion 2001$)

Candidate Standard Level	Effective Date	≥65,000 Btu/h to <135,00 Btu/h		≥135,000 Btu/h to <240,000Btu/h	
		12 EER Max Tech NPV (billion '01$)	2+ EER Max Tech NPV (billion '01$)	12 EER Max Tech NPV (billion '01$)	2+ EER Max Tech NPV (billion '01$)
ASHRAE 90.1-1999	2004	0.52	0.52	0.37	0.37
10.0 EER	2008	-	-	0.51	0.51
10.5 EER	2008	0.57	0.58	0.83	0.84
11.0 EER	2008	0.93	0.93	1.12	1.13
11.5 EER	2008	1.08	1.09	1.24	1.25
12.0 EER	2008	1.02	0.91	1.20	1.12

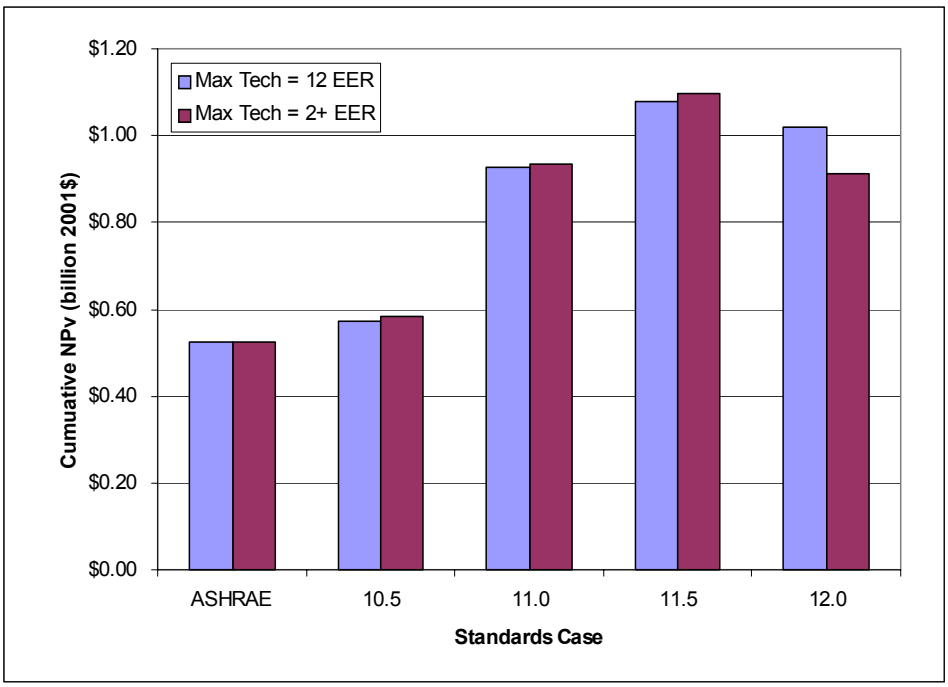

Figure U.3.3 ≥65,000 Btu/h to <135,000 Btu/h: Comparison of Cumulative NPV between Max Tech Cases

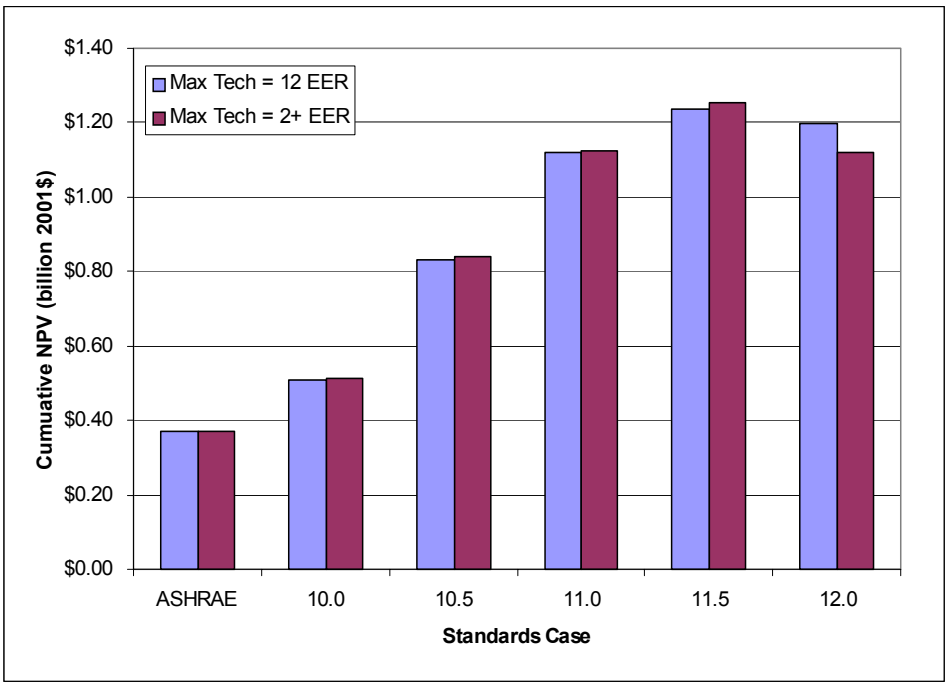

Figure U.3.4 ≥135,000 Btu/h to <240,000 Btu/h: Comparison of Cumulative NPV between Max Tech Cases