Changes to Assumptions, Selection of Trial Standard Levels and Summary of Results

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The Department published the Supplemental Advance Notice of Proposed Rulemaking (SANOPR) for Central Air Conditioners and Heat Pump Energy Efficiency Standards on November 24, 1999 and presented the results of the SANOPR analyses at a public workshop on December 9, 1999. The purpose of the SANOPR publication was to provide interested parties with the opportunity to comment on the product classes, analytical framework, preliminary economic analyses and the candidate standard levels which were developed from the analyses. The workshop presented the analyses and focused on issues and planned studies for the Notice of Proposed Rulemaking (NOPR) phase of the rulemaking. The Department also posted to the DOE website the results of several Life Cycle Cost (LCC) sensitivity analyses in January, 2000.

The Department received numerous comments and suggestions from the interested parties. All of these suggestions were carefully reviewed and a number were accepted as the basis for conducting the economic studies for the NOPR.

In addition to describing the Trial Standard Levels, this document highlights the changes to assumptions and summarizes the revised analyses performed in responding to written and oral comments provided by interested parties. Based on the Department's improved process for revising minimum efficiency standards, this information is presented to facilitate discussion amongst the interested parties and to provide feedback before the Department issues its NOPR.

Highlights of Changes to Assumptions

Life-Cycle Cost (LCC) Analysis

Of the several changes made to the LCC analysis assumptions, there are two which had a significant impact on the LCC results: 1) changes to the markups and 2) the addition of replacement costs for original compressor failures.

The markups used to convert manufacturer costs to consumer equipment prices were revised significantly based on estimates of the markups used by distributors/wholesalers and dealers/contractors on *marginal* increases in equipment costs. A new analysis of data from several sources indicates that distributors and dealers do not apply their average markups to marginal increases in equipment costs, but rather a much lower markup rate. This behavior appears to be consistent with the modest changes in the product handling costs incurred by distributors and dealers. The revised markups yield lower estimates of consumer equipment prices.

Equipment lifetime used in the SANOPR was based on a survey which showed a survival function with an 18.4 year mean lifetime. Comments from industry were critical of that assumption claiming the mean lifetime was too long. The Department, in reviewing the original survey determined that the 18.4 year mean lifetime was based on most households replacing a compressor once during the system's life. For the revised analysis, we retain the same lifetime assumption from the SANOPR, but now include a replacement costs for a compressor failure. Since more efficient systems utilize more expensive compressors, the compressor replacement costs associated with higher efficiency equipment are noticeably greater than those for baseline equipment.

Other, less significant, changes to the LCC analysis assumptions include: 1) changing the baseline manufacturer costs slightly, 2) conducting the primary analysis with Air-Conditioning & Refrigeration Institute (ARI) shipment-weighted mean manufacturer cost multipliers (although reverse engineering estimates are analyzed in an LCC scenario), 3) changing the installation costs slightly, 4) keeping repair costs constant through equipment efficiencies of 13 SEER, 5) updating residential energy use, equipment efficiency, and electricity price data to the 1997 Residential Energy Consumption Survey (RECS), 6) assuming equipment use in commercial buildings is 10 percent of unitary equipment shipments, and 7) using a new methodology to develop discount rates.

LCC Scenarios

The Department received a number of comments which recommended re-evaluation of two key assumptions for the LCC analysis: manufacturer costs and system lifetime. These comments suggested that values assumed for both factors may have been overestimated.

Manufacturer Cost Scenario

Manufacturer costs are one input to the LCC analysis where strong sentiments were expressed that industry-provided cost estimates were overstated. Several comments suggested that once a new standard takes effect, competitive pressures would likely force manufacturers to produce equipment at costs lower than the shipment-weighted mean estimates provided by ARI.

To provide balance for this issue, an LCC scenario in which manufacturer cost estimates based on the revised Reverse Engineering Analysis is substituted for the estimates provided by ARI

Lifetime Scenario

The Department received several comments suggesting that the 18.4 year unit life used in the SANOPR analysis was too long and proposed a 15 or even a 12 year life instead. Another comment argued that when a major component fails, the equipment is often repaired and its life extended. The Department determined that the detailed published field study from which an 18.4 year lifetime was established also concluded that most equipment owners extend the equipment's lifetime by replacing a compressor. But in order to investigate the impact of shorter equipment life, a lifetime scenario is considered based on a retirement function yielding an average lifetime of 14 years in which no compressor replacement occurs.

National Energy Savings (NES) Analysis

Changes to the LCC assumptions impact the National Energy Savings (NES) and the National Net Present Value (NPV) analyses directly as the NES analysis uses the same basic data as the LCC analysis for the energy use and cost of the central air-conditioning and heat pump equipment.

Estimates of NES and NPV depend on the distribution of product efficiencies in the marketplace, i.e., the percentage of shipments which occur in one SEER bins over the range from the new minimum standard to an 18 SEER standard. For the SANOPR, the assumed product efficiency distribution was based on a weighted-average equipment efficiency equal to the SEER of the new standard level. For the revised analysis, we assumed a different distribution of efficiencies based on three *alternative efficiency scenarios*:

- NAECA: The *NAECA* scenario (named after the legislation which promulgated minimum efficiency standards for central air conditioners and heat pumps) assumes that equipment efficiencies, after adoption of new standards, would change in the same pattern as the efficiency changes that occurred in 1992 when minimum efficiency standards first took effect.

- Roll-up: The *Roll-up* scenario assumes efficiency levels below the new standard level increase to the SEER value of the new standard. For example, in the case of a 12 SEER standard, if 60 percent of shipments have efficiencies below 12 SEER, all those shipments are moved to the 12 SEER level without affecting the efficiency distribution above 12 SEER.

- Shift: The *Shift* scenario assumes a new efficiency distribution based on the old distribution but simply adjusted to the new minimum standard .

NPV Scenarios

NPV is calculated as the difference between two relatively large numbers: the total purchase and operating cost at the National level, assuming no standards; and the total purchase and operating cost at the National level, under new standards. Associated with each of these total costs is uncertainty and variability in several assumptions used in both the LCC and NES analyses. Consequently, changes in some key input assumptions have a significant impact on the resulting NPVs.

In addition to the previous mentioned Manufacturer Cost Scenario and Equipment Life Scenario, we also examined a Discount Rate Scenario for the NPV analysis

NPV Manufacturer Cost Scenario

Using the revised Reverse Engineering Analysis cost data, we performed a manufacturer cost scenario analysis to determine the NPV under the NAECA efficiency scenario.

Lifetime Scenario

Using an average equipment lifetime of 14 years with no compressor replacement, we performed a lifetime scenario analysis to determine the NPV under the NAECA efficiency scenario.

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Discount Rates Scenario

Using a discount rate of 3% rather than a value of 7%, we performed a discount rate scenario analysis to determine the NPV under the NAECA efficiency scenario.

Trial Standard Levels

The Process Rule requires the Department to select a proposed standard level based on consensus stakeholder recommendations, analysis of impacts, and new information for screening design options. Included in the impacts analyses are the impacts on consumers, manufacturers, and the Nation, as well as impacts on competition, utilities, the environment, and non-regulatory approaches. Upon completing the consumer, manufacturer and National impacts analyses, but absent completion of all the other impact analyses, the Department decided to select Trial Standard Levels for further evaluation and for discussion by the interested parties prior to selecting a proposed standard..These Trial Standard Levels are based on a) SEER levels identified in the SANOPR b) the SEER level identified as the Maximum Technologically Feasible level, c) a combination of SEER levels for different product classes that has potentially positive impacts on consumers and the Nation.

Candidate Standard Levels from SANOPR

Based on the preliminary analyses performed in the SANOPR, the Department observed that, uniform efficiency levels for all product classes ranging from 11 to 13 SEER appeared to result in the greatest economic benefits to both consumers and the Nation. Consequently, the Department announced its intention to further consider and conduct analyses for SEER 11, SEER 12, and SEER 13, for each product class, prior to issuance of the NOPR:

Max Tech

In selecting candidate standard levels, the Process Rule requires the Department to consider equipment which has the most energy efficient combination of design options. The highest efficiency level that is "technologically feasible and economically justified" is known as "Max Tech." A product can be technologically feasible without being either commercially practical or economically justified. During the SANOPR, the Department performed an assessment of thermodynamic limitations and potential system improvements and estimated the highest commercially practical efficiency level to be about 20 SEER.

However, the Department received a number of comments from industry stating that despite significant efforts and using all available technologies that the highest efficiency level manufacturers have been able to achieve is an 18 SEER. Based on these comments, the Department revised the Maximum Technologically Feasible level for each product class to 18 SEER. We note that in conducting the economic analyses for this standard level, the greatest production cost multiplier data for each product class and efficiency level available to the Department was 15 SEER which was based on ARI data. Extrapolation of 15 SEER data to 18 SEER was believed to be unjustified. Consequently, the economic analyses for the 18 SEER case are all based on the 15 SEER cost multipliers, therefore, the economic results represent, at best, a lower bound to the actual values.

Other

In addition to considering equipment which has the most energy efficient combination of design options, other criteria for selecting candidate standard levels include: the combination of design options with the lowest life-cycle costs; and standard levels that incorporate noteworthy technologies or fill in large gaps between efficiency levels of other candidate standards levels. In this case the LCC results for different product classes show positive savings for consumers (although not necessarily the minimum savings) and fill in the gap between uniform efficiency levels for the candidate standard levels.

Based on these criteria, results will be presented for the following five Trial Standard Levels (TSL):

- **TSL 1**: 11 SEER for all product classes,
- **TSL 2**: 12 SEER for all product classes,
- **TSL 3**: 12 SEER for air conditioners and 13 SEER for heat pumps,
- **TSL 4**: 13 SEER for all product classes, and
- **TSL 5**: 18 SEER for all product classes.

Summary of Results

Life-Cycle Cost

At each TSL, the LCC analysis provides a distribution of net costs or net savings relative to the current baseline. In determining economic impacts on consumers, we examine the mean value for the distribution which might be a decrease in LCC (savings) or an increase in LCC (cost) relative to baseline. From the distribution, we also determine the percentage of consumers that are adversely impacted by a new standard..

For the SANOPR, all consumers incurring an LCC increase as a result of a new standard were considered to be adversely impacted. This adverse impact included consumers that incur a relatively small LCC increase (e.g., $10) relative to a much larger baseline LCC.. (Note that the baseline LCC is approximately $5000 for central air conditioners and $10,000 for heat pumps.)

We now introduce a new concept with regard to the percentage of consumers (both residential and commercial) that are adversely impacted. The revised analysis defines adverse impacts by including in this category only those consumers who incur LCC increases exceeding 2 percent of the baseline LCC. For central air conditioners, this translates to an LCC increase of approximately $100 or an annual expense of approximately $5 over the lifetime of the system. Note that the concept of 2 percent of the baseline LCC as being significant is also the basis of the proposed rule for water heaters.

Tables 1 through 4, respectively, show the revised LCC results for split system air conditioners, split system heat pumps, single package air conditioners and single package heat pumps. The tables show the average LCC values and the average LCC savings or increases. In addition, each table shows the percentage of consumers at each efficiency level that achieve either *significant* net LCC savings (i.e., LCC savings greater than 2 percent of the baseline LCC), an *insignificant* reduction or increase in LCC (i.e., within ±2 percent of the baseline LCC), or a *significant* net LCC increase (i.e., an LCC increase exceeding 2 percent of the baseline LCC).

Table 1 LCC Results for Split System Central Air Conditioners

SEER	Average LCC	Average LCC (Savings) Costs	Percent Consumers with		
			Net Savings (>2%)	No Significant Impact	Net Costs (>2%)
10	$5,170	-	-	-	-
11	$5,126	($44)	23%	68%	9%
12	$5,125	($45)	27%	34%	39%
13	$5,199	$29	25%	17%	58%
18	$5,725	$555	15%	4%	81%

Table 2 LCC Results for Split System Heat Pumps

SEER	Average LCC	Average LCC (Savings) Costs	Percent Consumers with		
			Net Savings (>2%)	No Significant Impact	Net Costs (>2%)
10	$9,679	-	-	-	-
11	$9,529	($150)	30%	70%	0%
12	$9,437	($242)	42%	55%	3%
13	$9,464	($215)	39%	39%	22%
18	$9,955	$276	23%	11%	66%

Table 3 LCC Results for Single Package Central Air Conditioners

SEER	Average LCC	Average LCC (Savings) Costs	Percent Consumers with		
			Net Savings (>2%)	No Significant Impact	Net Costs (>2%)
10	$5,629	-	-	-	-
11	$5,649	$20	16%	47%	37%
12	$5,600	($29)	26%	30%	44%
13	$5,804	$175	18%	11%	71%
18	$6,370	$741	12%	4%	84%

Table 4 LCC Results for Single Package Heat Pumps

SEER	Average LCC	Average LCC (Savings) Costs	Percent Consumers with		
			Net Savings (>2%)	No Significant Impact	Net Costs (>2%)
10	$9,626	-	-	-	-
11	$9,492	($134)	28%	72%	0%
12	$9,372	($254)	44%	49%	7%
13	$9,514	($112)	33%	31%	36%
18	$9,922	$296	24%	10%	66%

LCC Scenarios

Manufacturer Cost Scenario

Tables 5 through 8 show the LCC results for each of the product classes under the scenario of replacing the ARI manufacturer cost estimates with those from the Reverse Engineering Analysis. The following results are presented in the same manner as the previous LCC results where average LCC savings or costs and the percentage of consumers with net savings, insignificant impacts, and net costs are presented for each efficiency level. Note that since manufacturer cost multipliers were not available for the 18 SEER efficiency levels, 15 SEER cost multipliers were used for all 18 SEER calculations resulting in 18 SEER LCC results which underestimate their true cost level.

Table 5 LCC Results for Split System A/C – Scenario with Reverse Engineering Costs

	Average	Average LCC	Percent Consumers with		
SEER	LCC	(Savings) Costs	Net Savings (>2%)	No Significant Impact	Net Costs (>2%)
10	$5,170	-	-	-	-
11	$5,095	($75)	28%	70%	2%
12	$5,057	($113)	35%	40%	25%
13	$5,057	($113)	34%	27%	39%
18	$5,307	$137	25%	7%	68%

Table 6 LCC Results for Split System HP – Scenario with Reverse Engineering Costs

	Average	Average LCC	Percent Consumers with		
SEER	LCC	(Savings) Costs	Net Savings (>2%)	No Significant Impact	Net Costs (>2%)
10	$9,679	-	-	-	-
11	$9,470	($209)	40%	60%	0%
12	$9,314	($365)	58%	42%	0%
13	$9,307	($372)	52%	42%	6%
18	$9,720	$41	28%	15%	57%

Table 7 LCC Results for Single Package A/C – Scenario with Reverse Engineering Costs

	Average	Average LCC	Percent Consumers with		
SEER	LCC	(Savings) Costs	Net Savings (>2%)	No Significant Impact	Net Costs (>2%)
10	$5,629	-	-	-	-
11	$5,551	($78)	27%	72%	1%
12	$5,466	($163)	40%	51%	9%
13	$5,600	($29)	28%	20%	52%
18	$5,905	$276	21%	6%	73%

Table 8 LCC Results for Single Package HP – Scenario with Reverse Engineering Costs

SEER	Average LCC	Average LCC (Savings) Costs	Percent Consumers with Net Savings (>2%)	Percent Consumers with No Significant Impact	Percent Consumers with Net Costs (>2%)
10	$9,626	-	-	-	-
11	$9,419	($207)	39%	61%	0%
12	$9,205	($421)	66%	34%	0%
13	$9,273	($353)	50%	38%	12%
18	$9,460	($166)	37%	15%	48%

Lifetime Scenario

Tables 9 through 13 show the LCC results for each of the product classes under the 14 year lifetime, no compressor replacement scenario. The following results are presented in the same manner as the previous LCC results where average LCC savings or costs and the percentage of consumers with net savings, insignificant impacts, and net costs are presented for each efficiency level. Note that since manufacturer cost multipliers were not available for the 18 SEER efficiency levels, 15 SEER cost multipliers were used for all 18 SEER calculations resulting in 18 SEER LCC results which underestimate their true cost level.

Table 9 LCC Results for Split System A/C – Scenario with 14 year average Lifetime

SEER	Average LCC	Average LCC (Savings) Costs	Percent Consumers with Net Savings (>2%)	Percent Consumers with No Significant Impact	Percent Consumers with Net Costs (>2%)
10	$4,682	-	-	-	-
11	$4,650	($32)	22%	69%	9%
12	$4,672	($10)	24%	31%	45%
13	$4,769	$87	21%	15%	64%
18	$5,336	$654	12%	3%	85%

Table 10 LCC Results for Split System HP – Scenario with 14 year average Lifetime

SEER	Average LCC	Average LCC (Savings) Costs	Percent Consumers with Net Savings (>2%)	Percent Consumers with No Significant Impact	Percent Consumers with Net Costs (>2%)
10	$8,747	-	-	-	-
11	$8,623	($124)	27%	73%	0%
12	$8,587	($160)	35%	58%	7%
13	$8,630	($117)	33%	37%	30%
18	$9,184	$437	18%	9%	73%

Table 11 LCC Results for Single Package A/C – Scenario with 14 year average Lifetime

SEER	Average LCC	Average LCC (Savings) Costs	Percent Consumers with Net Savings (>2%)	No Significant Impact	Net Costs (>2%)
10	$5,150	-	-	-	-
11	$5,182	$32	14%	46%	40%
12	$5,157	$7	22%	29%	49%
13	$5,378	$228	14%	10%	76%
18	$6,011	$861	9%	3%	88%

Table 12 LCC Results for Single Package HP – Scenario with 14 year average Lifetime

SEER	Average LCC	Average LCC (Savings) Costs	Percent Consumers with Net Savings (>2%)	No Significant Impact	Net Costs (>2%)
10	$8,695	-	-	-	-
11	$8,597	($98)	25%	75%	0%
12	$8,528	($167)	37%	51%	12%
13	$8,707	$12	26%	27%	47%
18	$9,179	$484	18%	8%	74%

Manufacturer Impacts

Table 13 presents estimated changes in net present value for the unitary air conditioning industry for three shipment scenarios based on the industry-provided mean cost multipliers. Results assume that lower cost manufacturers control 25 percent of the market and higher cost manufacturers control 75 percent. Since we did not collect information regarding the cost or investments involved in manufacturing product solely at 18 SEER, we did not assess impacts under Max Tech (Standard Level 5).

Table 13 Changes in Industry Net Present Value

Trial Standard Level	Base Case NPV	Efficiency Scenario					
		NAECA		Roll-up		Shift	
	(million 98$)	*million 98$*	*% change*	*million 98$*	*% change*	*million 98$*	*% change*
1	$ 1,721	$ (33)	-2%	$ (191)	-11%	$ 155	9%
2	$ 1,721	$ (174)	-10%	$ (365)	-21%	$ 269	16%
3	$ 1,721	$ (193)	-11%	$ (377)	-22%	$ 293	17%
4	$ 1,721	$ (179)	-10%	$ (344)	-20%	$ 358	21%
5	$ 1,721	--	--	--	--	--	--

National Energy Savings and Net Present Value

The NES/NPV is an economic analysis that evaluates the consequences of alternative increases in minimum efficiency standards in terms of consumers' benefits and costs. For each Trial Standard Level, the benefits and costs are examined in relation to a baseline case in which there is no change from the current, i.e., NAECA, standard.

The NES is an estimate of the benefit to the Nation in terms of energy savings experienced by consumers. The NPV is an estimate of the economic benefits to the Nation in terms of savings in consumers' energy costs relative to increased costs to consumers for higher efficiency equipment.
The NPV does not include such benefits to the Nation as the monetary savings due to not constructing new power plants and the monetary savings due to fewer pollutant emissions.

National Energy Savings (NES) Results

Table 14 shows the NES results for the five TSLs. Three sets of results are provided based on the three efficiency scenarios described earlier: 1) NAECA, 2) Roll-up, and 3) Shift. Each set of results is based on electricity price forecasts from the *2000 Annual Energy Outlook (AEO)*, Reference Case.

Table 14 NES Results for Trial Standard Levels

	Efficiency Scenario		
	NAECA	**Roll-up**	**Shift**
Trial Standard Level	*Quads*	*Quads*	*Quads*
1	2.2	1.9	2.4
2	3.8	3.6	4.3
3	4.4	4.2	4.9
4	5.4	5.3	5.9
5	10.4	10.4	10.4

National Net Present Value (NPV)

The cumulative sum of equipment and operating costs to the Nation for all central air-conditioning and heat pump equipment under the base case (i.e., in the absence of new efficiency standards) is estimated at $381 billion. The NPV is the difference in equipment plus operating costs between the base case and those for each TSL.

Table 15 shows the NPV results for the five TSLs for the three efficiency scenarios. Each set of results is based on electricity price forecasts from the *2000 Annual Energy Outlook (AEO)*, Reference Case.

Table 15 shows the total (cumulative) national equipment and operating costs and the NPVs as both a cost difference and as a percentage of the total cost for the five TSLs. Total costs range from approximately $381 billion to $407 billion. NPVs (rounded to the nearest billion) range from a savings of $1 billion to a cost of $22 billion. As a percentage of the total costs, the NPVs range from a savings of 0.2 percent to a cost of 5.8 percent.

Table 15 NPV Results for Trial Standard Levels by Efficiency Scenario

	Base Case	Efficiency Scenario								
		NAECA			Roll-up			Shift		
	Total	Total	NPV		Total	NPV		Total	NPV	
TSL	*billion 98$*	*billion 98$*	*billion 98$*	*as % of Base Case Total*	*billion 98$*	*billion 98$*	*as % of Base Case Total*	*billion 98$*	*billion 98$*	*as % of Base Case Total*
1	$381	$381	$0	0.0%	$381	$1	0.2%	$385	$0	-0.1%
2	$381	$382	($1)	-0.3%	$381	$0	0.0%	$388	($3)	-0.9%
3	$381	$383	($2)	-0.5%	$382	($1)	-0.2%	$390	($5)	-1.4%
4	$381	$387	($5)	-1.4%	$386	($4)	-1.1%	$395	($10)	-2.5%
5	$381	$403	($22)	-5.8%	$403	($22)	-5.8%	$407	($22)	-5.8%

NPV Scenarios

Although in most cases TSLs 1 through 4 exhibit negative NPVs, they are small relative to the total costs to the Nation of owning and operating central air conditioners and heat pumps. Further, NPV is calculated by taking the difference between two relatively large numbers; the baseline cost and the cost under new standards. Associated with each of these total costs is an uncertainty which arises from uncertainty and variability in assumptions in both the LCC and NES analyses. Thus, changes in some key input inputs such as the manufacturer cost, equipment lifetime, discount rate, electricity price forecasts, and cooling load operating hours could turn the negative NPVs into positive values.
Consequently, as was performed in the revised LCC analysis, we examine key uncertainties as different scenarios.

Manufacturer Cost Scenario

Although manufacturer costs are only one of several inputs to the NPV calculation, the Department received numerous comments regarding overstated manufacturing costs and recommendations to use the reverse engineering cost data. Some of the comments suggested that once a new standard takes effect, competitive pressures would likely force manufacturers to produce equipment at costs lower than the shipment-weighted mean estimates provided by ARI.

To further investigate the sensitivity to manufacturer costs, NPVs are generated based on replacing the ARI-based manufacturer costs with those determined through the revised Reverse Engineering Analysis. Table 16 demonstrates that manufacturer costs based on the Reverse Engineering Analysis yield NPVs which are greater than or equal to zero for TSLs 1 through 4 based on the NAECA efficiency scenario.

Table 16 NPV Results for TSLs – Reverse Engineering Manufacturer Costs

TSL	Base Case Total *billion 98$*	TSL Total *billion 98$*	TSL NPV *billion 98$*	 *as % of Base Case Total*
1	$379	$378	$2	0.4%
2	$379	$377	$2	0.5%
3	$379	$378	$1	0.4%
4	$379	$379	$0	0.0%
5	$379	$390	($10)	-2.7%

Lifetime Scenario

Several comments suggested that the average equipment lifetime is closer to 14 years rather than the 18.4 year average that is used in the analysis. The shorter lifetime is based on the assumption that most, if not all, consumers when faced with replacing a failed compressor would choose to replace the entire system rather than replace the compressor in a relatively old system. In order to determine the impact of a shorter lifetime, a lifetime scenario is investigated where a retirement function yielding an average lifetime of 14 years is used instead of the function that results in a 18.4 year average life. In addition, compressor replacement costs are no longer considered.

Table 17 shows the NPV results based on the NAECA efficiency scenario when the "18.4 year" retirement function is replaced with one yielding a 14 year average life. The results based on the 14 year average lifetime are very similar to those based on the "18.4 year" retirement function (e.g., small negative NPVs result for TSLs 1 through 4).

Table 17 NES/NPV Results for TSLs – 14 year Average Lifetime

TSL	Base Case Total *billion 98$*	TSL Total *billion 98$*	TSL NPV *billion 98$*	 *as % of Base Case Total*
1	$363	$364	$0	0.0%
2	$363	$365	($2)	-0.5%
3	$363	$366	($3)	-0.8%
4	$363	$370	($7)	-1.9%
5	$363	$389	($25)	-6.9%

Discount Rate Scenario

Table 18 provides the NPV results based on a discount rate of 3% under the NAECA efficiency scenario. Note the dramatic increase in the total national costs of operating central air conditioners and heat pumps in the base case ($712 billion at a 3% discount rate as opposed to $381 billion at a 7% discount rate). As a result, all NPVs are less than 1% of the total base case national costs (with the exception TSL 5).

Table 18 NES/NPV Results for TSLs – 3% Discount Rate

TSL	Base Case Total *billion 98$*	TSL Total *billion 98$*	TSL NPV *billion 98$*	TSL NPV *as % of Base Case Total*
1	$712	$708	$3	0.5%
2	$712	$708	$4	0.5%
3	$712	$708	$3	0.4%
4	$712	$714	($3)	-0.4%
5	$712	$746	($35)	-4.9%