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Comparison of CAIR and CAIR Plus Proposal Using the Integrated Planning Model (IPM)

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Final Draft Report

Comparison of CAIR and CAIR Plus Proposal using the Integrated Planning Model (IPM®)

Prepared for

Mid-Atlantic Regional Air Management Association (MARAMA)

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Table of Contents

Table of Contents....2
A. Overview....3
B. Modeling Assumptions and Changes Made to VISTAS Run....3
C. Results....7
1. Production Costs....7
2. Projected Control Technology Retrofits....9
3. Emissions....10
4. Allowance Market....11
5. Fuel Consumption and Prices....13
6. Power Plant Retirements....14
7. Power Plant Generation....15
8. New Power Plant Builds....17
D. Limitations of Analysis....18
Appendix 1: Summary of Changes to EPA Base Case v2.1.9 by Vistas....19
Appendix 2: MANE-VU IPM Global Parameter Decisions....20
Appendix 3: Detailed Assumptions Used in MARAMA analysis....22
Appendix 4: Comparison of Assumptions Used in VISTAS and MARAMA analysis....36
Appendix 5: Emission and Cost Results....43

A. Overview

MARAMA has awarded a contract to ICF Resources, L.L.C. (ICF), seeking ICF's services to evaluate the impact of EPA's CAIR Policy and the Mid-Atlantic/Northeast Visibility Union (MANE-VU) CAIR Plus proposal on the electric generating sector for the contiguous United States using the Integrated Planning Model (IPM®).

IPM is a dynamic linear optimization model that can be used to examine air pollution control policies for various pollutants throughout the contiguous U.S. for the entire electric power system. The dynamic nature of IPM enables the projection of the behavior of the power system over a specified future period. The optimization logic determines the least-cost means of meeting electric generation and capacity requirements while complying with specified constraints including air pollution regulations, transmission bottlenecks, and plant-specific operational constraints. The versatility of IPM allows users to specify which constraints to exercise and populate IPM with their own datasets.

This report summarizes the analysis that ICF has performed in evaluating the impact of the CAIR Plus proposal in the CAIR Plus region on the electricity generating sector by using IPM (hereafter, the analysis is referred to as the MARAMA analysis). As part of this analysis, ICF has also developed a Base Case that implements EPA's CAIR, CAMR and CAVR policies. The model assumptions and data used in this analysis are presented in Section B. The results are presented in Section C and the analysis limitations are presented in Section D.

Since the modeling is based on analyses developed by U.S. EPA, VISTAS and LADCO, we have summarized only the incremental changes that were proposed by MARAMA as part of this analysis. The documentation for EPA's v2.1.9 and v3.0 base cases is available at http://www.epa.gov/airmarkets/progsregs/epa-ipm. The VISTAS study assumptions are summarized in Appendix 1 and 2.

B. Modeling Assumptions and Changes Made to VISTAS Run

The MARAMA analysis is based on the recent IPM based analysis performed for VISTAS except for changes made by MARAMA. These runs are based on the VISTASII_PC_1f run that was developed for VISTAS in 2005. As per direction from MARAMA, the following assumptions for modeling the MARAMA Base Case-CAIR/CAMR/CAVR (MARAMA 5c) and MARAMA CAIR Plus Policy Case (MARAMA 4c) were implemented. Detailed assumptions are summarized in Appendix 3.

a) Run year configuration: The run year configuration was updated to separate out the key analysis years of 2009, 2012 and 2018. The revised configuration is summarized in Table 1:

Table 1: Run Years in MARAMA Base Case and MARAMA CAIR Plus Policy Case

Run Year	Calendar Years
2008	2007-2008
2009	2009-2009
2010	2010-2011
2012	2012-2012
2015	2013-2017
2018	2018-2018
2020	2019-2022
2026	2023-2030

b) Natural Gas Prices: As per direction from MARAMA, ICF implemented the EPA Base Case v3.0 natural gas supply curves that were based on ICF's NANGAS (North American Natural Gas Analysis System) model as part of this analysis. These gas supply curves are documented in the EPA Base Case v3.0 documentation published on its website. The gas supply curves used in the VISTAS analysis were based on the EPA Base Case v2.1.9. The gas supply curves used in the MARAMA analysis will result in higher gas prices as compared to the VISTAS analysis. For example, for a 5 quad gas consumption in the power sector, the Henry hub gas price using the EPA Base Case v3.0 gas supply curves will result in a gas price that is approximately 40-60% (based on the run year) higher than if EPA Base Case v2.1.9 gas supply curves were used.

c) Fuel Oil Prices: The fuel oil price projections from AEO 2006 were implemented in the MARAMA analysis and are higher as compared to the VISTAS analysis. The fuel oil price projections used in the VISTAS analysis were based on AEO 2005. The AEO 2006 assumptions are documented in the EPA Base Case v3.0.

d) SCR and Scrubber Feasibility Limits: Table 2 summarizes the cumulative SCR and scrubber feasibility limits that were implemented (in the MARAMA analysis) in the years 2008, 2009 and 2010. These limits are beyond existing control installations and prevent the model from projecting a level of SCR and scrubber builds in the short-term that was higher than the industry's capability to deliver. The feasibility limits in 2008 and 2009 are based on actual planned SCR and scrubber installations. The 2010 limit for scrubbers is based on a projection for installation of SO_2 scrubbers under CAIR. It is based on an internal analysis that accounted for the 2008/2009 feasibility limits. In the VISTAS study, feasibility limits for SCR and scrubbers were not applied in 2008, 2009 and 2010.

Note that in 2008, 2009 and 2010 run years, the individual unit level decisions were not hardwired but IPM will choose to build only the most economic SCRs and scrubbers up to those limits.

Table 2: Cumulative SCR and FGD Feasibility Limits in MARAMA Base Case and MARAMA CAIR Plus Policy Case Runs

Year	SCR (GW)	Scrubbers (GW)
2008	9	31
2009	15	51
2010	No Limit	69

Note: The above limits are incremental to those that are already installed on existing units as assumed in NEEDS.

e) CAVR (Clean Air Visibility Rule): Consistent with U.S. EPA's implementation of the CAVR rule, MARAMA has implemented the CAVR rule beginning in the run year 2015 within the MARAMA Base Case and MARAMA CAIR Plus Policy Case runs.

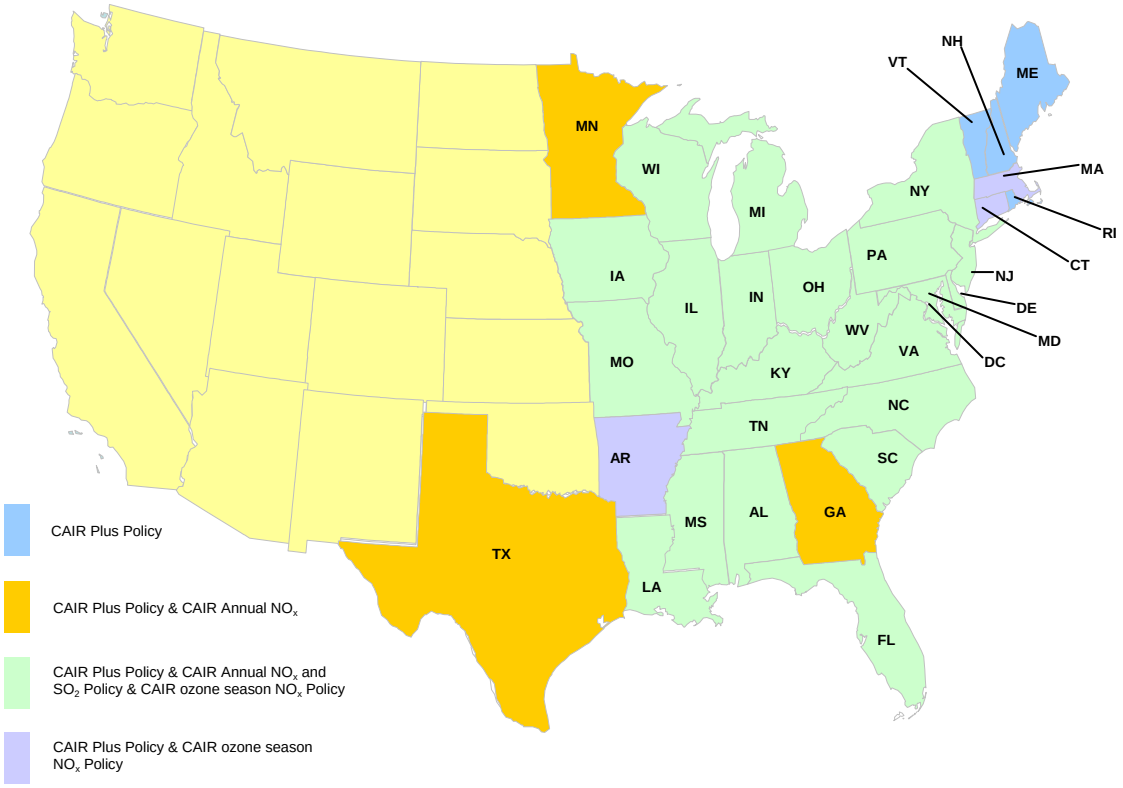
> *CAVR SO_2 Requirements*: All CAVR eligible, unscrubbed, non CAIR and non WRAP affected sources larger than 200 MW are required to meet an output emission rate of 0.15 lbs/MMBtu of SO_2 or achieve 95% removal. However, only the option to meet the 0.15 lbs/MMBtu of SO_2 emission rate was provided in IPM. This assumption was based on the results from a comparison of output SO_2 emission rates of unscrubbed CAVR affected units in the VISTAS analysis when adjusted for a 95% removal with 0.15 lbs/MMBtu. The 0.15 lbs/MMBtu rate limit was always higher and hence is a lower cost strategy.
>
> *CAVR NO_x Requirements*: All CAVR eligible, non CAIR affected sources larger than 200 MW are required to install combustion controls. SCRs are also required if the affected units are cyclone fired. All existing SCRs are required to operate annually.

Note that CAVR eligible sources in the above discussion imply the list of CAVR affected sources that U.S. EPA had modeled in their CAVR analysis using IPM. A list of units affected by the CAVR SO_2 and NO_x requirements are shown in Appendix 3 (tables A3.5a and A3.5b respectively).

f) Title IV SO_2 Bank: The IPM modeling time period in the MARAMA analysis is 2007-2030. In order to capture the dynamics of the SO_2 allowance market pre 2007, MARAMA has implemented a Title IV SO_2 allowance bank of 6.43 million tons going into the year 2007. This assumption is based on an internal ICF analysis of the current market conditions.

g) Applicable States for Programs: The MARAMA CAIR Plus Policy Case run is based on the MARAMA Base Case run with the MARAMA CAIR Plus Policy Case proposal implemented as a replacement of the CAIR policy. Figure 1 shows a U.S. map with states affected by CAIR and CAIR Plus policies highlighted.

Figure 1: States affected by CAIR and MARAMA CAIR Plus Policies



h) <u>NO_x and SO_2 Budgets</u>: Table 3 summarizes the NO_x budgets implemented in the MARAMA Base Case and MARAMA CAIR Plus Policy Case runs, and Table 4 summarizes SO_2 allowance retirement ratios implemented in the MARAMA Base Case and MARAMA CAIR Plus Policy Case runs. The NO_x budgets under the Base Case and CAIR Plus policy cases in Table 3 are not comparable because there are more states in the CAIR Plus domain as compared to the CAIR domain in the Base Case. In IPM, emissions budgets are modeled as a cap that all affected sources together are required to comply with. These sources can buy or sell emission allowances among themselves and bank for future use under favorable economics.

The SO_2 allowance retirement ratio is the number of Title IV SO_2 allowances that need to be surrendered for each ton of SO_2 emissions in the CAIR/CAIR Plus region. In IPM, a CAIR/CAIR Plus policy affected source is required to surrender the applicable number of Title IV SO_2 allowances determined by the SO_2 retirement ratio for every ton of SO_2 emission. A non CAIR/CAIR Plus policy affected source surrenders one Title IV SO_2 allowance for every ton of SO_2 emissions.

Table 3: NO_x Budgets in the CAIR/CAIR Plus Region (Thousand Tons)

	NO_x Ozone Season Budget		NO_x Annual Budget	
Year	MARAMA Base Case	MARAMA CAIR Plus Policy Case	MARAMA Base Case	MARAMA CAIR Plus Policy Case
2009	568	623	1,722*	1,553*
2010	568	623	1,522	1,353
2012	568	415	1,522	902
2015	518	395	1,370	858
2018	485	382	1,268	829

* Includes NO_x Compliance Supplement Pool of 199,997 tons included in 2009.
Note: The 2015 budgets as modeled in IPM are the average of the budgets over the period 2013-2017. The actual ozone season NO_x budgets proposed are 485 thousand tons in CAIR and 382 thousand tons in CAIR plus for 2015. The actual annual NO_x budgets proposed are 1,268 thousand tons in CAIR and 829 thousand tons in CAIR plus for 2015.

Table 4: SO_2 Allowance Retirement Ratios in the CAIR/CAIR Plus Region

	SO_2 Allowance Retirement Ratio	
Year	MARAMA Base Case	MARAMA CAIR Plus Policy Case
2009	1.00	1.00
2010	2.00	2.50
2012	2.00	2.94
2015	2.52	3.32
2018	2.86	4.16

Note: The 2015 retirement ratios as modeled in IPM are the average of the retirement ratios over the period 2013-2017. The actual retirement ratios are 2.86 for CAIR and 3.57 for CAIR Plus for 2015.

i) SO_2 and NO_x emission allowances were allowed to be banked in any year and then withdrawn from the bank in a future year under the CAIR program in the base case and the CAIR Plus programs.

C. Results

In this section, ICF has presented the costs, control installations, emissions, allowance market impacts, delivered fuel prices, generation, power plant retirements and new builds from the MARAMA Base Case and then compared these results with those from the MARAMA CAIR Plus Policy Case run. Appendix 5 summarizes the SO_2 and NO_x emission results and production cost components on a state and RPO level. The following paragraphs discuss the results from the two runs.

1. Production Costs

IPM projects the production cost of the U.S. power sector for each of the modeled run years. The production cost includes the annualized capital costs of new investment decisions (includes control equipment costs and new build costs), fuel costs and the total variable and fixed operation and maintenance (O&M) costs of power plants. Allowance costs are not listed as a separate category because on a region wide basis the net cost is zero (number of allowances

purchased is equal to the number of allowances sold). The administrative costs related to the purchase and sale of allowances are not modeled in IPM. The annualized incremental cost[1] of the MARAMA CAIR Plus Policy as compared to MARAMA Base Case is summarized in Table 5. The analysis projects a total cost of $10.7 billion in 2009 & $2.6 billion in 2018 respectively. Note that the cost of the policy is highest in 2009 (higher fuel costs being the main contributor of higher production costs) and then decreases starting 2010. This is because in 2009 there are limitations to the number of units that can install SCRs. In 2010 however, these limits are relaxed. In order to comply with the tight NO_x regulations and the limitations on SCR installations, the power sector increases natural gas-fired generation. In 2009 in the MARAMA CAIR Plus Policy Case the gas consumption increases by 812 TBtu and $0.85/MMBtu. This increase in gas consumption and the gas price result in a spike in fuel costs. Note that these costs are for the entire U.S. power sector and the policy could affect states that are within and outside the CAIR Plus region.

Table 5: Incremental Cost of the MARAMA CAIR Plus Policy Case Compared to MARAMA Base Case -- US Power Sector (1999 Billion Dollars)

	2008	2009	2010	2012	2015	2018
Variable O&M Cost	0.04	0.01	0.32	0.51	0.41	0.28
Fixed O&M Cost	0.01	-0.03	0.12	0.29	0.20	0.13
Fuel Cost	0.04	10.40	0.17	-0.90	0.04	0.23
Annualized Capital Cost	0.26	0.31	1.58	2.43	2.12	1.93
Total Production Cost	0.36	10.69	2.19	2.33	2.77	2.57

Note: To convert year 1999 dollars to year 2006 dollars, use a conversion factor of 1.1856

The marginal costs[2] of emission reductions as manifested in the projected allowance prices in the MARAMA Base Case and the MARAMA CAIR Plus Policy Case are shown in Table 6. The SO_2 and NO_x allowance prices in the CAIR Plus region in the MARAMA CAIR Plus Policy Case run are high starting in 2009 due to the relatively tighter policies applied to the CAIR Plus region as compared to the SO_2 and NO_x policies in the MARAMA Base Case. Tighter policies result in more expensive compliance options being chosen resulting in higher allowance prices. The NO_x allowance prices are high in 2009 and drop in 2010 because the SCR feasibility limits are relaxed starting in 2010. In 2009, due to limitations on SCR installations, a significant increase in natural gas fired generation occurs, driving up the annual NO_x allowance prices. Starting in 2010, SCRs are installed resulting in a reduction in the use of more expensive NO_x reduction options such as natural gas generation, driving down the annual NO_x allowance prices.

The compliance options available to power plants to reduce both annual NO_x emissions and the ozone season NO_x emissions are same. In addition the plants affected by the ozone season NO_x policy and the annual NO_x policy in the MARAMA CAIR Plus Policy Case are identical. A plant that installs a NO_x control option such as a SCR will be able to reduce emissions in both the ozone season and the non ozone season and hence simultaneously affect CAIR/CAIR Plus annual NO_x and ozone season NO_x allowance markets. It appears that complying with the annual NO_x policy results in an over compliance with the ozone season NO_x policy and is highlighted by the zero ozone season NO_x allowance price starting 2010.

[1] Annual Incremental Production Cost = Annualized Production Cost of MARAMA CAIR Plus Policy Case – Annualized Production Cost of MARAMA Base Case.
[2] Marginal cost is defined as the cost of reducing one additional ton of emissions.

Table 6: Allowance prices (Marginal Costs) of Emission Reductions in MARAMA Base Case and MARAMA CAIR Plus Policy Case (1999 $/ton)

CAIR/CAIR Plus Policy	2008	2009	2010	2012	2015	2018
MARAMA Base Case						
SO_2	640	692	748	809	943	1,106
NO_x – Ozone[3]	14,580	15,760	0	0	0	0
NO_x - Annual	NA	3,047	1,149	1,155	1,337	1,567
MARAMA CAIR Plus Policy Case						
SO_2	806	872	942	1,019	1,188	1,392
difference wrt MARAMA Base Case	166	180	194	210	245	286
NO_x – Ozone	14,710	11,150	0	0	0	0
difference wrt MARAMA Base Case	130	-4,610	0	0	0	0
NO_x - Annual	NA	17,920	4,240	4,586	5,346	6,266
difference wrt MARAMA Base Case	NA	14,873	3,091	3,431	4,009	4,699

Note: To convert year 1999 dollars to year 2006 dollars, use a conversion factor of 1.1856.

2. Projected Control Technology Retrofits

Installation of controls is one of the strategies that the power sector opts for complying with the CAIR Plus proposal requirements. This strategy is in addition to other compliance strategies such as changes to fuel switching, plant retirements, plant dispatch and new builds. Under the MARAMA CAIR Plus Policy Case, an additional 19.5 GW of SO_2 scrubbers and 77.8 GW of selective catalytic reduction (SCRs) are installed by 2012 (see Table 7). In the MARAMA CAIR Plus Policy Case, the SCR feasibility limits in 2008 and 2009 run years and the SO_2 scrubber limits in 2008 and 2010 run years are achieved.

Table 7: Incremental Pollution Control Installations by Technology in the MARAMA CAIR Plus Policy Case with the MARAMA Base Case (GW)

Technology	2008	2009	2010	2012	2015	2018
MARAMA Base Case						
Scrubber	24.9	31.4	59.7	65.6	87.5	98.7
SCR	9.0	15.0	38.5	42.1	58.6	66.3
MARAMA CAIR Plus Policy Case						
Scrubber	30.5	38.9	69.5	85.1	106.4	115.3
difference wrt MARAMA Base Case	5.6	7.5	9.8	19.5	18.9	16.6
SCR	9.0	15.0	115.2	120.0	124.5	131.2
difference wrt MARAMA Base Case	0.0	0.0	76.8	77.8	65.9	64.9

[3] The 2008 NO_x ozone season allowance price is for the SIP Call policy. Starting 2009 it is for the CAIR/CAIR Plus ozone season NO_x policy.

3. Emissions

Tables 8 and 9 summarize the SO_2 and NO_x emissions from all units including both fossil and nonfossil units in the MARAMA Base Case and the MARAMA CAIR Plus Policy Case in the 2008, 2009, 2010, 2012, 2015 and 2018 run years. The projected state-level emissions for SO_2 and NO_x for the MARAMA CAIR Plus Policy Case and the MARAMA Base Case are presented in Tables A5.1-A5.3 in Appendix 5.

Note, that the CAIR/CAIR Plus policies are not applied to the WRAP region in the MARAMA Base Case and MARAMA CAIR Plus Policy Case runs, and hence the SO_2 and NO_x emissions in the two runs in the WRAP region are similar. The CAIR/CAIR Plus NO_x programs start in 2009. Hence, the NO_x emissions are lower starting in 2009. The NO_x emissions in CAIR Plus region in Table 9 do not match the corresponding NO_x budgets in Table 3 because NO_x emissions in Table 9 include emissions from both CAIR Plus affected and not affected units.

The CAIR/CAIR Plus SO_2 programs start in 2010. However, the SO_2 emissions are lower prior to 2010 because Title IV SO_2 allowances that are banked prior to 2010 can be used to comply with the CAIR/CAIR Plus provisions starting 2010.

Both the CAIR and CAIR Plus programs are cap and trade policies. Therefore, while the CAIR Plus policy is more stringent than the CAIR policy, emissions can still go up in individual states in MARAMA CAIR Plus Policy Case as compared to MARAMA Base Case.

Table 8: Annual SO_2 Emissions from the U.S. Electric Power Sector (All Units including Fossil and Non-fossil units) (Thousand Tons)

	2008	2009	2010	2012	2015	2018
MARAMA Base Case						
MANE-VU	802.1	650.2	518.3	462.7	410.5	393.8
LADCO	1,950.5	1,785.1	1,594.8	1,593.4	1,490.5	1,437.7
VISTAS	2,879.6	2,702.0	2,094.5	1,981.2	1,689.7	1,398.2
CENRAP	1,395.3	1,391.1	1,397.3	1,385.4	1,158.9	1,136.8
WRAP	508.1	507.5	533.2	533.6	477.8	419.1
CAIR Plus Policy States	6,760.0	6,260.7	5,334.7	5,150.3	4,605.0	4,219.8
National Total	7,535.6	7,036.0	6,138.1	5,956.3	5,227.4	4,785.6
MARAMA CAIR Plus Policy Case						
MANE-VU	734.6	555.5	396.4	376.7	311.9	270.7
difference wrt MARAMA Base Case	-67.5	-94.8	-121.8	-86.0	-98.6	-123.1
LADCO	1,775.5	1,660.3	1,454.9	1,448.0	1,332.6	1,275.1
difference wrt MARAMA Base Case	-174.9	-124.8	-139.9	-145.4	-157.9	-162.6
VISTAS	2,696.8	2,049.4	1,769.9	1,461.5	1,190.6	991.8
difference wrt MARAMA Base Case	-182.9	-652.6	-324.7	-519.7	-499.1	-406.4
CENRAP	1,390.5	1,325.0	1,385.1	1,314.1	1,014.8	961.8
difference wrt MARAMA Base Case	-4.8	-66.1	-12.2	-71.3	-144.1	-175.0
WRAP	503.0	506.1	550.4	552.3	497.8	440.8
difference wrt MARAMA Base Case	-5.1	-1.4	17.1	18.7	20.0	21.7
CAIR Plus Policy States	6,331.6	5,324.1	4,735.4	4,325.7	3,705.2	3,350.8
difference wrt MARAMA Base Case	-428.4	-936.6	-599.3	-824.6	-899.8	-869.1
National Total	7,100.4	6,096.3	5,556.7	5,152.6	4,347.6	3,940.3
difference wrt MARAMA Base Case	-435.2	-939.7	-581.5	-803.8	-879.8	-845.3

Table 9: Annual NO_x Emissions from the U.S. Electric Power Sector (All Units including Fossil and Non-fossil units) (Thousand Tons)

MARAMA Base Case	2008	2009	2010	2012	2015	2018
MANE-VU	386.0	271.9	213.2	208.7	202.3	198.8
LADCO	803.9	483.4	413.0	409.0	389.5	382.1
VISTAS	1,207.6	699.9	622.0	621.1	502.0	452.9
CENRAP	754.5	604.1	603.0	616.0	539.4	538.3
WRAP	601.1	606.3	610.1	613.5	483.4	493.5
CAIR Plus Policy States	2,944.5	1,847.6	1,642.5	1,643.8	1,488.0	1,426.5
National Total	3,753.1	2,665.6	2,461.3	2,468.5	2,116.6	2,065.6
MARAMA CAIR Plus Policy Case						
MANE-VU	375.9	228.0	158.8	162.1	152.7	145.6
difference wrt MARAMA Base Case	-10.1	-43.9	-54.4	-46.7	-49.6	-53.2
LADCO	804.2	425.9	251.2	249.2	244.7	241.8
difference wrt MARAMA Base Case	0.4	-57.5	-161.8	-159.8	-144.8	-140.3
VISTAS	1,215.7	597.6	350.8	351.2	346.2	350.3
difference wrt MARAMA Base Case	8.0	-102.3	-271.2	-269.9	-155.8	-102.6
CENRAP	754.5	577.5	420.9	431.6	361.6	351.7
difference wrt MARAMA Base Case	0.1	-26.6	-182.1	-184.4	-177.8	-186.6
WRAP	600.5	606.5	610.0	615.2	485.5	495.7
difference wrt MARAMA Base Case	-0.6	0.2	-0.1	1.7	2.1	2.2
CAIR Plus Policy States	2,942.9	1,614.1	972.8	982.6	957.1	941.4
difference wrt MARAMA Base Case	-1.6	-233.4	-669.7	-661.2	-530.9	-485.1
National Total	3,750.9	2,435.5	1,791.6	1,809.3	1,590.7	1,585.1
difference wrt MARAMA Base Case	-2.2	-230.2	-669.7	-659.1	-525.8	-480.5

4. Allowance Market

Tables 10a and 10b summarize the CAIR/CAIR Plus SO_2 and NO_x allowance market as implemented in the CAIR/CAIR Plus region in the MARAMA Base Case and the MARAMA CAIR Plus Policy Case.

The going into 2007 Title IV SO_2 bank is assumed to be 6.43 million tons. In IPM, SO_2 emission allowances are banked in 2008 and 2009 and withdrawn in subsequent years. Allowances are not banked in later years as the CAIR/CAIR Plus policy starts in 2010 resulting in reduced opportunities for over complying. Annual NO_x emission allowances are banked in 2010 and not in 2009 in the MARAMA CAIR Plus Policy Case because restrictions on SCR installations prevent over compliance of the NO_x cap in 2009.

Starting 2010 in both the CAIR/CAIR Plus ozone season NO_x policies, the number of ozone season NO_x allowances that are withdrawn from the bank are less than the allowances that are banked. This occurs because of a surplus of ozone season NO_x allowance availability and is highlighted by the zero ozone season NO_x allowance price. On a separate note, the allowances banked in the SIP Call budget program are allowed to be banked and used in the ozone season NO_x program starting in 2009. The going into 2007 NO_x SIP Call bank is assumed to be zero.

Table 10a: Summary of SO_2 and NO_x Allowance Market in MARAMA Base Case (Thousand Tons)

Run Year	2008	2009	2010	2012	2015	2018	2020
Years Mapped to Run Year	2007-2008	2009	2010-2011	2012-2012	2013-2017	2018	2019-2022
CAIR - SO_2							
Annual Emissions at Affected Units (Fossil Units > 25 MW)	7,333	6,831	5,942	5,760	5,029	4,586	4,171
Allowances Banked	5,245	2,449	0	0	0	0	0
Allowances Withdrawn from Bank	0	0	-1,072	-888	-1,072	-1,143	-722
CAIR – Ozone Season NO_x							
Ozone Season Emission Budget	497	568	568	568	518	485	485
Ozone Season Emissions at Affected Units (Fossil Units > 25 MW in CAIR Region)	492	579	558	558	502	482	465
Allowances Banked	5	0	10	10	16	3	20
Allowances Withdrawn from Bank	0	-11	0	0	0	0	0
CAIR – Annual NO_x							
Annual Emission Budget	NA	1,722	1,522	1,522	1,370	1,268	1,268
Annual Emissions at Affected Units (Fossil Units > 25 MW in CAIR Region)	NA	1,722	1,522	1,522	1,363	1,298	1,268
Allowances Banked	NA	0	0	0	6	0	0
Allowances Withdrawn from Bank	NA	0	0	0	0	-30	0

Note: The 2008 NO_x ozone season results reflect those from the SIP Call NO_x program and starting 2009 reflect those from the CAIR ozone season NO_x policy.

Table 10b: Summary of SO_2 and NO_x Allowance Market in MARAMA CAIR Plus Policy Case (Thousand Tons)

Run Year	2008	2009	2010	2012	2015	2018	2020
Years Mapped to Run Year	2007-2008	2009	2010-2011	2012-2012	2013-2017	2018	2019-2022
CAIR Plus - SO_2							
Annual Emissions at Affected Units (Fossil Units > 25 MW)	6,898	5,900	5,360	4,956	4,151	3,739	3,205
Allowances Banked	5,680	3,380	0	0	0	0	0
Allowances Withdrawn from Bank	0	0	-1,353	-1,424	-1,094	-1,234	-691
CAIR Plus – Ozone Season NO_x							
Ozone Season Emission Budget	497	623	623	416	395	382	382
Ozone Season Emissions at Affected Units (Fossil Units > 25 MW in CAIR Plus Region)	497	623	404	412	398	395	389
Allowances Banked	0	0	219	4	0	0	0
Allowances Withdrawn from Bank	0	0	0	0	-3	-13	-7
CAIR Plus – Annual NO_x							
Annual Emission Budget	NA	1,553	1,353	902	858	829	829
Annual Emissions at Affected Units (Fossil Units > 25 MW in CAIR Plus Region)	NA	1,553	918	927	898	882	867
Allowances Banked	NA	0	436	0	0	0	0
Allowances Withdrawn from Bank	NA	0	0	-25	-39	-53	-38

Note: The 2008 NO_x ozone season results reflect those from the SIP Call NO_x program and starting 2009 reflect those from the CAIR ozone season NO_x policy.

5. Fuel Consumption and Prices

Table 11a summarizes the coal and natural gas consumption in the U.S. power sector as projected by IPM in the MARAMA Base Case and MARAMA CAIR Plus Policy Case runs. Table 11b summarizes the delivered coal and natural gas prices solved by IPM in the MARAMA Base Case and MARAMA CAIR Plus Policy Case runs. The delivered gas prices are not inputs to the model but are determined endogenously by equilibrating demand and supply.

In the MARAMA Base Case, the natural gas prices in 2008 are higher than 2009. This is due to differences in the supply curves for the two years. As an example, for a gas consumption level of 5,696 TBtu, the gas price in 2008 is $7.23/MMbtu. However, at the same level of gas consumption, the gas price in 2009 would be at $6.12.

The fuel costs shown in Table 5 are incremental costs (i.e. MARAMA CAIR Plus Policy Case – MARAMA Base Case). The increase in fuel costs of $10.4 billion dollars in 2009 is a result of the incremental increase in natural gas prices of $0.85MMBtu between the two cases (i.e. $7.83/MMBtu in the CAIR Plus Policy case versus $6.98 in the MARAMA Base Case) and an increase in natural gas consumption 812 TBtu.

The gas prices are higher in most years in the MARAMA CAIR Plus Policy Case, in comparison to the MARAMA Base Case. This is a result of an increase in gas consumption as shifting from coal to gas is a compliance option leading to higher gas prices. In 2009 the gas prices increase is the highest because of restrictions on new SCR builds which result in an increase in gas consumption by 812 TBtu.

Table 11a: Fuel Consumption in MARAMA Base Case and MARAMA CAIR Plus Policy Case (TBtu)

	2008	2009	2010	2012	2015	2018
MARAMA Base Case						
Coal	22,938	22,706	25,594	26,050	27,489	29,198
Natural Gas	5,696	6,598	4,619	5,314	5,191	5,444
MARAMA CAIR Plus Policy Case						
Coal	22,863	21,503	25,396	26,099	27,318	28,699
difference wrt MARAMA Base Case	-76	-1,203	-198	49	-171	-500
Natural Gas	5,728	7,410	4,679	5,186	5,209	5,647
difference wrt MARAMA Base Case	32	812	60	-129	18	203

Table 11b: Delivered Fuel Prices in MARAMA Base Case and MARAMA CAIR Plus Policy Case (1999 $/MMBtu)

	2008	2009	2010	2012	2015	2018
MARAMA Base Case						
Coal	1.09	1.08	1.07	1.05	1.03	1
Natural Gas	7.39	6.98	4.82	4.75	4.15	4.01
MARAMA CAIR Plus Policy Case						
Coal	1.09	1.06	1.06	1.04	1.02	0.99
difference wrt MARAMA Base Case	0	-0.02	-0.01	-0.01	-0.01	-0.01
Natural Gas	7.39	7.83	4.88	4.75	4.19	4.05
difference wrt MARAMA Base Case	0	0.85	0.06	0	0.04	0.04

6. Power Plant Retirements

A tighter environmental policy increases the total production costs of a power plant, including its compliance costs, and thus could make it uneconomic. Table 12 summarizes the power plant retirements in the MARAMA Base Case and the MARAMA CAIR Plus Policy Case. Note that the more stringent CAIR Plus policy results in an increase in total retirements by 4.9 GW in 2009. Oil/gas steam units that are uneconomic to run under the CAIR Plus policy retire. Increase in natural gas use as presented in Table 11a is accounted for by the remaining gas fired units that have relatively lower costs of operation.

Table 12: Power Plant Retirements in MARAMA CAIR Plus Policy Case with the MARAMA Base Case (MW)

	2008	2009	2010	2012	2015	2018
MARAMA Base Case						
Coal Steam	196	196	196	196	196	196
Combined Cycle	2,669	2,669	3,340	3,340	3,464	3,464
Combustion Turbine	2,804	2,804	3,143	3,143	3,143	3,143
Oil/Gas Steam	53,826	53,826	60,763	60,763	60,858	60,858
Other[1]	0	0	0	0	0	0
National Total	59,495	59,495	67,442	67,442	67,661	67,661
MARAMA CAIR Plus Policy Case						
Coal Steam	279	2,269	2,689	2,689	2,689	2,689
difference wrt MARAMA Base Case	83	2,073	2,493	2,493	2,493	2,493
Combined Cycle	2,822	2,822	3,540	3,540	3,541	3,541
difference wrt MARAMA Base Case	153	153	200	200	77	77
Combustion Turbine	2,804	2,804	3,143	3,143	3,143	3,143
difference wrt MARAMA Base Case	0	0	0	0	0	0
Oil/Gas Steam	56,467	56,467	63,023	63,023	63,023	63,023
difference wrt MARAMA Base Case	2,641	2,641	2,260	2,260	2,165	2,165
Other	0	0	0	0	0	0
difference wrt MARAMA Base Case	0	0	0	0	0	0
National Total	62,372	64,362	72,395	72,395	72,396	72,396
difference wrt MARAMA Base Case	2,877	4,867	4,953	4,953	4,735	4,735

Note: The category "Other" includes all plant types other than coal steam, oil/gas steam, combined cycle and combustion turbines.

7. Power Plant Generation

Changes in power plant generation is one of the compliance strategies for meeting a tighter environmental policy. In the MARAMA CAIR Plus Policy Case as compared to the MARAMA Base Case, the generation mix changes towards lower emission intensive fuel and plant types. Table 13 summarizes the generation mix in the MARAMA Base Case and the MARAMA CAIR Plus Policy Case. Note that there is an increase in natural gas fired generation (from combined cycles, combustion turbines and oil/gas steam units) and a reduction in coal fired generation (from coal steam and IGCC units) in all years except 2012. The overall increase in coal fired generation in 2012 occurs because it is the first year when the scrubber feasibility limits are no longer applicable resulting in an increase in scrubber installations and a relatively lower drop in generation from the coal steam units. Coal generation in 2010 is also not higher due to the presence of scrubber limits. In years after 2012, the SO_2 and NO_x policies in the MARAMA CAIR Plus Policy Case continue to become more stringent resulting in an increase in gas based generation.

The electricity demand in both the MARAMA Base Case and the MARAMA CAIR Plus Policy Case are identical. However the power generation in the two runs is different due to differences in transmission and pump storage losses.

Table 13: Generation by Plant Type in the U.S. Electric Power Sector (GWh)

	2008	2009	2010	2012	2015	2018
MARAMA Base Case						
Coal Steam	2,202,868	2,180,582	2,491,528	2,541,830	2,560,775	2,735,709
Combined Cycle	698,066	785,335	589,215	665,117	664,622	687,933
Combustion Turbine	37,735	49,113	30,941	38,341	36,254	49,527
Oil/Gas Steam	48,477	53,885	13,752	20,565	18,459	17,581
IGCC	4,702	4,702	14,142	14,148	192,239	226,262
Nuclear	796,130	796,715	797,725	801,460	810,065	807,698
Hydro (includes Pump Storage)	295,814	289,778	293,886	292,400	295,679	295,911
Biomass	14,301	14,929	17,039	22,183	25,969	29,742
Landfill Gas	13,715	13,747	13,747	13,747	16,063	16,384
Wind	32,308	32,414	32,664	32,782	34,486	36,289
Other	69,259	69,420	75,569	75,931	78,123	75,889
National Total	4,213,375	4,290,620	4,370,208	4,518,504	4,732,734	4,978,925
MARAMA CAIR Plus Policy Case						
Coal Steam	2,194,992	2,067,557	2,451,724	2,530,526	2,541,139	2,663,300
difference wrt MARAMA Base Case	-7,876	-113,025	-39,804	-11,304	-19,636	-72,409
Combined Cycle	703,266	889,217	598,711	650,084	671,380	736,610
difference wrt MARAMA Base Case	5,200	103,882	9,496	-15,033	6,758	48,677
Combustion Turbine	38,778	54,216	31,351	36,534	33,886	37,414
difference wrt MARAMA Base Case	1,043	5,103	410	-1,807	-2,368	-12,113
Oil/Gas Steam	46,979	55,463	12,714	19,655	18,028	17,755
difference wrt MARAMA Base Case	-1,498	1,578	-1,038	-910	-431	174
IGCC	4,702	4,702	41,408	41,408	205,343	259,435
difference wrt MARAMA Base Case	0	0	27,266	27,260	13,104	33,173
Nuclear	796,130	796,715	797,725	801,460	810,065	807,698
difference wrt MARAMA Base Case	0	0	0	0	0	0
Hydro (includes Pump Storage)	294,857	289,566	292,858	292,016	294,154	294,310
difference wrt MARAMA Base Case	-957	-212	-1,028	-384	-1,525	-1,601
Biomass	14,307	14,935	17,421	20,998	26,426	30,466
difference wrt MARAMA Base Case	6	6	382	-1,185	457	724
Landfill Gas	14,259	14,290	14,290	14,290	16,607	16,607
difference wrt MARAMA Base Case	544	543	543	543	544	223
Wind	34,522	34,627	34,877	34,936	35,383	37,187
difference wrt MARAMA Base Case	2,214	2,213	2,213	2,154	897	898
Other	69,259	68,125	75,569	75,931	78,123	75,889
difference wrt MARAMA Base Case	0	-1,295	0	0	0	0
National Total	4,212,051	4,289,413	4,368,648	4,517,838	4,730,534	4,976,671
difference wrt MARAMA Base Case	-1,324	-1,207	-1,560	-666	-2,200	-2,254

Note: The plant type “Other” includes solar, geothermal and waste fired units.

8. New Power Plant Builds

Table 14 summarizes the new power plant builds in the MARAMA Base Case and the MARAMA CAIR Plus Policy Case. In the MARAMA CAIR Plus Policy Case, new builds are higher than in the MARAMA Base Case because of a need to compensate for the increase in power plant retirements as presented in Table 12 and to take advantage of the relatively cleaner emission profiles of the new technologies.

New IGCC's have lower emission rates and lower heat rates making them more valuable under a stringent environmental policy. Hence IGCC's are built in 2010 and 2012 in the MARAMA CAIR Plus Policy Case and not in the MARAMA Base Case.

In 2018, the SO_2 allowance retirement ratio increases from 3.32 to 4.16. This increase results in a drop in coal fired generation and an increase in natural gas fired generation. In order to support this increase, in 2018 there is a significant increase in new combined cycle capacity that is more cost effective for base and intermediate load operation and a corresponding decrease in new combustion turbine capacity that is cost effective for peak load operation.

Table 14: New Power Plant Builds by Plant Type in the United States (MW)

	2008	2009	2010	2012	2015	2018
MARAMA Base Case						
Coal Steam	0	0	38,084	44,332	48,833	75,341
IGCC	0	0	0	0	23,187	27,617
Combined Cycle	6,550	6,550	6,550	8,580	20,518	24,265
Combustion Turbine	4,625	4,625	4,625	4,625	4,848	16,302
Biomass	0	0	349	978	1,570	2,099
Landfill Gas	1,241	1,241	1,241	1,241	1,552	1,595
Wind	5,153	5,153	5,153	5,193	5,739	6,283
National Total	17,569	17,569	56,002	64,949	106,247	153,502
MARAMA CAIR Plus Policy Case						
Coal Steam	0	0	35,674	46,627	52,245	72,806
difference wrt MARAMA Base Case	0	0	-2,410	2,295	3,412	-2,535
IGCC	0	0	3,651	3,651	24,995	32,038
difference wrt MARAMA Base Case	0	0	3,651	3,651	1,808	4,421
Combined Cycle	6,814	6,814	6,814	8,163	21,120	33,615
difference wrt MARAMA Base Case	264	264	264	-417	602	9,350
Combustion Turbine	4,781	4,781	4,781	4,781	4,781	10,473
difference wrt MARAMA Base Case	156	156	156	156	-67	-5,829
Biomass	0	0	349	815	1,570	2,099
difference wrt MARAMA Base Case	0	0	0	-163	0	0
Landfill Gas	1,314	1,314	1,314	1,314	1,625	1,625
difference wrt MARAMA Base Case	73	73	73	73	73	30
Wind	5,843	5,843	5,843	5,863	5,985	6,529
difference wrt MARAMA Base Case	690	690	690	670	246	246
National Total	18,752	18,752	58,426	71,214	112,321	159,185
difference wrt MARAMA Base Case	1,183	1,183	2,424	6,265	6,074	5,683

D. Limitations of Analysis

MARAMA modeling using IPM is based on various economic and engineering input assumptions that are inherently uncertain, such as assumptions for future fuel prices, electricity demand growth and the cost and performance of control technologies. As configured, IPM does not take into account demand response (i.e., consumer reaction to changes in electricity prices).

Appendix 1: Summary of Changes to EPA Base Case v2.1.9 by Vistas

The EPA Base Case v.2.1.9 was developed by ICF under the direction of the U.S. Environmental Protection Agency (EPA). It serves as the starting point for the analysis presented in this report. Subsequent to its release the VISTAS Regional Planning Organization initiated a two-phase study using IPM. Starting with the EPA 2.1.9 as a base, VISTAS, along with study participants from CENRAP and LADCO RPOs, made several changes to the underlying datasets and modeling assumptions. The starting point for the MARAMA analyses discussed in this report was work from the VISTAS study as modeled in the run VISTASII_PC_1f.

VISTAS and its workgroup initiated a review of NEEDS and recommended a large number of changes to the data. This occurred in two phases. In addition to unit level changes, VISTAS and its workgroup made a number of global changes that are reflected in this case. These are briefly described below:

- Demand forecast were changed to reflect unadjusted EIA AEO 2005 national electricity and peak demand values.

- AEO 2005 data was used for all assumptions regarding new builds of conventional technologies. The cost and performance assumptions for these units were as per the AEO 2005 documentation, while assumptions for renewable capacity were the same as those used in the EPA Base Case 2004 v.2.1.9.

- For nuclear units, the cost of continued operation was updated to approximately $27 per kilowatt-year based on AEO 2005.

- Hardwired Duke Power and Progress Energy control technology investment strategies for complying with the North Carolina Clean Smoke Stacks rule.

- The renewable portfolio standards (RPS) is modeled based on the most recent RGGI documentation using a single RPS region for Massachusetts (MA), Rhode Island (RI), New York (NY), New Jersey (NJ), Maryland (MD) and Connecticut (CT). The RPS requirements within these states can be met by renewable generation from New England, New York and PJM. EPA Base Case 2004 v.2.1.9 methodology and EIA AEO 2004 projected renewable builds were used for the rest of the regions.

- The run years used were 2008 (2007-2008), 2009 (2009), 2012 (2010-2013), 2015 (2014-2017), 2018 (2018), 2020 (2019-2022), and 2026 (2023-2030).

- The Clean Air Mercury Rule (CAMR) was modeled.

Appendix 2: MANE-VU IPM Global Parameter Decisions

This section summarizes the decisions as made by MANE-VU for global assumptions to be used in EGU forecasting with IPM as part of the VISTAS analysis. These decisions and changes are made to EPA Base Case version 2.1.9 assumptions.

A. Market Assumptions

1. National Electricity and Peak Demand
Decision: Use unadjusted EIA AEO 2005 national electricity and peak demand values.
(This is the same as the assumption used by VISTAS, MRPO, and CENRAP.
See 5/11/05 Inter-RPO IPM Global Decisions memo.)

2. Regional Electricity and Demand Breakout
Decision: Use the existing IPM region breakdown as conducted in earlier modeling.
(This is the same as the assumption used by VISTAS, MRPO, and CENRAP.
See 5/11/05 Inter-RPO IPM Global Decisions memo.)

3. Natural Gas Supply Curve and Price Forecast
Decision: Use fuel supply curves and fuel price forecasts from IPM version 2.1.9. These are the same fuel price forecasts and supply curve assumptions used in EPA's latest CAIR runs.
(This is the same as the assumption used by VISTAS, MRPO, and CENRAP. See e-mail from Megan Schuster dated 7/5/05.)

4. Oil Price Forecast
Decision: Use fuel supply curves and fuel price forecasts from IPM version 2.1.9. These are the same fuel price forecasts and supply curve assumptions used in EPA's latest CAIR runs.
(This is the same as the assumption used by VISTAS, MRPO, and CENRAP. See e-mail from Meagan Schuster dated 7/5/05.)

5. Coal Supply and Price Forecast
Decision: Use fuel supply curves and fuel price forecasts from IPM version 2.1.9. These are the same fuel price forecasts and supply curve assumptions used in EPA's latest CAIR runs.
(This is the same as the assumption used by VISTAS, MRPO, and CENRAP. See e-mail from Megan Schuster dated 7/1/05.)

B. Technical Assumptions

1. Firmly Planned Capacity Assumptions
Decision: Use revisions and new data as provided by RPOs and stakeholders.
Decision: Allow NC Clean Smokestacks 2009 data as provided to define "must run" units.
(These are the same as the assumptions used by VISTAS, MRPO, and CENRAP.
See 5/11/05 Inter-RPO IPM Global Decisions memo.)

2. Pollution Control Retrofit Cost and Performance [SO2, NOx, Hg]
Decision: Retain pollution control retrofit cost and performance values.
(This is the same as the assumption used by VISTAS, MRPO, and CENRAP.
See 5/11/05 Inter-RPO IPM Global Decisions memo.)

3. New Conventional Capacity cost and performance assumptions
Decision: Use EIA AEO 2005 cost and performance assumptions for new conventional capacity.
Decision: Retain existing 2.1.9 framework cost and performance for new renewable capacity.
Decision: Exclude constraint on new capacity type builds (i.e., no new coal).
(These are the same as the assumptions used by VISTAS, MRPO, and CENRAP.
See 5/11/05 Inter-RPO IPM Global Decisions memo.)

4. SO_2 Title IV Allowance Bank

Decision: Use existing SO2 allowance bank value (4.99 million tons) for 2007.
(This is the same as the assumption used by VISTAS, MRPO, and CENRAP.
See 5/11/05 Inter-RPO IPM Global Decisions memo.)

5. Nuclear Re-licensing and Uprate
Decision: Use existing IPM configuration with updated EIA AEO 2005 (~$27/kW) incurrence cost for continued operation.
(This is the same as the assumption used by VISTAS, MRPO, and CENRAP.
See 5/11/05 Inter-RPO IPM Global Decisions memo.)

C. Strategy Assumptions

1. Clear Air Mercury Rule (CAMR)
Decision: Include CAMR in future rounds of IPM modeling.
(This is the same as the assumption used by VISTAS, MRPO, and CENRAP.
See 5/11/05 Inter-RPO IPM Global Decisions memo.)

2. Renewable Portfolio Standards
Decision**:** Model RPS based on the most recent RGGI documentation using a single RPS region for MA, RI, NY, NJ, MD and CT. The RPS requirements within these states can be met by renewable generation from New England, New York and PJM. EPA 2.1.9 methodology and hardwired EIA AEO 2004 projected renewable builds for the remainder of the country.
(This is the same as the assumption used by VISTAS, MRPO, and CENRAP.
See 5/11/05 Inter-RPO IPM Global Decisions memo.)

D. Other Assumptions

1. Run Years
Decision: Parsed output data will be provided for 2009, 2012 and 2018.
Run years to 2008, 2009, 2012, 2015, 2018, 2020, and 2026.
(Run Year 2008 [2007-2008], Run Year 2009 [2009], Run Year 2012 [2010-2013],
Run Year 2015 [2014-2017], Run Year 2018 [2018], Run Year 2020 [2019-2022] and
Run Year 2026 [2023-2030]
(This is the same as the assumption used by VISTAS, MRPO, and CENRAP.
See 5/11/05 Inter-RPO IPM Global Decisions memo.)

2. Canadian Sources
Decision: Utilize existing v.2.1.9 configuration (no Canadian site specific sources).
(This is the same as the assumption used by VISTAS, MRPO, and CENRAP.
See 5/11/05 Inter-RPO IPM Global Decisions memo.)

Appendix 3: Detailed Assumptions Used in MARAMA analysis

Table A.3.1 shows the run year configuration used in the MARAMA Base Case and Policy Case.

Table A.3.1 Run Year Configuration

Run Year	Calendar Years
2008	2007-2008
2009	2009-2009
2010	2010-2011
2012	2012-2012
2015	2013-2017
2018	2018-2018
2020	2019-2022
2026	2023-2030

Table A3.2 shows the natural gas prices used in the MARAMA analysis. These supply curves are based on ICF's NANGAS model.

Table A3.2 Natural Gas Supply Curve in the MARAMA Analysis

Year	Price (1999$/MMBtu)	Non electric gas demand (TBtu)	Total gas supply (TBtu)	Gas supply to electric sector (TBtu)
2008	3.50	20987	21160	173
2008	3.63	20734	21230	496
2008	3.78	20493	21300	807
2008	3.91	20264	21360	1096
2008	4.05	20045	21420	1375
2008	4.19	19836	21480	1644
2008	4.32	19635	21540	1905
2008	4.47	19443	21600	2157
2008	4.60	19258	21660	2402
2008	4.75	19080	21710	2630
2008	4.88	18909	21760	2851
2008	5.01	18744	21810	3066
2008	5.16	18585	21860	3275
2008	5.29	18432	21910	3478
2008	5.44	18284	21960	3676
2008	5.57	18141	22010	3869
2008	5.71	18002	22060	4058
2008	5.85	17868	22100	4232
2008	5.98	17738	22140	4402
2008	6.12	17612	22180	4568
2008	6.26	17489	22220	4731
2008	6.40	17370	22260	4890
2008	6.54	17254	22300	5046
2008	6.67	17141	22340	5199
2008	6.81	17031	22380	5349
2008	6.95	16924	22420	5496
2008	7.09	16820	22460	5640
2008	7.23	16719	22500	5781
2008	7.36	16620	22540	5920
2008	7.50	16524	22570	6046
2008	7.64	16430	22600	6170
2008	7.78	16338	22630	6292
2008	7.92	16248	22660	6412
2008	8.06	16160	22690	6530
2008	8.19	16074	22720	6646
2008	8.33	15990	22750	6760
2008	8.47	15908	22780	6872
2008	8.61	15828	22810	6982
2008	8.75	15749	22840	7091
2008	8.88	15672	22870	7198
2008	9.02	15596	22900	7304
2008	9.16	15522	22930	7408
2008	9.30	15449	22960	7511
2008	9.44	15378	22990	7612
2008	9.57	15308	23020	7712

Year	Price (1999$/MMBtu)	Non electric gas demand (TBtu)	Total gas supply (TBtu)	Gas supply to electric sector (TBtu)
2008	9.72	15239	23050	7811
2009	3.22	21520	22270	750
2009	3.36	21235	22340	1105
2009	3.50	20965	22410	1445
2009	3.63	20709	22480	1771
2009	3.78	20465	22540	2075
2009	3.91	20233	22600	2367
2009	4.05	20011	22660	2649
2009	4.19	19799	22720	2921
2009	4.32	19596	22780	3184
2009	4.47	19401	22830	3429
2009	4.60	19214	22880	3666
2009	4.75	19034	22930	3896
2009	4.88	18861	22980	4119
2009	5.01	18695	23030	4335
2009	5.16	18535	23080	4545
2009	5.29	18380	23130	4750
2009	5.44	18230	23180	4950
2009	5.57	18085	23220	5135
2009	5.71	17945	23260	5315
2009	5.85	17809	23300	5491
2009	5.98	17677	23340	5663
2009	6.12	17549	23380	5831
2009	6.26	17425	23420	5995
2009	6.40	17305	23460	6155
2009	6.54	17188	23500	6312
2009	6.67	17074	23540	6466
2009	6.81	16963	23580	6617
2009	6.95	16855	23620	6765
2009	7.09	16750	23660	6910
2009	7.23	16648	23690	7042
2009	7.36	16548	23720	7172
2009	7.50	16451	23750	7299
2009	7.64	16356	23780	7424
2009	7.78	16263	23810	7547
2009	7.92	16172	23840	7668
2009	8.06	16083	23870	7787
2009	8.19	15996	23900	7904
2009	8.33	15911	23930	8019
2009	8.47	15828	23960	8132
2009	8.61	15747	23990	8243
2009	8.75	15668	24020	8352
2009	8.88	15590	24050	8460
2009	9.02	15514	24080	8566
2009	9.16	15439	24110	8671
2009	9.30	15366	24140	8774
2009	9.44	15294	24170	8876
2009	9.57	15224	24200	8976
2009	9.72	15155	24230	9075

Year	Price (1999$/MMBtu)	Non electric gas demand (TBtu)	Total gas supply (TBtu)	Gas supply to electric sector (TBtu)
2010	3.22	21688	23220	1532
2010	3.36	21387	23300	1913
2010	3.50	21102	23370	2268
2010	3.63	20832	23440	2608
2010	3.78	20575	23510	2935
2010	3.91	20330	23580	3250
2010	4.05	20097	23640	3543
2010	4.19	19874	23700	3826
2010	4.32	19661	23760	4099
2010	4.47	19457	23820	4363
2010	4.60	19261	23880	4619
2010	4.75	19073	23940	4867
2010	4.88	18892	23990	5098
2010	5.01	18717	24040	5323
2010	5.16	18549	24090	5541
2010	5.29	18387	24140	5753
2010	5.44	18230	24190	5960
2010	5.57	18078	24240	6162
2010	5.71	17931	24290	6359
2010	5.85	17789	24340	6551
2010	5.98	17651	24390	6739
2010	6.12	17518	24430	6912
2010	6.26	17388	24470	7082
2010	6.40	17262	24510	7248
2010	6.54	17140	24550	7410
2010	6.67	17021	24590	7569
2010	6.81	16905	24630	7725
2010	6.95	16793	24670	7877
2010	7.09	16683	24710	8027
2010	7.23	16576	24750	8174
2010	7.36	16472	24790	8318
2010	7.50	16371	24830	8459
2010	7.64	16272	24870	8598
2010	7.78	16175	24910	8735
2010	7.92	16081	24940	8859
2010	8.06	15989	24970	8981
2010	8.19	15899	25000	9101
2010	8.33	15811	25030	9219
2010	8.47	15725	25060	9335
2010	8.61	15641	25090	9449
2010	8.75	15558	25120	9562
2010	8.88	15477	25150	9673
2010	9.02	15398	25180	9782
2010	9.16	15320	25210	9890
2010	9.30	15244	25240	9996
2010	9.44	15169	25270	10101
2010	9.57	15096	25300	10204
2010	9.72	15024	25330	10306
2012	3.22	22121	24260	2139

Year	Price (1999$/MMBtu)	Non electric gas demand (TBtu)	Total gas supply (TBtu)	Gas supply to electric sector (TBtu)
2012	3.36	21813	24350	2537
2012	3.50	21522	24430	2908
2012	3.63	21246	24510	3264
2012	3.78	20983	24590	3607
2012	3.91	20733	24670	3937
2012	4.05	20494	24740	4246
2012	4.19	20266	24810	4544
2012	4.32	20048	24880	4832
2012	4.47	19839	24950	5111
2012	4.60	19638	25020	5382
2012	4.75	19445	25080	5635
2012	4.88	19259	25140	5881
2012	5.01	19080	25200	6120
2012	5.16	18908	25260	6352
2012	5.29	18742	25320	6578
2012	5.44	18582	25380	6798
2012	5.57	18427	25430	7003
2012	5.71	18277	25480	7203
2012	5.85	18132	25530	7398
2012	5.98	17991	25580	7589
2012	6.12	17854	25630	7776
2012	6.26	17722	25680	7958
2012	6.40	17593	25730	8137
2012	6.54	17468	25780	8312
2012	6.67	17346	25830	8484
2012	6.81	17228	25880	8652
2012	6.95	17113	25920	8807
2012	7.09	17001	25960	8959
2012	7.23	16892	26000	9108
2012	7.36	16786	26040	9254
2012	7.50	16682	26080	9398
2012	7.64	16581	26120	9539
2012	7.78	16482	26160	9678
2012	7.92	16385	26200	9815
2012	8.06	16291	26240	9949
2012	8.19	16199	26280	10081
2012	8.33	16109	26320	10211
2012	8.47	16021	26360	10339
2012	8.61	15935	26400	10465
2012	8.75	15851	26440	10589
2012	8.88	15768	26480	10712
2012	9.02	15687	26520	10833
2012	9.16	15608	26550	10942
2012	9.30	15530	26580	11050
2012	9.44	15454	26610	11156
2012	9.57	15379	26640	11261
2012	9.72	15306	26670	11364
2015	3.22	22107	25450	3343
2015	3.36	21844	25540	3696

Year	Price (1999$/MMBtu)	Non electric gas demand (TBtu)	Total gas supply (TBtu)	Gas supply to electric sector (TBtu)
2015	3.50	21595	25620	4025
2015	3.63	21358	25700	4342
2015	3.78	21132	25780	4648
2015	3.91	20917	25850	4933
2015	4.05	20711	25920	5209
2015	4.19	20514	25990	5476
2015	4.32	20325	26060	5735
2015	4.47	20144	26130	5986
2015	4.60	19970	26190	6220
2015	4.75	19802	26250	6448
2015	4.88	19641	26310	6669
2015	5.01	19485	26370	6885
2015	5.16	19335	26430	7095
2015	5.29	19190	26490	7300
2015	5.44	19050	26540	7490
2015	5.57	18914	26590	7676
2015	5.71	18782	26640	7858
2015	5.85	18654	26690	8036
2015	5.98	18530	26740	8210
2015	6.12	18410	26790	8380
2015	6.26	18293	26840	8547
2015	6.40	18180	26890	8710
2015	6.54	18070	26940	8870
2015	6.67	17963	26980	9017
2015	6.81	17858	27020	9162
2015	6.95	17756	27060	9304
2015	7.09	17657	27100	9443
2015	7.23	17560	27140	9580
2015	7.36	17466	27180	9714
2015	7.50	17374	27220	9846
2015	7.64	17284	27260	9976
2015	7.78	17196	27300	10104
2015	7.92	17110	27340	10230
2015	8.06	17026	27380	10354
2015	8.19	16944	27420	10476
2015	8.33	16863	27460	10597
2015	8.47	16784	27500	10716
2015	8.61	16707	27540	10833
2015	8.75	16631	27570	10939
2015	8.88	16557	27600	11043
2015	9.02	16484	27630	11146
2015	9.16	16413	27660	11247
2015	9.30	16343	27690	11347
2015	9.44	16274	27720	11446
2015	9.57	16207	27750	11543
2015	9.72	16141	27780	11639
2018	3.22	23169	26880	3711
2018	3.36	22871	27010	4139
2018	3.50	22589	27130	4541

Year	Price (1999$/MMBtu)	Non electric gas demand (TBtu)	Total gas supply (TBtu)	Gas supply to electric sector (TBtu)
2018	3.63	22321	27250	4929
2018	3.78	22066	27360	5294
2018	3.91	21823	27470	5647
2018	4.05	21591	27580	5989
2018	4.19	21369	27680	6311
2018	4.32	21156	27780	6624
2018	4.47	20952	27880	6928
2018	4.60	20756	27980	7224
2018	4.75	20568	28070	7502
2018	4.88	20387	28160	7773
2018	5.01	20212	28250	8038
2018	5.16	20044	28340	8296
2018	5.29	19881	28420	8539
2018	5.44	19724	28500	8776
2018	5.57	19572	28580	9008
2018	5.71	19425	28660	9235
2018	5.85	19282	28740	9458
2018	5.98	19144	28820	9676
2018	6.12	19010	28890	9880
2018	6.26	18880	28960	10080
2018	6.40	18753	29030	10277
2018	6.54	18630	29100	10470
2018	6.67	18510	29170	10660
2018	6.81	18394	29240	10846
2018	6.95	18281	29310	11029
2018	7.09	18170	29380	11210
2018	7.23	18062	29440	11378
2018	7.36	17957	29500	11543
2018	7.50	17854	29560	11706
2018	7.64	17754	29620	11866
2018	7.78	17656	29680	12024
2018	7.92	17560	29740	12180
2018	8.06	17467	29800	12333
2018	8.19	17376	29860	12484
2018	8.33	17287	29920	12633
2018	8.47	17200	29980	12780
2018	8.61	17114	30030	12916
2018	8.75	17030	30080	13050
2018	8.88	16948	30130	13182
2018	9.02	16868	30180	13312
2018	9.16	16789	30230	13441
2018	9.30	16712	30280	13568
2018	9.44	16636	30330	13694
2018	9.57	16562	30380	13818
2018	9.72	16489	30430	13941
2020	3.22	23815	26120	2305
2020	3.36	23496	26280	2784
2020	3.50	23194	26440	3246
2020	3.63	22907	26590	3683

Year	Price (1999$/MMBtu)	Non electric gas demand (TBtu)	Total gas supply (TBtu)	Gas supply to electric sector (TBtu)
2020	3.78	22634	26740	4106
2020	3.91	22374	26880	4506
2020	4.05	22126	27020	4894
2020	4.19	21889	27150	5261
2020	4.32	21662	27280	5618
2020	4.47	21445	27410	5965
2020	4.60	21236	27530	6294
2020	4.75	21035	27650	6615
2020	4.88	20842	27770	6928
2020	5.01	20656	27880	7224
2020	5.16	20477	27990	7513
2020	5.29	20304	28100	7796
2020	5.44	20137	28210	8073
2020	5.57	19975	28310	8335
2020	5.71	19818	28410	8592
2020	5.85	19666	28510	8844
2020	5.98	19519	28610	9091
2020	6.12	19376	28710	9334
2020	6.26	19238	28800	9562
2020	6.40	19104	28890	9786
2020	6.54	18973	28980	10007
2020	6.67	18846	29070	10224
2020	6.81	18722	29160	10438
2020	6.95	18602	29250	10648
2020	7.09	18485	29340	10855
2020	7.23	18371	29420	11049
2020	7.36	18260	29500	11240
2020	7.50	18151	29580	11429
2020	7.64	18045	29660	11615
2020	7.78	17941	29740	11799
2020	7.92	17840	29820	11980
2020	8.06	17741	29900	12159
2020	8.19	17644	29980	12336
2020	8.33	17550	30050	12500
2020	8.47	17458	30120	12662
2020	8.61	17368	30190	12822
2020	8.75	17279	30260	12981
2020	8.88	17192	30330	13138
2020	9.02	17107	30400	13293
2020	9.16	17024	30470	13446
2020	9.30	16942	30540	13598
2020	9.44	16862	30610	13748
2020	9.57	16783	30680	13897
2020	9.72	16706	30750	14044

Table A3.3 shows the fuel oil prices used in the MARAMA analysis. These prices based on AEO 2006.

Table A3.3 Residual and Distillate Fuel Oil Prices (1999$/MMBtu)

	Residual Oil		Distillate Oil	
Year	**MAAC**	**New England**	**MAAC**	**New England**
2008	5.13	4.41	8.63	8.69
2009	5.00	4.13	8.30	8.38
2010	4.88	3.87	7.98	8.05
2012	4.75	3.83	8.06	8.12
2015	4.75	3.77	7.90	7.96
2018	5.03	3.90	8.27	8.33
2020	5.06	3.98	8.41	8.47
Source: AEO 2006				

Table A3.4 summarizes the cumulative SCR and scrubber feasibility limits that were implemented in the years 2008, 2009 and 2010. These limits are based on projections of planned installations.

Table A3.4 SCR and Scrubber Feasibility Limits

Year	SCR (GW)	Scrubbers (GW)
2008	9	31
2009	15	51
2010	No Limit	69

Tables A3.5a and 3.5b show the list of CAVR eligible sources for SO_2 and NO_x requirements.

Table A3.5a CAVR SO_2 Requirements: All CAVR eligible, unscrubbed, non CAIR and non WRAP affected sources larger than 200 MW

Unique ID	Plant Name	State
6138_B_1	Flint Creek	Arkansas
6641_B_1	Independence	Arkansas
6009_B_1	White Bluff	Arkansas
6009_B_2	White Bluff	Arkansas
469_B_4	Cherokee	Colorado
470_B_1	Comanche	Colorado
470_B_2	Comanche	Colorado
6248_B_1	Pawnee	Colorado
8219_B_1	Rray d Nixon	Colorado
568_B_BHB3	Bridgeport Harbor	Connecticut
1241_B_2	La Cygne	Kansas
6064_B_N1	Nearman Creek	Kansas
1619_B_1	Brayton Point	Massachusetts
1619_B_2	Brayton Point	Massachusetts
1619_B_3	Brayton Point	Massachusetts
2817_B_1	leland Olds	North Dakota
2817_B_2	leland Olds	North Dakota
2823_B_B1	Milton R Young	North Dakota
6077_B_1	Gerald Gentleman	Nebraska
6077_B_2	Gerald Gentleman	Nebraska
6096_B_1	Nebraska City	Nebraska
2291_B_5	North Omaha	Nebraska
2364_B_2	Merrimack	New Hampshire
8224_B_1	North Valmy	Nevada
2952_B_4	Muskogee	Oklahoma
2952_B_5	Muskogee	Oklahoma
2963_B_3313	Northeastern	Oklahoma
2963_B_3314	Northeastern	Oklahoma
6095_B_1	Sooner	Oklahoma
6095_B_2	Sooner	Oklahoma
6098_B_1	Big Stone	South Dakota

Table A3.5b CAVR NO_X Requirements: CAVR eligible, non CAIR affected sources larger than 200 MW

Unique ID	Plant Name	State
6138_B_1	Flint Creek	Arkansas
6641_B_1	Independence	Arkansas
6009_B_1	White Bluff	Arkansas
6009_B_2	White Bluff	Arkansas
113_B_2	Cholla	Arizona
113_B_3	Cholla	Arizona
113_B_4	Cholla	Arizona
6177_B_U1B	Coronado	Arizona
6177_B_U2B	Coronado	Arizona
4941_B_1	Navajo	Arizona
4941_B_2	Navajo	Arizona
4941_B_3	Navajo	Arizona
469_B_4	Cherokee	Colorado
470_B_1	Comanche	Colorado
470_B_2	Comanche	Colorado
6021_B_C1	Craig	Colorado
6021_B_C2	Craig	Colorado
525_B_H2	Hayden	Colorado
6248_B_1	Pawnee	Colorado
8219_B_1	Ray D Nixon	Colorado
568_B_BHB3	Bridgeport Harbor	Connecticut
6068_B_1	Jeffrey Energy Center	Kansas
6068_B_2	Jeffrey Energy Center	Kansas
1241_B_1	La Cygne	Kansas
1241_B_2	La Cygne	Kansas
1250_B_5	Lawrence	Kansas
6064_B_N1	Nearman Creek	Kansas
1619_B_1	Brayton Point	Massachusetts
1619_B_2	Brayton Point	Massachusetts
1619_B_3	Brayton Point	Massachusetts
6076_B_1	Colstrip	Montana
6076_B_2	Colstrip	Montana
6030_B_1	Coal Creek	North Dakota
6030_B_2	Coal Creek	North Dakota
2817_B_1	Leland Olds	North Dakota
2817_B_2	Leland Olds	North Dakota
2823_B_B1	Milton R Young	North Dakota
2823_B_B2	Milton R Young	North Dakota
6077_B_1	Gerald Gentleman	Nebraska
6077_B_2	Gerald Gentleman	Nebraska
6096_B_1	Nebraska City	Nebraska
2291_B_5	North Omaha	Nebraska
2364_B_2	Merrimack	New Hampshire
2442_B_3	Four Corners	New Mexico
2442_B_4	Four Corners	New Mexico
2442_B_5	Four Corners	New Mexico
2451_B_1	San Juan	New Mexico
2451_B_2	San Juan	New Mexico

Unique ID	Plant Name	State
2451_B_3	San Juan	New Mexico
2451_B_4	San Juan	New Mexico
2341_B_1	Mohave	Nevada
2341_B_2	Mohave	Nevada
8224_B_1	North Valmy	Nevada
2952_B_4	Muskogee	Oklahoma
2952_B_5	Muskogee	Oklahoma
2963_B_3313	Northeastern	Oklahoma
2963_B_3314	Northeastern	Oklahoma
6095_B_1	Sooner	Oklahoma
6095_B_2	Sooner	Oklahoma
6106_B_1SG	Boardman	Oregon
6098_B_1	Big Stone	South Dakota
6165_B_1	Hunter (Emery)	Utah
6165_B_2	Hunter (Emery)	Utah
8069_B_1	Huntington	Utah
8069_B_2	Huntington	Utah
3845_B_BW21	Centralia	Washington
3845_B_BW22	Centralia	Washington
4158_B_BW43	Dave Johnston	Wyoming
4158_B_BW44	Dave Johnston	Wyoming
8066_B_BW71	Jim Bridger	Wyoming
8066_B_BW72	Jim Bridger	Wyoming
8066_B_BW73	Jim Bridger	Wyoming
8066_B_BW74	Jim Bridger	Wyoming
6204_B_1	Laramie River	Wyoming
6204_B_2	Laramie River	Wyoming
6204_B_3	Laramie River	Wyoming
4162_B_2	Naughton	Wyoming
4162_B_3	Naughton	Wyoming
6101_B_BW91	Wyodak	Wyoming

Title IV SO_2 bank – In order to capture the dynamics of the SO_2 allowance market pre 2007, MARAMA has implemented a Title IV SO_2 allowance bank of 6.43 million tons, going into the year 2007.

Tables A3.6 and A3.7 show the national regulations modeled in the MARAMA base case and policy cases respectively, along with the details regarding affected units, policy structure and amount of allowances.

Table A3.6 Trading and Banking Rules in the MARAMA Base Case

	Title IV SO_2	**CAIR Annual NO_x**	**CAIR Ozone Season NO_x**	**CAVR Rule – SO_2**	**CAVR Rule – NO_x**	**CAMR (Clean Air Mercury Rule)**
Coverage	All Fossil units >25 MW	All Fossil units >25 MW *	All Fossil units >25 MW **	All Coal, CAVR Eligible, Non CAIR Unscrubbed and Non WRAP > 200 MW ***	All Coal & CAVR Eligible Outside CAIR > 200 MW	All Coal Units > 25 MW
Timing	Annual	Annual	Ozone Season (May – September)	Annual	Annual	Annual
Size of Initial Bank	6,437 thousand tons starting in 2007	The bank starting in 2009 is assumed to be zero.	The bank starting in 2007 is assumed to be zero.	N/A	N/A	-
Policy Structure	Trading and Banking allowed	Trading and Banking allowed	Trading and Banking allowed	No Trading or banking	No Trading or banking	Trading and Banking allowed
Rules						
Total Allowances (thousand tons except for CAMR is in tons)	2007-2009: 9,470 2010-2030: 8,950	2009: 1,722 2010-2014: 1,522 2015-2030: 1,268	2007-2008: 497[1] 2009-2014: 568 2015-2030: 485	N/A	N/A	2010-2017: 38 2018-2030: 15
Total Allowances Pre 2007 Bank Less NSR and North Carolina SO_2 Allowance Retirements (thousand tons)	2007: 15,805 2008: 9,350 2009: 9,280 2010-2012: 8,813 2013-2030: 8,611	2009: 1,722 2010-2014: 1,522 2015-2030: 1,268	2007-2008: 497[1] 2009-2014: 568 2015-2030: 485	N/A	N/A	2010-2017: 38 2018-2030: 15
Non Cap and Trade Policy Specifications	N/A	N/A	N/A	0.15 lbs/MMBtu	Combustion Controls on units >200MW and SCRs on cyclone fired units	N/A
Retirement Ratio	2010: 2.0 2012: 2.0 2015: 2.52 2018: 2.86	2009-2030: 1.0	2007-2030: 1.0	N/A	N/A	2007-2030: 1.0

* **CAIR Region States**: Alabama, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, West Virginia, Wisconsin, New Jersey, Delaware.

** **CAIR Ozone Season States**: Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, West Virginia, Wisconsin.

*** **WRAP States**: Arizona, New Mexico, Oregon, Utah, Wyoming

1. SIP Call

Table A3.7 Trading and Banking Rules in the MARAMA Policy Case

	Title IV SO_2	MARAMA CAIR Plus - Annual NO_x	MARAMA SIP Call and CAIR Plus - Ozone season NO_x	CAVR Rule – SO_2	CAVR Rule – NO_x	CAMR (Clean Air Mercury Rule)
Coverage	All Fossil units >25 MW	All Fossil units >25 MW *	All Fossil units >25 MW **	All Coal, CAVR Eligible, Non CAIR Unscrubbed and Non WRAP > 200 MW ***	All Coal & CAVR Eligible Outside CAIR > 200 MW	All Coal Units > 25 MW
Timing	Annual	Annual	Ozone Season (May – September)	Annual	Annual	Annual
Size of Initial Bank	6,437 thousand tons starting in 2007	The bank starting in 2009 is assumed to be zero.	The bank starting in 2007 is assumed to be zero.	N/A	N/A	-
Policy Structure	Trading and Banking allowed	Trading and Banking allowed	Trading and Banking allowed	No Trading or banking	No Trading or banking	Trading and Banking allowed
Rules						
Total Allowances (thousand tons except for CAMR is in Tons)	2007-2009: 9,470 2010-2030: 8,950	2009: 1,553 2010-2011: 1,353 2012-2014: 902 2015-2030: 829	2007-2008: 497[1] 2009-2011: 623 2012-2014: 416 2015-2030: 382	N/A	N/A	2010-2017: 38 2018-2030: 15
Total Allowances Pre 2007 Bank Less NSR and North Carolina SO_2 Allowance Retirements (thousand tons)	2007: 15,805 2008: 9,350 2009: 9,280 2010-2012: 8,813 2013-2030: 8,611	2009: 1,553 2010-2011: 1,353 2012-2014: 902 2015-2030: 829	2007-2008: 497[1] 2009-2011: 623 2012-2014: 416 2015-2030: 382	N/A	N/A	2010-2017: 38 2018-2030: 15
Non Cap and Trade Policy Specifications	N/A	N/A	N/A	0.15 lbs/MMBtu	Combustion Controls on units >200MW and SCRs on cyclone fired units	N/A
Retirement Ratio	2010: 2.5 2012: 2.94 2015: 3.32 2018: 4.16	2009-2030: 1.0	2007-2030: 1.0	N/A	N/A	2007-2030: 1.0

* **CAIR Plus Policy States**: Alabama, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, West Virginia, Wisconsin, Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New Jersey, Delaware, Arkansas.

**** CAIR Ozone Season States**: Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, West Virginia, Wisconsin.

***** WRAP States**: Arizona, New Mexico, Oregon, Utah, Wyoming

1. SIP Call

Appendix 4: Comparison of Assumptions Used in VISTAS and MARAMA analysis

Table 4.1 Differences in assumptions between the VISTAS and MARAMA projects.

Parameter	**VISTAS**	**MARAMA**
Run Years	2007,2010,2015,2020,2026	2008,2009, 2010,2012,2015,2018,2020,2026
Gas Supply Curve	EPA Base Case v.2.19 (see table below)	EPA Base Case v.3.0 (refer to table A3.2 in Appendix 3.)
Fuel Oil Prices	AEO 2004 (See table below)	AEO 2006 (Refer to table A3.3 in Appendix 3)
SCR and Scrubber Feasibility Limits	No limits applied in 2008, 2009 and 2010	Limits applied in 2008, 2009 and 2010. (Refer to table A3.4 in Appendix 3)
Clean Air Visibility Rule	Not modeled	Implemented the CAVR rule for SO_2 and NO_X
Title IV SO_2 Bank (2007)	4.98 million tons	6.43 million tons

Table A4.2: Natural Gas Supply Curve Used in VISTAS Run

Year	Price (1999$/Mmbtu)	Non electric gas demand (TBtu)	Total gas supply (TBtu)	Gas supply to power sector (TBtu)
2007	2.75	19411	23560	4149
2007	2.80	19314	23580	4266
2007	2.85	19220	23600	4380
2007	2.90	19128	23620	4492
2007	2.95	19038	23640	4602
2007	3.00	18950	23660	4710
2007	3.05	18863	23680	4817
2007	3.10	18778	23700	4922
2007	3.15	18695	23720	5025
2007	3.20	18614	23730	5116
2007	3.25	18534	23740	5206
2007	3.26	18514	23740	5226
2007	3.30	18457	23790	5333
2007	3.35	18378	23800	5422
2007	3.40	18299	23810	5511
2007	3.44	18243	23820	5577
2007	3.45	18224	23820	5596
2007	3.50	18157	23830	5673
2007	3.55	18090	23840	5750
2007	3.57	18066	23840	5774
2007	3.60	18021	23850	5829
2007	3.65	17952	23860	5908
2007	3.70	17884	23870	5986
2007	3.75	17818	23880	6062
2007	3.80	17753	23890	6137
2007	3.85	17689	23900	6211
2007	3.90	17626	23910	6284
2007	3.95	17564	23920	6356
2007	4.00	17503	23930	6427
2007	4.05	17443	23940	6497
2007	4.10	17384	23950	6566
2007	4.15	17326	23960	6634
2007	4.20	17269	23970	6701
2007	4.25	17212	23980	6768
2007	4.30	17156	23990	6834
2007	4.35	17101	24000	6899
2007	4.40	17047	24010	6963
2007	4.45	16994	24020	7026
2007	4.50	16941	24030	7089
2007	4.55	16889	24040	7151
2007	4.60	16838	24050	7212
2007	4.65	16788	24060	7272
2007	4.70	16738	24070	7332
2007	4.75	16689	24080	7391
2007	4.80	16641	24090	7449
2007	4.85	16593	24100	7507
2007	4.90	16546	24110	7564
2007	4.95	16500	24120	7620

Year	Price (1999$/Mmbtu)	Non electric gas demand (TBtu)	Total gas supply (TBtu)	Gas supply to power sector (TBtu)
2007	5.00	16454	24130	7676
2007	5.05	16409	24140	7731
2007	5.10	16364	24150	7786
2007	5.15	16320	24160	7840
2007	5.20	16276	24170	7894
2007	5.25	16233	24180	7947
2007	5.30	16190	24190	8000
2007	5.35	16148	24200	8052
2007	5.40	16106	24210	8104
2007	5.41	16064	24220	8156
2010	2.75	19727	23780	4053
2010	2.80	19621	23890	4269
2010	2.85	19517	23990	4473
2010	2.90	19415	24090	4675
2010	2.95	19316	24190	4874
2010	3.00	19219	24290	5071
2010	3.05	19124	24390	5266
2010	3.10	19031	24490	5459
2010	3.15	18940	24590	5650
2010	3.16	18916	24620	5704
2010	3.20	18856	24850	5994
2010	3.25	18766	24970	6204
2010	3.29	18691	25070	6379
2010	3.30	18678	25080	6402
2010	3.35	18597	25130	6533
2010	3.40	18516	25180	6664
2010	3.45	18435	25230	6795
2010	3.46	18411	25240	6829
2010	3.50	18355	25300	6945
2010	3.55	18277	25390	7113
2010	3.60	18200	25480	7280
2010	3.65	18125	25570	7445
2010	3.70	18051	25660	7609
2010	3.75	17978	25740	7762
2010	3.80	17907	25820	7913
2010	3.85	17837	25900	8063
2010	3.90	17768	25980	8212
2010	3.95	17700	26060	8360
2010	4.00	17633	26140	8507
2010	4.05	17567	26220	8653
2010	4.10	17502	26300	8798
2010	4.15	17438	26380	8942
2010	4.20	17375	26460	9085
2010	4.25	17313	26540	9227
2010	4.30	17252	26620	9368
2010	4.35	17192	26700	9508
2010	4.40	17133	26770	9637
2010	4.45	17075	26840	9765
2010	4.50	17018	26910	9892
2010	4.55	16962	26980	10018

Year	Price (1999$/Mmbtu)	Non electric gas demand (TBtu)	Total gas supply (TBtu)	Gas supply to power sector (TBtu)
2010	4.60	16906	27050	10144
2010	4.65	16851	27120	10269
2010	4.70	16797	27190	10393
2010	4.75	16744	27260	10516
2010	4.80	16691	27330	10639
2010	4.85	16639	27400	10761
2010	4.90	16588	27470	10882
2010	4.95	16538	27540	11002
2010	5.00	16488	27610	11122
2010	5.05	16439	27680	11241
2010	5.10	16390	27750	11360
2010	5.15	16342	27820	11478
2010	5.20	16295	27890	11595
2010	5.25	16248	27960	11712
2010	5.30	16202	28020	11818
2010	5.35	16156	28080	11924
2010	5.40	16111	28140	12029
2010	5.41	16066	28200	12134
2015	2.75	20148	24960	4812
2015	2.80	20060	25140	5080
2015	2.85	19974	25320	5346
2015	2.90	19890	25500	5610
2015	2.95	19808	25670	5862
2015	3.00	19727	25840	6113
2015	3.05	19648	26010	6362
2015	3.08	19599	26120	6521
2015	3.10	19569	26210	6641
2015	3.15	19489	26460	6971
2015	3.18	19442	26610	7168
2015	3.20	19413	26680	7267
2015	3.25	19343	26850	7507
2015	3.30	19273	27020	7747
2015	3.35	19203	27190	7987
2015	3.39	19144	27330	8186
2015	3.40	19134	27350	8216
2015	3.45	19069	27480	8411
2015	3.50	19004	27610	8606
2015	3.55	18939	27740	8801
2015	3.60	18874	27870	8996
2015	3.65	18809	28000	9191
2015	3.70	18744	28130	9386
2015	3.70	18741	28140	9399
2015	3.75	18683	28280	9597
2015	3.80	18623	28430	9807
2015	3.85	18564	28580	10016
2015	3.90	18506	28730	10224
2015	3.95	18449	28880	10431
2015	4.00	18393	29020	10627
2015	4.05	18338	29160	10822
2015	4.10	18283	29300	11017

Year	Price (1999$/Mmbtu)	Non electric gas demand (TBtu)	Total gas supply (TBtu)	Gas supply to power sector (TBtu)
2015	4.15	18229	29440	11211
2015	4.20	18176	29580	11404
2015	4.25	18124	29720	11596
2015	4.30	18073	29860	11787
2015	4.35	18022	30000	11978
2015	4.40	17972	30140	12168
2015	4.45	17923	30280	12357
2015	4.50	17874	30410	12536
2015	4.55	17826	30540	12714
2015	4.60	17779	30670	12891
2015	4.65	17732	30800	13068
2015	4.70	17686	30930	13244
2015	4.75	17641	31060	13419
2015	4.80	17596	31190	13594
2015	4.85	17552	31320	13768
2015	4.90	17508	31450	13942
2015	4.95	17465	31580	14115
2015	5.00	17422	31710	14288
2015	5.05	17380	31840	14460
2015	5.10	17338	31960	14622
2015	5.15	17297	32080	14783
2015	5.20	17256	32200	14944
2015	5.25	17216	32320	15104
2015	5.30	17176	32440	15264
2015	5.35	17137	32560	15423
2015	5.40	17098	32680	15582
2020	2.75	20782	27560	6778
2020	2.80	20695	27720	7025
2020	2.85	20610	27870	7260
2020	2.90	20527	28020	7493
2020	2.95	20449	28160	7711
2020	2.95	20445	28170	7725
2020	3.00	20369	28320	7951
2020	3.05	20293	28470	8177
2020	3.10	20217	28620	8403
2020	3.15	20141	28770	8629
2020	3.20	20065	28920	8855
2020	3.25	19989	29070	9081
2020	3.29	19935	29180	9245
2020	3.30	19914	29230	9316
2020	3.35	19844	29400	9556
2020	3.40	19774	29570	9796
2020	3.45	19704	29740	10036
2020	3.49	19646	29880	10234
2020	3.50	19636	29900	10264
2020	3.55	19577	30010	10433
2020	3.60	19518	30120	10602
2020	3.65	19459	30230	10771
2020	3.70	19400	30340	10940
2020	3.75	19341	30450	11109

Year	Price (1999$/Mmbtu)	Non electric gas demand (TBtu)	Total gas supply (TBtu)	Gas supply to power sector (TBtu)
2020	3.80	19282	30560	11278
2020	3.85	19223	30670	11447
2020	3.90	19164	30780	11616
2020	3.95	19105	30890	11785
2020	4.00	19046	31000	11954
2020	4.02	19024	31040	12016
2020	4.05	18990	31120	12130
2020	4.10	18936	31240	12304
2020	4.15	18883	31360	12477
2020	4.20	18830	31480	12650
2020	4.25	18778	31600	12822
2020	4.30	18727	31720	12993
2020	4.35	18677	31840	13163
2020	4.40	18627	31950	13323
2020	4.45	18578	32060	13482
2020	4.50	18530	32170	13640
2020	4.55	18482	32280	13798
2020	4.60	18435	32390	13955
2020	4.65	18389	32500	14111
2020	4.70	18343	32610	14267
2020	4.75	18298	32720	14422
2020	4.80	18253	32830	14577
2020	4.85	18209	32940	14731
2020	4.90	18165	33050	14885
2020	4.95	18122	33160	15038
2020	5.00	18080	33270	15190
2020	5.05	18038	33370	15332
2020	5.10	17997	33470	15473
2020	5.15	17956	33570	15614
2020	5.20	17916	33670	15754
2020	5.25	17876	33770	15894
2020	5.30	17837	33870	16033
2020	5.35	17798	33970	16172
2020	5.40	17759	34070	16311

Table A4.3: Fuel Oil Prices Used in VISTAS Run

High Sulfur Residual Oil Prices ($1999/MMBtu)		
	IPM Region	
Year	MACE	New England
2007	3.51	2.93
2010	3.57	2.98
2015	3.67	3.11
2020	3.76	3.22
Source: AEO 2004		

Low Sulfur Residual Oil Prices ($1999/MMBtu)		
	IPM Region	
Year	MACE	New England
2007	3.73	3.30
2010	3.79	3.35
2015	3.90	3.47
2020	3.99	3.58
Source: AEO 2004		

Distillate Oil Prices ($1999/MMBtu)		
	IPM Region	
Year	MACE	New England
2007	4.72	4.80
2010	4.86	4.94
2015	5.23	5.29
2020	5.58	5.60
Source: AEO 2004		

Appendix 5: Emission and Cost Results

Tables A5.1- A5.3 present SO_2 and NO_x emissions from the MARAMA Base Case and MARAMA CAIR Plus Policy Case runs by state in 2008, 2009, 2012, 2015 and 2018 run years. These emissions are from all units and include emissions from fossil and non-fossil units

Tables A5.4- A5.8 present variable O&M costs, fixed O&M costs, annualized capital costs, fuel costs and total production costs from the MARAMA Base Case and MARAMA CAIR Plus Policy Case runs by state in 2008, 2009, 2012, 2015 and 2018 run years.

Table A5.1: State Level Annual SO_2 Emissions in MARAMA Base Case and MARAMA CAIR Plus Policy Case (Thousand Tons)

		MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
RPO	State	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018
MANE-VU	Connecticut	3.92	3.97	9.93	12.18	14.71	3.02	3.07	4.29	4.94	5.01	-0.90	-0.90	-5.65	-7.24	-9.70
	Delaware	33.74	32.55	17.58	15.39	14.43	33.74	29.61	28.25	8.08	3.33	0.00	-2.93	10.67	-7.31	-11.09
	District of Columbia	0.00	0.00	0.19	0.29	0.63	0.00	0.00	0.41	0.49	0.69	0.00	0.00	0.22	0.20	0.05
	Maine	38.00	38.37	8.27	8.99	9.87	34.72	33.00	5.23	5.16	4.89	-3.27	-5.37	-3.04	-3.82	-4.98
	Maryland	130.21	65.67	52.98	31.47	35.48	100.07	39.07	33.04	31.42	32.81	-30.13	-26.60	-19.94	-0.04	-2.67
	Massachusetts	78.18	36.10	29.38	29.53	33.89	74.98	37.13	15.75	11.47	8.96	-3.19	1.03	-13.62	-18.05	-24.93
	New Hampshire	7.66	7.66	11.88	13.38	15.17	7.66	4.97	3.38	3.17	3.27	0.00	-2.68	-8.50	-10.21	-11.90
	New Jersey	26.56	25.85	28.02	26.43	23.32	26.23	25.89	26.67	23.82	16.93	-0.34	0.04	-1.35	-2.61	-6.39
	New York	124.38	121.50	102.95	90.74	85.54	110.99	105.26	76.55	72.32	66.51	-13.39	-16.24	-26.40	-18.42	-19.03
	Pennsylvania	359.35	318.52	199.42	179.15	156.97	343.13	277.39	182.70	150.27	127.58	-16.22	-41.13	-16.72	-28.88	-29.39
	Rhode Island	0.00	0.00	1.29	1.77	2.32	0.00	0.00	0.26	0.40	0.42	0.00	0.00	-1.02	-1.37	-1.90
	Vermont	0.06	0.06	0.87	1.16	1.51	0.06	0.06	0.22	0.31	0.32	0.00	0.00	-0.65	-0.86	-1.19
MANE-VU Total		802.06	650.24	462.75	410.48	393.84	734.60	555.46	376.75	311.86	270.72	-67.45	-94.78	-86.00	-98.62	-123.12
LADCO	Illinois	304.36	305.10	260.79	242.83	244.94	299.78	274.23	240.60	222.03	238.38	-4.59	-30.87	-20.19	-20.80	-6.57
	Indiana	496.08	483.36	463.56	414.50	376.78	476.80	410.99	409.93	377.38	332.21	-19.28	-72.38	-53.63	-37.11	-44.57
	Michigan	407.01	407.02	398.16	397.45	399.56	406.35	390.37	397.12	391.05	376.77	-0.66	-16.64	-1.04	-6.40	-22.79
	Ohio	581.77	440.10	317.26	282.43	264.40	431.30	436.33	249.67	194.09	184.86	-150.46	-3.77	-67.58	-88.34	-79.54
	Wisconsin	161.24	149.57	153.59	153.31	152.02	161.30	148.40	150.63	148.06	142.94	0.06	-1.17	-2.96	-5.25	-9.09
LADCO Total		1,950.46	1,785.15	1,593.35	1,490.51	1,437.70	1,775.52	1,660.32	1,447.95	1,332.62	1,275.15	-174.93	-124.83	-145.40	-157.89	-162.56
VISTAS	Alabama	357.18	332.19	286.09	253.71	217.58	336.53	264.83	219.62	185.76	158.36	-20.65	-67.36	-66.47	-67.96	-59.22
	Florida	213.04	210.85	194.80	194.07	165.00	212.81	190.25	157.71	156.67	115.33	-0.22	-20.60	-37.09	-37.40	-49.67
	Georgia	558.02	560.12	312.67	214.82	183.00	573.16	371.67	92.72	94.53	74.99	15.14	-188.45	-219.95	-120.29	-108.01
	Kentucky	386.28	376.19	274.92	274.02	239.92	362.81	328.20	274.84	223.64	203.38	-23.47	-47.99	-0.08	-50.39	-36.54
	Mississippi	82.21	70.23	85.73	27.87	23.15	81.55	62.58	25.44	23.13	24.60	-0.66	-7.65	-60.29	-4.75	1.44
	North Carolina	261.33	167.47	130.55	110.64	101.45	260.58	146.20	121.39	92.23	73.64	-0.74	-21.27	-9.15	-18.41	-27.81
	South Carolina	184.15	171.26	119.43	115.66	114.30	162.00	138.43	119.59	91.30	63.08	-22.15	-32.83	0.16	-24.37	-51.21
	Tennessee	246.52	244.39	235.35	231.69	141.52	237.50	168.68	197.69	136.09	109.20	-9.03	-75.71	-37.66	-95.60	-32.32
	Virginia	200.04	178.64	146.24	117.17	81.50	180.42	156.77	126.48	71.27	46.67	-19.62	-21.88	-19.76	-45.90	-34.84
	West Virginia	390.89	390.67	195.44	150.00	130.75	289.42	221.84	126.03	115.98	122.55	-101.46	-168.83	-69.41	-34.02	-8.20
VISTAS Total		2,879.64	2,702.01	1,981.22	1,689.66	1,398.18	2,696.77	2,049.45	1,461.51	1,190.59	991.81	-182.87	-652.56	-519.71	-499.07	-406.38
CENRAP	Arkansas	82.63	82.63	83.25	40.83	42.15	82.63	81.80	83.30	37.71	40.29	0.00	-0.82	0.05	-3.12	-1.87
	Iowa	145.10	139.66	147.98	143.60	144.93	146.70	130.53	140.02	138.56	137.16	1.60	-9.13	-7.96	-5.04	-7.76
	Kansas	80.16	80.52	81.49	59.32	59.32	78.46	78.82	81.49	59.33	59.35	-1.70	-1.70	0.00	0.01	0.03
	Louisiana	111..31	111..31	75.49	77.24	79.60	111..31	91.70	75.59	77.31	76.61	0.00	-19.61	0.10	0.07	-2.99

		MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
RPO	State	**2008**	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**
	Minnesota	96.56	87.90	86.82	85.30	84.26	95.74	84.24	83.05	69.59	65.86	-0.82	-3.66	-3.76	-15.70	-18.39
	Missouri	266.99	276.53	280.25	279.80	279.97	264.07	248.11	273.51	266.06	224.45	-2.93	-28.42	-6.75	-13.74	-55.53
	Nebraska	73.63	73.63	73.63	37.18	37.18	73.63	73.63	73.63	37.18	37.18	0.00	0.00	0.00	0.00	0.00
	Oklahoma	113.68	113.68	117.28	48.06	50.15	113.68	113.68	119.44	48.08	52.18	0.00	0.00	2.17	0.02	2.03
	Texas	425.27	425.27	439.21	387.56	359.20	424.27	422.47	384.06	280.92	268.72	-1.00	-2.80	-55.15	-106.63	-90.48
CENRAP Total		1,395.34	1,391.13	1,385.39	1,158.90	1,136.76	1,390.49	1,324.98	1,314.08	1,014.75	961.80	-4.85	-66.15	-71.31	-144.15	-174.96
WRAP	Arizona	60.54	60.55	63.28	63.28	56.83	60.54	60.55	63.80	64.22	57.78	0.00	0.00	0.52	0.95	0.96
	California	6.79	6.79	7.53	7.53	7.45	6.79	6.67	7.63	7.63	7.49	0.00	-0.12	0.10	0.10	0.04
	Colorado	87.22	86.55	87.21	52.84	53.62	86.55	86.56	87.21	52.84	53.75	-0.67	0.01	0.00	0.00	0.14
	Idaho	0.05	0.05	1.14	1.14	1.01	0.05	0.05	1.28	1.28	1.08	0.00	0.00	0.14	0.14	0.07
	Montana	19.88	19.88	20.51	20.51	20.46	16.72	16.72	20.60	20.60	20.50	-3.16	-3.16	0.08	0.08	0.04
	Nevada	31.24	31.30	31.96	28.21	29.00	31.24	31.30	32.10	28.44	29.23	0.00	0.00	0.15	0.24	0.23
	New Mexico	52.92	52.92	53.64	53.64	54.42	52.92	52.92	53.77	53.85	54.63	0.00	0.00	0.13	0.21	0.20
	North Dakota	92.63	92.65	93.39	85.04	85.05	96.70	100.00	109.45	101.11	101.91	4.07	7.35	16.06	16.07	16.86
	Oregon	10.18	10.18	16.27	16.27	15.54	10.18	10.18	17.07	17.07	15.91	0.00	0.00	0.79	0.79	0.37
	South Dakota	12.09	12.09	12.09	4.15	4.20	12.09	12.09	12.09	4.18	4.20	0.00	0.00	0.00	0.03	0.00
	Utah	53.16	53.16	53.16	53.16	33.55	53.16	53.16	53.16	53.16	33.55	0.00	0.00	0.00	0.00	0.00
	Washington	11.25	11.25	20.75	20.68	19.29	11.25	11.25	22.18	20.96	22.06	0.00	0.00	1.44	0.28	2.76
	Wyoming	70.13	70.10	72.69	71.37	38.69	64.79	64.64	71.95	72.45	38.72	-5.35	-5.46	-0.74	1.08	0.02
WRAP Total		508.08	507.48	533.62	477.82	419.10	502.97	506.09	552.29	497.79	440.80	-5.11	-1.39	18.67	19.97	21.70
CAIR Plus Policy States		6,760.02	6,260.69	5,150.31	4,604.99	4,219.83	6,331.62	5,324.07	4,325.72	3,705.23	3,350.76	-428.40	-936.62	-824.59	-899.76	-869.07
National		7,535.57	7,036.00	5,956.32	5,227.37	4,785.59	7,100.36	6,096.28	5,152.57	4,347.61	3,940.28	-435.21	-939.72	-803.75	-879.77	-845.31

Table A5.2: State Level Annual NO_x Emissions in MARAMA Base Case and MARAMA CAIR Plus Policy Case (Thousand Tons)

		MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
RPO	State	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018
MANE-VU	Connecticut	3.45	3.60	5.07	5.19	5.69	3.42	3.74	3.64	3.81	3.86	-0.03	0.15	-1.43	-1.38	-1.83
	Delaware	12.51	10.72	11.40	10.91	10.72	12.52	10.16	9.68	4.84	3.88	0.01	-0.56	-1.72	-6.07	-6.83
	District of Columbia	0.11	0.13	0.21	0.30	0.48	0.11	0.13	0.33	0.39	0.50	0.00	0.00	0.12	0.10	0.02
	Maine	7.80	7.94	2.66	2.64	2.78	7.42	3.25	1.87	1.89	1.86	-0.38	-4.69	-0.79	-0.75	-0.92
	Maryland	54.68	16.33	16.10	16.76	19.22	54.68	14.38	17.36	17.54	18.73	0.00	-1.96	1.26	0.79	-0.49
	Massachusetts	30.40	24.25	24.57	22.05	22.55	20.90	13.89	12.03	9.89	9.96	-9.49	-10.37	-12.54	-12.16	-12.59
	New Hampshire	3.96	4.07	5.32	5.28	5.65	3.96	2.92	2.45	2.56	2.66	0.00	-1.15	-2.87	-2.72	-2.99
	New Jersey	16.90	10.82	11.00	12.70	12.54	16.88	11.57	10.64	12.06	10.89	-0.02	0.75	-0.36	-0.65	-1.64
	New York	48.33	48.42	46.14	41.52	38.72	47.59	41.00	31.26	30.61	28.72	-0.74	-7.42	-14.88	-10.91	-9.99
	Pennsylvania	207.46	144.89	85.35	83.95	79.34	208.06	126.22	72.38	68.60	64.08	0.60	-18.66	-12.98	-15.35	-15.26
	Rhode Island	0.26	0.59	0.53	0.57	0.67	0.26	0.58	0.23	0.27	0.27	0.00	-0.01	-0.30	-0.30	-0.40
	Vermont	0.13	0.17	0.39	0.40	0.47	0.13	0.16	0.19	0.21	0.23	0.00	0.00	-0.20	-0.18	-0.24
MANE-VU Total		385.99	271.92	208.74	202.25	198.82	375.92	228.00	162.05	152.67	145.64	-10.06	-43.92	-46.69	-49.58	-53.18
LADCO	Illinois	131.60	87.21	73.57	70.99	72.80	130.94	62.34	56.53	54.12	53.33	-0.66	-24.87	-17.03	-16.87	-19.46
	Indiana	219.40	144.58	107.85	96.96	85.08	221.73	136.98	54.83	53.22	51.32	2.33	-7.60	-53.02	-43.74	-33.76
	Michigan	120.64	86.96	85.53	87.16	92.62	120.00	82.48	39.77	40.44	41.42	-0.64	-4.48	-45.76	-46.72	-51.21
	Ohio	272.07	116.53	97.31	89.00	85.95	271.91	101.79	66.96	65.25	63.56	-0.16	-14.75	-30.35	-23.75	-22.39
	Wisconsin	60.14	48.14	44.77	45.39	45.66	59.63	42.34	31.15	31.70	32.17	-0.51	-5.80	-13.63	-13.69	-13.49
LADCO Total		803.86	483.42	409.04	389.50	382.12	804.22	425.92	249.25	244.74	241.79	0.36	-57.50	-159.79	-144.77	-140.32
VISTAS	Alabama	131.82	82.73	68.84	47.15	47.46	134.12	52.64	31.69	31.13	32.74	2.30	-30.10	-37.15	-16.02	-14.72
	Florida	164.71	115.54	78.29	74.45	66.66	164.71	105.40	49.61	49.19	48.58	0.00	-10.13	-28.68	-25.25	-18.07
	Georgia	239.40	96.35	91.57	59.66	51.41	239.40	74.34	37.81	38.67	42.01	0.00	-22.01	-53.76	-20.99	-9.40
	Kentucky	171.39	96.49	88.06	70.17	58.75	176.12	97.11	38.57	37.75	37.35	4.73	0.62	-49.49	-32.42	-21.40
	Mississippi	38.10	31.42	31.53	8.19	9.06	38.10	29.14	7.67	8.53	9.64	0.00	-2.29	-23.87	0.34	0.58
	North Carolina	62.68	55.96	56.86	56.91	56.57	62.71	52.14	52.66	51.01	49.03	0.03	-3.82	-4.19	-5.90	-7.54
	South Carolina	50.92	35.94	39.26	38.95	40.67	52.51	37.72	27.56	27.14	29.35	1.58	1.78	-11.70	-11.81	-11.31
	Tennessee	104.12	48.39	39.34	39.14	29.16	104.92	28.22	20.27	20.23	20.28	0.80	-20.17	-19.07	-18.91	-8.89
	Virginia	65.86	61.62	55.49	48.35	39.70	65.11	56.29	35.25	33.27	31.77	-0.74	-5.34	-20.25	-15.08	-7.93
	West Virginia	178.66	75.42	71.84	59.08	53.44	177.99	64.59	50.12	49.30	49.51	-0.66	-10.83	-21.72	-9.78	-3.93
VISTAS Total		1,207.64	699.87	621.10	502.04	452.87	1,215.69	597.58	351.22	346.21	350.26	8.05	-102.29	-269.88	-155.83	-102.62
CENRAP	Arkansas	45.27	32.09	33.00	34.03	35.42	45.27	32.47	16.46	12.16	13.69	0.01	0.38	-16.54	-21.87	-21.73
	Iowa	74.73	46.67	50.84	47.85	48.69	75.86	41.36	20.33	20.31	19.64	1.14	-5.31	-30.50	-27.54	-29.06
	Kansas	82.69	82.77	82.84	53.35	53.55	82.69	83.10	82.87	53.38	53.55	0.00	0.33	0.03	0.03	0.00
	Louisiana	50.66	31.88	33.58	32.36	34.75	50.79	31.59	14.73	15.69	17.95	0.13	-0.28	-18.85	-16.67	-16.81

		MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
RPO	State	**2008**	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**
	Minnesota	74.90	41.18	40.77	40.40	40.52	74.85	36.54	18.58	17.40	16.71	-0.05	-4.64	-22.20	-23.01	-23.81
	Missouri	121.35	72.43	74.57	67.79	67.90	121.95	67.82	49.68	48.50	45.56	0.60	-4.61	-24.89	-19.30	-22.34
	Nebraska	50.75	50.77	50.77	38.47	38.57	50.82	50.86	50.85	38.56	38.58	0.08	0.08	0.08	0.09	0.01
	Oklahoma	74.02	78.23	77.50	53.42	53.52	73.94	80.88	77.80	56.21	55.85	-0.08	2.64	0.30	2.79	2.33
	Texas	180.11	168.10	172.16	171.74	165.40	178.34	152.86	100.30	99.43	90.16	-1.77	-15.24	-71.86	-72.32	-75.24
CENRAP Total		754.46	604.11	616.04	539.42	538.33	754.51	577.47	431.60	361.63	351.69	0.05	-26.64	-184.44	-177.79	-186.64
WRAP	Arizona	79.45	79.51	82.42	67.94	71.85	79.46	79.50	82.92	68.46	72.74	0.01	-0.01	0.50	0.52	0.89
	California	30.21	33.26	26.83	28.51	31.66	30.18	33.44	26.49	28.19	31.04	-0.03	0.18	-0.34	-0.32	-0.62
	Colorado	68.06	68.82	68.90	60.47	61.54	68.05	68.89	68.94	60.43	61.47	0.00	0.06	0.04	-0.03	-0.06
	Idaho	0.71	0.71	0.79	0.79	0.79	0.71	0.71	0.87	0.87	0.87	0.00	0.00	0.08	0.08	0.08
	Montana	38.43	38.43	38.79	38.79	38.81	38.43	38.44	38.84	38.84	38.86	0.00	0.01	0.05	0.05	0.05
	Nevada	46.56	46.66	47.08	30.70	31.59	46.56	46.80	47.22	30.83	31.84	0.00	0.15	0.13	0.13	0.26
	New Mexico	73.49	73.64	74.31	72.30	73.16	73.49	73.68	74.47	72.55	73.46	0.00	0.04	0.17	0.25	0.30
	North Dakota	71.54	71.71	71.69	39.86	39.93	70.92	71.76	71.76	39.94	39.94	-0.61	0.05	0.07	0.09	0.02
	Oregon	10.84	10.84	14.27	14.27	14.27	10.84	10.84	14.72	14.72	14.72	0.00	0.00	0.45	0.45	0.45
	South Dakota	14.54	14.54	14.55	1.75	1.82	14.57	14.58	14.58	1.80	1.82	0.03	0.04	0.03	0.05	0.00
	Utah	60.79	60.79	60.79	53.39	53.36	60.79	60.79	60.79	53.39	53.36	0.00	0.00	0.00	0.00	0.00
	Washington	25.34	26.23	31.95	21.54	21.54	25.34	25.90	32.42	22.40	22.40	0.00	-0.33	0.47	0.86	0.86
	Wyoming	81.17	81.17	81.18	53.07	53.17	81.18	81.18	81.18	53.07	53.19	0.01	0.01	0.01	0.00	0.01
WRAP Total		601.11	606.30	613.54	483.37	493.48	600.52	606.50	615.20	485.50	495.72	-0.60	0.20	1.66	2.13	2.24
CAIR Plus Policy States		2,944.50	1,847.55	1,643.80	1,487.96	1,426.50	2,942.89	1,614.14	982.59	957.10	941.40	-1.61	-233.41	-661.20	-530.87	-485.10
National		3,753.06	2,665.62	2,468.46	2,116.58	2,065.62	3,750.86	2,435.47	1,809.32	1,590.75	1,585.10	-2.20	-230.15	-659.14	-525.84	-480.52

Table A5.3: State Level Ozone Season NO_x Emissions in MARAMA Base Case and MARAMA CAIR Plus Policy Case (Thousand Tons)

		MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
RPO	State	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018
MANE-VU	Connecticut	1.55	1.62	2.20	2.25	2.47	1.54	1.68	1.60	1.66	1.69	0.00	0.06	-0.60	-0.59	-0.78
	Delaware	4.63	4.20	4.98	4.51	4.38	4.64	4.12	3.91	1.96	1.64	0.01	-0.08	-1.07	-2.55	-2.74
	District of Columbia	0.05	0.08	0.09	0.12	0.20	0.05	0.08	0.14	0.17	0.21	0.00	0.00	0.05	0.04	0.01
	Maine	3.59	3.55	1.14	1.13	1.16	3.49	1.31	0.79	0.80	0.81	-0.10	-2.24	-0.34	-0.32	-0.35
	Maryland	12.69	7.18	7.40	7.42	8.59	12.69	6.56	7.84	7.72	8.29	0.00	-0.62	0.43	0.30	-0.30
	Massachusetts	10.68	9.47	10.62	9.07	9.37	6.38	5.60	5.11	4.25	4.16	-4.31	-3.87	-5.51	-4.83	-5.21
	New Hampshire	1.75	1.82	2.32	2.30	2.46	1.75	1.03	1.07	1.08	1.15	0.00	-0.79	-1.25	-1.23	-1.31
	New Jersey	4.67	4.84	4.88	5.70	5.59	4.67	5.25	4.85	5.31	5.10	0.00	0.41	-0.04	-0.39	-0.49
	New York	19.58	19.11	21.09	18.58	17.43	19.27	17.10	14.37	13.68	12.49	-0.31	-2.00	-6.72	-4.91	-4.93
	Pennsylvania	62.25	57.36	36.82	36.24	34.25	62.83	43.56	30.97	29.61	28.35	0.58	-13.80	-5.85	-6.63	-5.89
	Rhode Island	0.16	0.27	0.23	0.24	0.29	0.16	0.27	0.10	0.11	0.12	0.00	-0.01	-0.13	-0.13	-0.17
	Vermont	0.06	0.10	0.17	0.17	0.20	0.06	0.10	0.09	0.09	0.10	0.00	0.00	-0.08	-0.08	-0.10
MANE-VU Total		121.67	109.58	91.93	87.75	86.38	117.54	86.66	70.83	66.43	64.11	-4.13	-22.92	-21.10	-21.32	-22.27
LADCO	Illinois	30.31	28.33	32.45	31.95	31.69	29.03	26.58	24.94	24.00	23.26	-1.28	-1.75	-7.51	-7.95	-8.44
	Indiana	61.31	60.02	46.53	41.46	36.50	63.58	54.08	23.69	23.16	22.42	2.27	-5.93	-22.83	-18.30	-14.09
	Michigan	36.78	36.92	36.29	36.73	38.88	35.96	33.31	16.79	17.24	17.72	-0.82	-3.62	-19.50	-19.49	-21.16
	Ohio	48.38	42.32	41.24	37.73	36.63	49.00	40.18	28.70	28.03	27.74	0.62	-2.13	-12.55	-9.70	-8.88
	Wisconsin	26.45	18.68	19.11	19.68	19.74	26.31	18.10	13.33	13.57	13.92	-0.14	-0.57	-5.77	-6.10	-5.82
LADCO Total		203.23	186.27	175.61	167.55	163.44	203.88	172.26	107.46	106.01	105.05	0.65	-14.01	-68.16	-61.54	-58.39
VISTAS	Alabama	33.72	30.51	30.95	20.94	21.00	36.02	20.24	14.30	14.22	14.73	2.30	-10.27	-16.65	-6.72	-6.27
	Florida	76.17	53.00	36.71	34.10	30.75	76.17	44.39	24.18	22.93	23.06	0.00	-8.61	-12.53	-11.16	-7.68
	Georgia	106.58	43.62	41.36	26.77	23.56	106.58	30.03	17.10	17.48	18.91	0.00	-13.59	-24.26	-9.30	-4.65
	Kentucky	41.98	39.49	38.10	30.09	25.80	46.68	36.23	16.90	16.59	16.52	4.70	-3.26	-21.20	-13.50	-9.28
	Mississippi	17.34	11.93	14.27	3.97	4.33	17.34	11.75	3.70	4.10	4.59	0.00	-0.17	-10.56	0.13	0.26
	North Carolina	21.62	14.73	21.91	24.26	25.43	21.65	18.17	20.95	21.97	21.30	0.03	3.43	-0.96	-2.29	-4.12
	South Carolina	15.98	16.01	17.34	16.81	17.31	17.57	15.09	12.06	11.68	12.91	1.58	-0.91	-5.28	-5.14	-4.40
	Tennessee	15.84	16.04	17.28	17.06	12.44	16.64	9.33	8.94	8.89	8.92	0.80	-6.71	-8.34	-8.17	-3.52
	Virginia	25.68	25.05	24.19	20.22	17.49	25.16	21.60	15.09	14.10	14.16	-0.52	-3.45	-9.10	-6.12	-3.32
	West Virginia	30.03	28.84	30.57	25.42	22.52	29.98	25.48	22.10	21.30	21.46	-0.05	-3.37	-8.46	-4.13	-1.06
VISTAS Total		384.93	279.23	272.67	219.65	200.63	393.79	232.32	155.32	153.27	156.57	8.85	-46.91	-117.35	-66.39	-44.06
CENRAP	Arkansas	20.41	14.25	14.67	15.20	15.84	20.41	14.23	7.34	5.32	6.12	0.00	-0.03	-7.33	-9.88	-9.72
	Iowa	32.58	18.17	22.00	20.63	21.01	33.60	17.55	8.94	8.79	8.43	1.03	-0.62	-13.07	-11.84	-12.58
	Kansas	36.80	36.80	36.86	23.79	23.86	36.80	37.07	36.88	23.81	23.91	0.00	0.27	0.02	0.03	0.04
	Louisiana	23.29	14.60	15.67	15.00	15.97	23.42	13.86	7.29	7.19	8.19	0.13	-0.75	-8.38	-7.81	-7.78

		MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
RPO	State	**2008**	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**
	Minnesota	33.21	18.53	17.78	17.65	17.76	32.89	15.79	8.15	7.61	7.60	-0.32	-2.75	-9.62	-10.04	-10.16
	Missouri	31.11	29.96	32.81	29.80	29.49	31.60	27.90	21.68	20.82	19.65	0.49	-2.06	-11.13	-8.98	-9.84
	Nebraska	22.49	22.51	22.51	17.07	17.11	22.52	22.55	22.55	17.11	17.13	0.03	0.04	0.03	0.04	0.01
	Oklahoma	34.87	38.92	36.74	25.77	25.38	34.79	41.16	37.05	28.43	27.47	-0.08	2.24	0.30	2.66	2.09
	Texas	89.83	84.14	86.94	86.85	85.82	88.29	72.23	50.44	49.58	46.21	-1.54	-11.91	-36.50	-37.27	-39.60
CENRAP Total		324.58	277.90	285.98	251.76	252.23	324.33	262.33	200.31	168.66	164.70	-0.26	-15.57	-85.67	-83.10	-87.53
WRAP	Arizona	35.13	35.14	36.28	30.09	31.66	35.14	35.12	36.48	30.18	32.00	0.01	-0.01	0.19	0.09	0.34
	California	12.71	13.83	11.61	12.53	13.83	12.70	14.10	11.34	12.43	13.55	-0.01	0.27	-0.27	-0.10	-0.28
	Colorado	29.98	30.12	30.17	26.60	27.04	29.98	30.24	30.16	26.62	27.03	0.00	0.12	-0.01	0.01	-0.01
	Idaho	0.31	0.31	0.34	0.34	0.34	0.31	0.31	0.37	0.37	0.37	0.00	0.00	0.03	0.03	0.03
	Montana	17.00	17.00	17.15	17.15	17.16	17.00	17.01	17.17	17.17	17.18	0.00	0.01	0.02	0.02	0.02
	Nevada	20.90	20.93	20.93	13.65	14.06	20.90	20.99	20.98	13.71	14.18	0.00	0.06	0.05	0.06	0.12
	New Mexico	32.68	32.83	33.03	32.13	32.48	32.68	32.84	33.11	32.24	32.64	0.00	0.01	0.08	0.11	0.16
	North Dakota	31.60	31.74	31.73	17.63	17.66	31.18	31.77	31.77	17.68	17.68	-0.41	0.02	0.04	0.06	0.02
	Oregon	4.76	4.76	6.23	6.23	6.23	4.76	4.76	6.42	6.42	6.42	0.00	0.00	0.19	0.19	0.19
	South Dakota	6.44	6.44	6.44	0.77	0.81	6.45	6.46	6.45	0.80	0.81	0.01	0.02	0.01	0.03	0.00
	Utah	26.91	26.91	26.91	23.64	23.60	26.91	26.91	26.91	23.64	23.60	0.00	0.00	0.00	0.00	0.00
	Washington	11.19	11.52	14.01	9.41	9.41	11.19	11.19	14.21	9.77	9.77	0.00	-0.33	0.20	0.37	0.37
	Wyoming	35.93	35.93	35.93	23.49	23.54	35.93	35.93	35.93	23.49	23.54	0.00	0.00	0.00	0.00	0.01
WRAP Total		265.54	267.46	270.77	213.66	217.81	265.13	267.62	271.31	214.53	218.78	-0.41	0.17	0.54	0.87	0.97
CAIR Plus Policy States		940.26	754.74	730.08	660.09	636.33	945.41	652.79	437.45	425.01	421.93	5.16	-101.95	-292.63	-235.08	-214.39
National		1,299.95	1,120.44	1,096.96	940.38	920.49	1,304.66	1,021.20	805.23	708.90	709.22	4.71	-99.24	-291.74	-231.48	-211.27

Table A5.4: State Level Fixed O&M Costs in MARAMA Base Case and MARAMA CAIR Plus Policy Case (1999 Million Dollars)

		MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
RPO	State	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018
MANE-VU	Connecticut	433.6	434.1	457.0	468.9	506.5	436.3	436.8	463.5	478.3	511.6	2.7	2.7	6.5	9.4	5.1
	Delaware	59.0	59.0	66.5	69.5	71.2	55.5	55.5	58.8	62.6	65.7	-3.5	-3.5	-7.8	-6.9	-5.5
	District of Columbia	14.2	14.2	15.4	20.8	22.9	14.2	14.2	16.8	20.7	22.0	0.0	0.0	1.4	-0.1	-1.0
	Maine	61.5	61.5	56.1	60.7	64.1	62.4	62.8	68.8	74.6	76.4	0.9	1.3	12.7	13.9	12.2
	Maryland	460.1	475.4	503.3	587.3	617.0	464.9	480.2	526.9	587.2	605.8	4.8	4.8	23.6	-0.1	-11.2
	Massachusetts	442.0	443.2	427.7	448.2	465.0	441.1	442.3	432.1	460.0	468.6	-0.9	-0.9	4.4	11.7	3.7
	New Hampshire	209.5	209.5	225.7	234.1	240.4	211.2	211.2	227.1	237.8	241.1	1.7	1.7	1.4	3.7	0.7
	New Jersey	856.7	856.7	896.5	919.5	959.3	853.3	853.3	891.3	919.8	970.2	-3.4	-3.4	-5.1	0.3	10.9
	New York	1,429.0	1,429.1	1,502.5	1,563.6	1,604.4	1,426.6	1,426.7	1,506.8	1,544.9	1,607.0	-2.4	-2.4	4.3	-18.7	2.6
	Pennsylvania	1,968.4	1,972.2	2,027.5	2,105.6	2,191.4	1,963.6	1,960.7	2,014.8	2,103.8	2,198.9	-4.8	-11.5	-12.7	-1.8	7.5
	Rhode Island	22.2	22.2	20.5	23.1	25.0	21.3	21.3	21.9	25.1	26.0	-0.9	-0.9	1.4	2.0	1.1
	Vermont	120.2	120.2	123.3	125.2	126.4	120.5	120.5	124.2	126.5	127.1	0.3	0.3	0.9	1.3	0.7
MANE-VU Total		6,076.4	6,097.3	6,322.0	6,626.6	6,893.7	6,070.8	6,085.3	6,352.9	6,641.2	6,920.4	-5.6	-11.9	30.9	14.6	26.7
LADCO	Illinois	2,021.9	2,022.7	2,058.7	2,168.5	2,391.2	2,028.4	2,023.5	2,060.8	2,178.8	2,395.1	6.6	0.8	2.1	10.3	3.9
	Indiana	625.1	634.1	672.6	716.8	727.8	622.8	629.2	680.3	735.0	766.9	-2.3	-5.0	7.8	18.2	39.1
	Michigan	1,094.0	1,094.1	1,094.7	1,132.7	1,236.4	1,084.0	1,084.1	1,101.7	1,141.9	1,200.1	-10.1	-10.1	7.0	9.2	-36.3
	Ohio	1,031.1	1,058.5	1,129.5	1,170.0	1,205.8	1,048.8	1,046.4	1,127.7	1,196.1	1,252.1	17.7	-12.1	-1.8	26.1	46.3
	Wisconsin	515.7	515.9	529.6	552.9	589.7	507.1	507.7	531.1	552.5	578.9	-8.6	-8.2	1.5	-0.5	-10.8
LADCO Total		5,287.7	5,325.4	5,485.1	5,741.0	6,150.8	5,291.0	5,290.8	5,501.6	5,804.3	6,193.0	3.3	-34.5	16.6	63.3	42.1
VISTAS	Alabama	987.4	989.5	1,030.4	1,123.6	1,181.0	987.0	986.7	1,064.0	1,130.5	1,190.9	-0.3	-2.8	33.6	6.9	9.9
	Florida	1,355.1	1,356.0	1,503.5	1,678.5	1,745.0	1,355.2	1,356.1	1,519.8	1,697.1	1,733.5	0.1	0.1	16.3	18.6	-11.4
	Georgia	835.8	857.9	901.2	1,089.1	1,208.6	836.1	878.2	989.8	1,107.1	1,229.5	0.2	20.3	88.6	18.0	20.9
	Kentucky	495.5	496.2	533.6	556.5	569.1	494.7	494.0	542.3	582.2	592.5	-0.8	-2.1	8.6	25.7	23.4
	Mississippi	307.9	311.1	312.8	389.1	411.0	305.9	309.2	333.8	385.2	407.0	-2.0	-2.0	21.0	-4.0	-4.0
	North Carolina	970.1	986.3	1,087.7	1,189.6	1,251.6	969.0	986.1	1,095.3	1,188.7	1,248.9	-1.1	-0.2	7.5	-0.9	-2.8
	South Carolina	936.7	936.8	995.5	1,088.5	1,148.3	936.6	936.6	1,002.3	1,093.9	1,163.2	-0.2	-0.2	6.9	5.3	14.9
	Tennessee	663.6	664.6	735.2	754.3	782.6	663.4	664.4	747.6	785.4	794.3	-0.3	-0.3	12.4	31.1	11.8
	Virginia	625.6	625.6	719.5	789.7	831.7	620.4	614.8	718.0	790.4	826.4	-5.2	-10.7	-1.6	0.7	-5.3
	West Virginia	517.6	529.5	576.1	605.8	613.3	535.9	541.2	584.3	609.5	622.5	18.3	11.7	8.2	3.7	9.2
VISTAS Total		7,695.4	7,753.4	8,395.5	9,264.7	9,742.2	7,704.2	7,767.2	8,597.1	9,369.9	9,808.7	8.8	13.8	201.6	105.3	66.6
CENRAP	Arkansas	383.8	383.8	421.2	465.1	484.1	383.8	383.8	422.9	458.4	485.8	0.0	0.0	1.7	-6.7	1.7
	Iowa	274.5	282.0	285.1	297.5	303.1	275.7	277.7	283.0	286.7	290.9	1.2	-4.3	-2.1	-10.8	-12.2
	Kansas	340.7	341.6	357.5	395.1	414.5	337.5	338.4	354.2	391.9	394.6	-3.3	-3.3	-3.3	-3.2	-19.9
	Louisiana	437.9	437.9	468.7	524.8	583.9	438.1	442.8	471.9	527.6	584.8	0.3	5.0	3.2	2.7	0.9

RPO	State	MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
		2008	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**
	Minnesota	443.2	441.2	447.3	447.3	453.0	444.6	439.3	446.4	450.2	454.6	1.4	-1.9	-0.9	3.0	1.6
	Missouri	444.5	447.6	457.3	506.9	538.8	445.3	443.6	455.7	494.6	535.6	0.8	-4.0	-1.6	-12.3	-3.2
	Nebraska	303.8	309.8	313.9	325.3	326.0	304.4	310.4	314.5	325.5	325.9	0.6	0.6	0.6	0.2	-0.1
	Oklahoma	301.4	301.4	350.9	386.1	418.3	301.4	301.4	351.1	385.3	414.0	0.0	0.0	0.2	-0.9	-4.3
	Texas	1,985.4	2,015.4	2,328.6	2,424.2	2,631.0	1,983.1	2,017.0	2,341.9	2,449.9	2,626.5	-2.3	1.7	13.3	25.7	-4.5
CENRAP Total		4,915.3	4,960.7	5,430.4	5,772.5	6,152.8	4,913.9	4,954.5	5,441.5	5,770.2	6,112.7	-1.3	-6.2	11.1	-2.3	-40.1
WRAP	Arizona	711.5	716.5	756.1	756.1	900.0	691.9	696.9	744.5	749.6	893.6	-19.7	-19.7	-11.5	-6.5	-6.4
	California	1,515.4	1,518.2	1,545.8	1,698.7	1,760.8	1,544.9	1,547.6	1,569.3	1,717.1	1,779.2	29.4	29.4	23.5	18.4	18.4
	Colorado	197.0	201.0	204.3	224.7	232.0	196.0	199.9	203.2	223.6	232.1	-1.1	-1.1	-1.1	-1.1	0.1
	Idaho	49.1	49.1	52.9	52.9	52.9	49.1	49.1	53.8	53.8	53.8	0.0	0.0	0.9	0.9	0.9
	Montana	136.5	142.9	147.1	147.1	150.6	136.5	143.0	147.7	147.7	151.2	0.0	0.0	0.6	0.6	0.6
	Nevada	184.7	185.5	197.3	207.4	218.4	184.7	185.5	199.3	210.7	221.7	0.0	0.0	2.0	3.3	3.3
	New Mexico	171.5	171.5	186.3	194.6	205.9	171.5	171.5	187.3	189.8	208.5	0.0	0.0	0.9	-4.8	2.5
	North Dakota	142.1	142.1	147.2	163.5	163.9	140.5	140.5	145.6	152.6	161.9	-1.6	-1.6	-1.6	-10.8	-2.0
	Oregon	252.9	252.9	295.6	295.6	295.6	252.9	252.9	300.9	300.9	300.9	0.0	0.0	5.3	5.3	5.3
	South Dakota	44.2	44.2	44.2	47.9	48.3	44.4	44.4	44.4	48.2	48.3	0.2	0.2	0.2	0.3	0.0
	Utah	162.4	162.4	162.4	164.3	179.6	162.4	162.4	162.4	164.3	179.7	0.0	0.0	0.0	0.0	0.0
	Washington	597.7	598.8	674.6	700.7	700.7	597.7	598.8	682.9	710.8	710.8	0.0	0.0	8.3	10.0	10.0
	Wyoming	228.7	228.7	236.4	236.4	248.3	228.8	228.8	236.4	236.4	248.5	0.0	0.0	0.0	0.0	0.2
WRAP Total		4,393.9	4,413.8	4,650.2	4,889.9	5,157.3	4,401.3	4,421.2	4,677.8	4,905.5	5,190.2	7.4	7.4	27.7	15.6	33.0
CAIR Plus Policy States		23,028.9	23,184.0	24,610.6	26,298.2	27,780.7	23,036.7	23,147.7	24,873.4	26,482.9	27,900.2	7.8	-36.2	262.7	184.7	119.6
National		28,368.7	28,550.7	30,283.1	32,294.7	34,096.7	28,381.2	28,519.1	30,571.0	32,491.1	34,225.0	12.6	-31.5	287.9	196.3	128.3

Note: To convert year 1999 dollars to year 2006 dollars, use a conversion factor of 1.1856

Table A5.5: State Level Variable O&M Costs in MARAMA Base Case and MARAMA CAIR Plus Policy Case (1999 Million Dollars)

		MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
RPO	State	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018
MANE-VU	Connecticut	45.2	48.4	67.2	71.7	78.7	44.6	51.3	55.4	62.0	63.2	-0.6	2.9	-11.7	-9.6	-15.4
	Delaware	15.9	19.5	24.0	22.7	23.2	15.9	18.7	18.6	11.1	11.0	0.0	-0.8	-5.4	-11.6	-12.2
	District of Columbia	0.0	0.0	1.5	4.6	7.3	0.0	0.0	3.2	5.5	7.1	0.0	0.0	1.8	0.9	-0.2
	Maine	29.6	29.9	23.8	24.0	25.8	28.7	28.7	19.1	21.4	21.6	-0.8	-1.2	-4.7	-2.7	-4.2
	Maryland	102.9	129.6	152.8	196.0	232.0	105.4	130.9	178.2	207.4	228.4	2.5	1.3	25.3	11.4	-3.6
	Massachusetts	115.6	99.3	136.2	133.8	145.9	115.8	98.5	112.3	116.1	119.6	0.2	-0.8	-23.9	-17.8	-26.4
	New Hampshire	29.2	30.7	49.1	51.7	57.0	29.2	29.6	38.2	43.8	45.3	0.0	-1.1	-10.9	-7.9	-11.7
	New Jersey	91.3	96.4	99.8	96.3	100.3	91.3	102.2	98.5	98.0	105.7	0.0	5.8	-1.3	1.7	5.4
	New York	165.0	167.1	284.2	304.1	310.5	167.3	167.6	308.3	317.0	328.7	2.3	0.5	24.1	12.9	18.2
	Pennsylvania	427.8	471.9	537.7	532.4	534.7	432.0	469.1	531.3	528.5	529.1	4.2	-2.8	-6.3	-3.9	-5.6
	Rhode Island	1.9	5.1	6.5	7.6	9.2	1.9	5.1	3.8	5.5	5.7	0.0	0.0	-2.6	-2.1	-3.4
	Vermont	6.0	6.0	9.9	10.3	11.2	6.0	6.0	8.1	9.1	9.1	0.0	0.0	-1.8	-1.2	-2.1
MANE-VU Total		1,030.4	1,104.1	1,392.5	1,455.3	1,535.9	1,038.1	1,107.9	1,375.0	1,425.5	1,474.6	7.7	3.8	-17.5	-29.9	-61.3
LADCO	Illinois	289.8	308.1	367.0	377.8	460.7	292.8	301.3	377.7	392.3	482.3	3.0	-6.7	10.7	14.5	21.6
	Indiana	309.2	353.4	390.3	426.6	432.7	309.5	341.8	426.4	452.1	468.0	0.3	-11.6	36.1	25.6	35.3
	Michigan	190.4	212.8	212.0	247.4	338.6	191.4	219.1	255.4	288.2	318.8	1.1	6.3	43.4	40.8	-19.8
	Ohio	408.3	519.5	568.8	591.5	592.6	429.3	507.4	568.1	600.5	610.4	20.9	-12.1	-0.7	9.0	17.7
	Wisconsin	127.2	129.7	145.7	164.2	185.9	128.9	137.6	166.1	184.3	206.7	1.7	7.9	20.4	20.1	20.8
LADCO Total		1,324.8	1,523.5	1,683.9	1,807.5	2,010.5	1,351.8	1,507.1	1,793.7	1,917.4	2,086.2	26.9	-16.4	109.8	109.9	75.6
VISTAS	Alabama	219.5	256.9	298.0	347.1	377.4	213.3	246.9	336.1	357.0	400.5	-6.2	-10.1	38.1	9.9	23.1
	Florida	325.0	348.4	513.0	581.5	658.2	325.0	345.8	524.7	598.3	627.2	0.0	-2.6	11.6	16.8	-31.0
	Georgia	204.6	252.0	321.3	411.7	465.0	204.6	277.6	445.7	485.3	554.3	0.0	25.5	124.4	73.6	89.3
	Kentucky	267.7	305.5	346.3	362.9	373.9	262.1	281.2	360.1	381.4	386.4	-5.6	-24.3	13.8	18.5	12.6
	Mississippi	56.6	61.3	66.1	104.2	120.8	56.6	72.0	91.0	107.2	126.1	0.0	10.7	25.0	3.0	5.3
	North Carolina	283.9	245.0	293.0	316.7	360.5	284.1	243.9	302.9	323.2	358.9	0.2	-1.1	9.9	6.5	-1.6
	South Carolina	170.8	190.8	243.5	260.3	296.8	166.7	184.9	250.3	269.0	312.6	-4.1	-5.9	6.7	8.7	15.8
	Tennessee	159.8	186.5	195.0	194.1	212.9	155.4	162.7	203.9	213.5	217.9	-4.4	-23.7	8.8	19.4	5.0
	Virginia	121.8	133.7	189.2	212.4	253.9	121.9	130.3	201.6	224.7	255.5	0.0	-3.5	12.3	12.3	1.6
	West Virginia	285.2	326.2	391.7	413.0	419.4	314.3	355.9	407.0	418.5	427.0	29.1	29.8	15.3	5.5	7.6
VISTAS Total		2,095.0	2,306.3	2,857.3	3,203.9	3,538.9	2,104.1	2,301.2	3,123.2	3,378.1	3,666.5	9.1	-5.1	265.9	174.1	127.6
CENRAP	Arkansas	65.6	71.0	81.8	128.4	148.4	65.7	80.4	88.7	137.5	162.2	0.1	9.4	6.9	9.1	13.8
	Iowa	85.2	93.0	96.9	101.5	108.3	86.2	98.0	113.4	115.7	120.5	0.9	5.0	16.5	14.2	12.2
	Kansas	104.9	105.1	105.3	118.2	128.9	104.9	105.8	105.4	118.2	120.2	0.0	0.8	0.1	0.0	-8.8
	Louisiana	80.6	82.2	109.1	137.6	174.0	82.0	94.2	124.2	149.0	182.4	1.4	12.0	15.1	11.3	8.4

		MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
RPO	State	**2008**	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**
	Minnesota	111.9	107.1	105.8	105.7	106.2	111.8	108.0	120.0	124.2	123.4	-0.2	1.0	14.2	18.5	17.1
	Missouri	145.5	172.1	177.7	193.3	218.1	143.9	151.4	182.9	187.6	230.0	-1.6	-20.8	5.3	-5.7	11.9
	Nebraska	47.6	47.7	47.7	73.1	73.1	47.6	47.7	47.7	72.9	72.9	0.0	0.0	0.0	-0.2	-0.2
	Oklahoma	110.7	118.9	151.2	173.3	194.0	110.7	127.0	152.0	178.4	200.6	0.0	8.2	0.8	5.1	6.6
	Texas	601.2	621.5	876.4	935.3	1,030.5	603.3	627.8	950.4	1,021.3	1,081.6	2.1	6.3	74.0	85.9	51.1
CENRAP Total		1,353.3	1,418.6	1,751.9	1,966.5	2,181.6	1,356.1	1,440.5	1,884.7	2,104.9	2,293.9	2.9	21.9	132.8	138.3	112.3
WRAP	Arizona	198.3	199.3	245.3	246.0	302.5	198.4	199.3	253.6	257.0	316.8	0.1	0.0	8.3	11.0	14.2
	California	504.9	528.5	522.1	602.3	648.8	504.0	530.8	513.1	590.5	632.8	-1.0	2.3	-9.0	-11.8	-16.0
	Colorado	93.3	98.4	99.3	112.1	123.3	93.3	99.1	99.3	111.9	124.0	0.0	0.7	0.0	-0.2	0.7
	Idaho	2.5	2.5	9.4	9.4	9.4	2.5	2.5	10.6	10.6	10.6	0.0	0.0	1.2	1.2	1.2
	Montana	48.7	48.7	53.9	53.9	54.2	48.7	48.7	54.6	54.6	54.9	0.0	0.0	0.7	0.7	0.7
	Nevada	91.7	94.4	108.3	113.1	126.7	91.7	94.7	110.7	116.8	130.7	0.0	0.3	2.4	3.8	4.0
	New Mexico	86.3	86.7	101.3	104.6	118.3	86.3	86.8	100.2	102.4	121.6	0.0	0.1	-1.0	-2.2	3.3
	North Dakota	71.8	72.2	72.1	81.9	82.0	69.9	71.2	71.2	77.1	81.0	-1.9	-0.9	-0.9	-4.8	-0.9
	Oregon	23.9	23.9	74.1	74.1	74.1	23.9	23.9	80.6	80.6	80.6	0.0	0.0	6.5	6.5	6.5
	South Dakota	5.4	5.4	5.5	9.6	9.9	5.4	5.5	5.5	9.7	9.9	0.0	0.0	0.0	0.1	0.0
	Utah	88.3	88.3	88.3	88.3	91.8	88.3	88.3	88.3	88.3	91.8	0.0	0.0	0.0	0.0	0.0
	Washington	51.1	53.7	146.4	145.4	145.4	51.1	52.7	157.9	157.9	157.9	0.0	-0.9	11.4	12.4	12.4
	Wyoming	116.8	116.8	117.4	117.4	124.2	116.8	116.8	117.4	117.4	124.4	0.0	0.0	0.0	0.0	0.2
WRAP Total		1,383.1	1,418.8	1,643.5	1,758.2	1,910.5	1,380.3	1,420.3	1,663.2	1,775.0	1,937.0	-2.8	1.6	19.6	16.8	26.4
CAIR Plus Policy States		5,540.3	6,080.8	7,381.3	8,068.7	8,870.8	5,586.8	6,076.1	7,871.6	8,456.2	9,127.4	46.6	-4.8	490.2	387.5	256.6
National		7,186.6	7,771.3	9,329.1	10,191.5	11,177.4	7,230.4	7,777.0	9,839.8	10,600.8	11,458.1	43.8	5.8	510.7	409.3	280.7

Note: To convert year 1999 dollars to year 2006 dollars, use a conversion factor of 1.1856

Table A5.6: State Level Annualized Capital Costs in MARAMA Base Case and MARAMA CAIR Plus Policy Case (1999 Million Dollars)

		MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
RPO	State	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018
MANE-VU	Connecticut	99.6	99.6	269.5	345.1	413.3	116.9	116.9	287.6	379.6	414.3	17.3	17.3	18.2	34.5	1.0
	Delaware	10.6	10.6	28.7	40.6	49.3	10.8	10.8	18.0	34.9	52.1	0.2	0.2	-10.8	-5.7	2.7
	District of Columbia	1.8	1.8	10.2	42.2	57.5	1.8	1.8	20.3	43.5	52.5	0.0	0.0	10.0	1.4	-4.9
	Maine	34.5	34.5	100.7	129.8	156.2	41.0	42.6	108.5	144.0	157.4	6.4	8.1	7.9	14.2	1.3
	Maryland	91.4	139.0	267.5	708.9	915.7	102.4	150.0	411.4	730.1	858.2	11.0	11.0	144.0	21.2	-57.5
	Massachusetts	209.9	209.9	528.7	670.5	798.6	245.2	245.2	565.7	738.1	803.4	35.4	35.4	37.0	67.7	4.8
	New Hampshire	75.7	75.7	196.0	249.5	297.9	87.5	87.5	208.5	274.1	298.7	11.8	11.8	12.4	24.6	0.9
	New Jersey	23.6	23.6	71.7	147.7	203.1	25.0	25.0	70.6	178.8	289.2	1.5	1.5	-1.1	31.1	86.1
	New York	172.1	172.1	1,097.4	1,426.5	1,494.1	190.1	190.1	1,252.0	1,441.4	1,643.9	18.0	18.0	154.6	14.9	149.8
	Pennsylvania	87.0	91.5	282.7	386.9	431.6	92.6	92.6	291.5	454.7	565.6	5.6	1.1	8.8	67.8	134.0
	Rhode Island	19.2	19.2	55.8	72.1	86.8	22.8	22.8	59.6	79.4	86.9	3.6	3.6	3.8	7.3	0.1
	Vermont	12.1	12.1	35.3	45.7	55.0	14.4	14.4	37.7	50.3	55.1	2.3	2.3	2.4	4.6	0.1
MANE-VU Total		837.4	889.6	2,944.2	4,265.4	4,959.1	950.5	999.8	3,331.4	4,549.0	5,277.3	113.1	110.3	387.2	283.6	318.2
LADCO	Illinois	44.1	44.2	133.6	265.4	801.4	60.0	60.0	170.2	354.8	870.1	15.9	15.8	36.6	89.4	68.7
	Indiana	26.6	43.6	110.4	311.2	349.1	31.3	52.1	222.1	492.8	640.5	4.7	8.5	111.7	181.6	291.4
	Michigan	6.4	6.4	6.4	220.4	753.0	7.2	7.2	172.3	399.3	594.7	0.8	0.8	165.8	178.9	-158.4
	Ohio	97.3	175.0	525.2	748.7	762.4	140.9	169.3	485.0	841.3	990.6	43.5	-5.7	-40.1	92.7	228.2
	Wisconsin	14.9	14.9	50.3	159.9	256.2	0.4	3.9	118.6	236.2	386.0	-14.6	-11.0	68.3	76.3	129.8
LADCO Total		189.3	284.1	825.9	1,705.6	2,922.2	239.7	292.5	1,168.2	2,324.5	3,481.9	50.4	8.4	342.3	618.9	559.7
VISTAS	Alabama	20.8	20.8	83.4	521.4	814.8	17.4	31.6	278.4	553.6	877.3	-3.4	10.8	195.0	32.2	62.5
	Florida	13.0	26.7	941.9	1,717.7	2,125.8	13.0	27.0	1,052.4	1,855.0	2,051.0	0.0	0.3	110.5	137.3	-74.7
	Georgia	1.4	1.4	112.6	864.8	1,343.9	2.6	56.5	508.8	931.3	1,446.5	1.2	55.1	396.2	66.6	102.6
	Kentucky	8.2	9.8	86.6	190.5	230.4	5.8	5.8	169.7	325.0	386.8	-2.4	-3.9	83.0	134.5	156.3
	Mississippi	0.5	0.5	15.0	236.4	365.2	0.7	0.7	109.2	230.1	362.8	0.2	0.2	94.1	-6.3	-2.4
	North Carolina	234.1	275.2	623.4	866.4	1,113.6	234.2	275.1	677.4	878.4	1,117.3	0.1	-0.1	54.0	12.0	3.7
	South Carolina	23.3	23.4	321.4	535.7	748.9	21.8	21.8	381.9	573.7	807.4	-1.5	-1.6	60.5	38.0	58.5
	Tennessee	18.0	18.0	31.6	31.6	107.1	15.7	15.7	80.9	125.8	146.5	-2.3	-2.3	49.4	94.2	39.4
	Virginia	9.7	9.7	307.1	539.7	766.4	10.8	10.8	373.6	591.6	804.4	1.0	1.0	66.4	51.9	37.9
	West Virginia	2.7	2.7	139.8	281.7	313.6	52.0	62.6	202.5	352.8	431.9	49.3	59.9	62.6	71.1	118.4
VISTAS Total		331.9	388.3	2,662.9	5,785.8	7,929.6	374.1	507.7	3,834.8	6,417.4	8,431.9	42.2	119.3	1,171.8	631.6	502.3
CENRAP	Arkansas	0.1	0.1	45.9	191.3	314.3	0.1	0.1	71.0	224.9	349.3	0.0	0.0	25.1	33.7	34.9
	Iowa	0.0	0.7	0.7	10.4	17.3	2.4	4.9	45.6	46.1	52.8	2.4	4.2	44.9	35.7	35.5
	Kansas	0.0	0.0	0.0	22.2	71.5	0.0	0.0	0.0	22.3	39.4	0.0	0.0	0.0	0.0	-32.1
	Louisiana	0.1	0.1	107.6	290.4	508.7	0.1	11.8	149.1	326.0	532.0	0.0	11.6	41.5	35.6	23.3

		MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
RPO	State	**2008**	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**
	Minnesota	45.1	84.0	84.1	84.1	86.9	47.9	88.7	119.2	132.0	132.0	2.8	4.6	35.2	47.9	45.1
	Missouri	2.8	14.1	19.7	91.3	257.6	4.7	5.6	53.6	117.9	307.1	2.0	-8.6	33.9	26.7	49.5
	Nebraska	0.0	0.0	0.0	34.4	35.7	1.2	1.2	1.2	35.3	35.7	1.2	1.2	1.2	0.8	0.0
	Oklahoma	0.5	0.5	237.8	345.3	524.2	0.5	0.5	239.1	351.6	521.5	0.0	0.0	1.2	6.3	-2.7
	Texas	225.6	225.6	2,245.5	2,610.3	3,446.4	243.1	260.7	2,399.5	2,822.6	3,626.5	17.5	35.1	154.0	212.2	180.1
CENRAP Total		274.2	325.2	2,741.4	3,679.7	5,262.7	300.1	373.4	3,078.2	4,078.7	5,596.3	25.9	48.2	336.9	399.0	333.6
WRAP	Arizona	2.8	2.8	264.0	264.0	583.3	2.8	2.8	322.2	357.9	677.7	0.0	0.0	58.2	93.9	94.4
	California	792.1	792.1	980.4	1,506.9	1,691.7	823.0	823.0	964.9	1,453.1	1,637.9	30.9	30.9	-15.4	-53.8	-53.8
	Colorado	0.0	0.0	0.0	42.3	93.4	0.0	0.0	0.0	42.2	102.3	0.0	0.0	0.0	-0.2	8.9
	Idaho	9.0	9.0	61.8	61.8	61.8	9.0	9.0	68.7	68.7	68.7	0.0	0.0	6.9	6.9	6.9
	Montana	5.2	5.2	36.0	36.0	37.5	5.3	5.3	40.1	40.1	41.7	0.1	0.1	4.1	4.1	4.3
	Nevada	0.7	0.7	65.7	70.5	148.6	0.7	0.7	80.2	93.9	171.8	0.0	0.0	14.5	23.4	23.3
	New Mexico	0.6	0.6	68.1	75.4	152.1	0.6	0.6	80.7	90.4	172.8	0.0	0.0	12.6	14.9	20.7
	North Dakota	23.2	23.2	23.2	48.0	48.8	19.3	19.3	19.3	36.2	44.2	-3.8	-3.8	-3.8	-11.8	-4.6
	Oregon	50.2	50.2	346.1	346.1	346.1	50.2	50.2	384.7	384.7	384.7	0.0	0.0	38.6	38.6	38.6
	South Dakota	0.0	0.0	0.0	13.3	14.8	0.5	0.5	0.5	13.9	14.9	0.5	0.5	0.5	0.6	0.1
	Utah	0.0	0.0	0.0	0.0	15.6	0.0	0.0	0.0	0.0	15.7	0.0	0.0	0.0	0.0	0.1
	Washington	95.2	95.2	657.3	657.3	657.3	95.2	95.2	730.5	730.5	730.5	0.0	0.0	73.3	73.3	73.3
	Wyoming	0.0	0.0	0.0	0.0	33.5	0.1	0.1	0.1	0.1	34.9	0.1	0.1	0.1	0.1	1.4
WRAP Total		979.0	979.0	2,502.6	3,121.7	3,884.3	1,006.7	1,006.7	2,692.0	3,311.7	4,097.9	27.7	27.7	189.4	190.0	213.6
CAIR Plus Policy States		1,632.3	1,886.6	8,936.5	15,034.5	20,442.3	1,862.7	2,171.6	11,172.4	16,960.4	22,190.9	230.4	285.0	2,235.8	1,925.9	1,748.7
National		2,611.8	2,866.1	11,677.0	18,558.1	24,958.0	2,871.1	3,180.0	14,104.7	20,681.3	26,885.4	259.3	313.9	2,427.7	2,123.1	1,927.4

Note: To convert year 1999 dollars to year 2006 dollars, use a conversion factor of 1.1856

Table A5.7: State Level Fuel Costs in MARAMA Base Case and MARAMA CAIR Plus Policy Case (1999 Million Dollars)

		MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
RPO	State	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018
MANE-VU	Connecticut	768.8	806.3	312.3	286.3	289.9	724.6	1,058.0	330.8	278.7	288.6	-44.1	251.7	18.5	-7.6	-1.4
	Delaware	133.8	132.5	126.9	118.1	121.2	134.7	141.9	114.8	63.2	61.2	0.9	9.4	-12.2	-54.9	-60.0
	District of Columbia	0.8	4.6	4.6	14.6	21.7	1.0	5.1	9.4	16.6	20.6	0.1	0.5	4.8	2.0	-1.1
	Maine	594.3	580.6	219.4	203.1	199.9	578.1	569.5	211.6	204.9	201.1	-16.2	-11.1	-7.8	1.7	1.2
	Maryland	548.2	562.5	574.2	691.8	782.3	545.6	567.2	634.3	718.8	760.9	-2.6	4.6	60.1	27.0	-21.4
	Massachusetts	2,558.0	2,382.5	1,509.2	1,097.8	1,088.0	2,530.1	2,474.2	1,488.2	1,103.7	1,194.3	-27.9	91.7	-21.0	5.9	106.3
	New Hampshire	161.6	254.6	197.1	197.5	208.7	158.3	257.9	166.4	178.8	187.3	-3.3	3.3	-30.7	-18.7	-21.4
	New Jersey	791.9	844.7	686.7	575.2	624.8	789.6	1,226.1	676.7	610.3	673.9	-2.4	381.4	-10.0	35.1	49.1
	New York	3,017.9	3,031.9	1,809.5	1,615.5	1,705.7	3,043.8	3,410.1	1,765.3	1,676.8	1,736.8	25.9	378.2	-44.3	61.3	31.1
	Pennsylvania	2,676.7	2,878.9	2,501.0	2,286.8	2,210.0	2,742.5	3,601.3	2,442.4	2,299.3	2,269.6	65.8	722.4	-58.6	12.4	59.6
	Rhode Island	118.9	305.2	33.3	35.7	36.1	118.7	338.1	35.5	33.7	33.4	-0.2	33.0	2.2	-2.0	-2.7
	Vermont	22.4	23.2	34.0	35.3	37.4	22.4	22.8	30.7	34.3	33.9	0.0	-0.4	-3.3	-1.1	-3.5
MANE-VU Total		11,393.4	11,807.5	8,008.2	7,157.8	7,325.7	11,389.3	13,672.2	7,905.9	7,218.9	7,461.5	-4.0	1,864.7	-102.3	61.1	135.8
LADCO	Illinois	1,792.0	1,761.4	1,822.0	1,780.1	1,832.1	1,793.8	1,747.9	1,803.1	1,752.7	1,808.5	1.8	-13.5	-18.9	-27.4	-23.5
	Indiana	1,659.0	1,765.3	1,608.0	1,539.3	1,445.0	1,684.7	2,042.4	1,575.6	1,527.2	1,503.8	25.7	277.1	-32.4	-12.0	58.8
	Michigan	1,511.1	1,599.1	1,445.7	1,458.5	1,572.6	1,528.2	1,991.8	1,488.3	1,459.7	1,458.7	17.1	392.6	42.6	1.2	-113.9
	Ohio	2,198.6	2,389.0	2,162.0	2,099.3	2,058.3	2,161.3	2,640.3	2,067.8	2,069.3	2,033.2	-37.2	251.3	-94.2	-30.0	-25.2
	Wisconsin	752.4	770.8	757.7	716.9	710.5	804.4	859.9	726.2	706.9	699.2	52.0	89.1	-31.5	-10.0	-11.3
LADCO Total		7,913.0	8,285.7	7,795.4	7,594.1	7,618.5	7,972.5	9,282.2	7,661.0	7,515.8	7,503.3	59.5	996.5	-134.4	-78.3	-115.2
VISTAS	Alabama	2,349.4	2,611.5	2,296.2	1,977.2	1,975.6	2,352.9	3,291.0	2,237.1	1,981.0	2,029.4	3.5	679.5	-59.1	3.9	53.8
	Florida	6,214.9	6,265.3	4,440.6	4,101.8	4,245.8	6,215.1	7,332.2	4,264.5	4,167.0	4,416.4	0.2	1,066.9	-176.1	65.2	170.7
	Georgia	3,109.1	3,276.3	2,525.7	2,439.5	2,536.7	3,086.8	3,272.5	2,527.8	2,500.4	2,624.9	-22.3	-3.7	2.1	60.9	88.2
	Kentucky	1,067.2	1,050.9	980.1	1,008.9	1,015.0	1,083.2	1,020.3	969.3	1,011.4	1,017.5	16.0	-30.6	-10.9	2.5	2.6
	Mississippi	884.1	991.6	737.9	720.0	736.8	885.5	1,758.7	745.0	751.7	766.2	1.4	767.1	7.1	31.7	29.4
	North Carolina	1,439.6	1,297.9	1,358.6	1,434.3	1,526.2	1,416.1	1,387.1	1,372.9	1,446.8	1,504.8	-23.5	89.2	14.3	12.5	-21.4
	South Carolina	1,243.8	1,412.2	1,285.7	1,248.7	1,339.1	1,236.8	1,685.0	1,286.4	1,270.4	1,403.1	-7.0	272.8	0.7	21.8	63.9
	Tennessee	820.3	822.1	849.4	816.4	799.5	807.5	717.7	832.5	822.4	801.2	-12.9	-104.5	-17.0	6.0	1.8
	Virginia	1,152.1	1,587.3	1,198.4	1,138.4	1,169.9	1,155.6	1,707.8	1,148.7	1,116.4	1,167.9	3.5	120.5	-49.7	-22.0	-1.9
	West Virginia	1,074.6	1,054.2	1,000.3	1,015.2	1,005.1	1,026.7	1,007.4	960.9	1,014.9	1,013.7	-47.9	-46.8	-39.4	-0.3	8.6
VISTAS Total		19,355.1	20,369.4	16,672.8	15,900.3	16,349.6	19,266.2	23,179.8	16,344.9	16,082.3	16,745.1	-88.9	2,810.4	-327.9	182.0	395.6
CENRAP	Arkansas	1,004.4	1,208.0	1,054.6	928.9	910.6	1,009.3	1,775.0	969.8	904.8	887.5	4.9	567.1	-84.8	-24.1	-23.1
	Iowa	617.8	672.3	631.9	613.2	664.4	630.1	832.7	613.8	629.7	652.0	12.2	160.5	-18.1	16.5	-12.5
	Kansas	450.8	447.3	428.0	420.6	462.5	452.0	503.2	439.3	420.4	430.2	1.2	55.9	11.2	-0.2	-32.2
	Louisiana	1,171.6	1,223.1	994.5	873.6	881.4	1,242.0	1,764.1	983.6	837.2	875.0	70.4	541.0	-10.9	-36.4	-6.4

RPO	State	MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
		2008	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**
	Minnesota	510.6	511.0	468.7	453.6	446.2	510.9	505.4	453.1	449.9	440.1	0.3	-5.6	-15.5	-3.6	-6.1
	Missouri	928.1	992.2	1,001.7	976.7	987.2	926.3	972.4	979.3	930.5	897.7	-1.8	-19.9	-22.4	-46.2	-89.5
	Nebraska	261.3	262.8	253.3	245.8	237.9	261.3	264.6	253.3	247.3	238.6	0.0	1.8	0.0	1.5	0.7
	Oklahoma	2,064.3	2,230.8	1,480.1	1,315.1	1,191.4	2,065.1	2,855.6	1,492.8	1,422.1	1,369.9	0.8	624.8	12.6	107.0	178.5
	Texas	11,112.6	11,303.2	6,765.2	6,275.9	6,356.6	11,116.4	12,545.3	6,753.2	6,307.3	6,359.4	3.7	1,242.1	-11.9	31.4	2.9
CENRAP Total		18,121.5	18,850.6	13,077.9	12,103.5	12,138.3	18,213.3	22,018.3	12,938.2	12,149.3	12,150.5	91.8	3,167.7	-139.8	45.8	12.2
WRAP	Arizona	3,549.0	3,407.8	2,509.3	2,289.7	2,346.7	3,552.9	3,765.2	2,479.6	2,191.9	2,334.9	3.9	357.4	-29.7	-97.8	-11.8
	California	6,750.1	7,136.6	4,345.0	4,945.5	5,650.9	6,722.2	7,996.5	4,163.8	4,821.3	5,424.8	-27.9	859.8	-181.1	-124.2	-226.2
	Colorado	509.1	693.8	576.7	581.7	625.6	508.7	765.3	578.2	579.0	610.4	-0.4	71.5	1.4	-2.7	-15.2
	Idaho	117.9	110.9	19.2	18.6	18.0	117.9	124.7	21.4	20.6	20.0	0.0	13.8	2.3	2.0	2.0
	Montana	105.5	104.2	114.0	111.0	107.8	107.5	107.3	114.8	112.0	109.0	2.0	3.1	0.7	1.1	1.2
	Nevada	1,194.4	1,142.9	845.6	774.8	778.6	1,194.5	1,272.6	849.2	778.1	789.1	0.1	129.7	3.5	3.3	10.6
	New Mexico	408.8	414.3	393.5	390.8	446.5	408.7	424.9	400.9	400.5	458.4	-0.1	10.6	7.4	9.7	11.9
	North Dakota	229.8	229.3	223.4	238.5	232.6	231.6	234.8	223.0	238.7	232.3	1.8	5.5	-0.5	0.2	-0.3
	Oregon	877.9	826.8	656.1	585.9	564.7	877.9	926.3	668.2	600.6	578.6	0.0	99.5	12.0	14.6	13.9
	South Dakota	36.3	35.9	35.8	33.9	37.5	36.3	36.8	35.5	34.0	33.5	0.0	0.9	-0.3	0.1	-4.1
	Utah	230.1	223.8	217.8	211.4	206.8	230.1	223.7	219.0	210.1	206.4	0.0	-0.1	1.2	-1.3	-0.4
	Washington	591.6	731.0	603.8	529.8	512.1	591.3	736.9	593.3	554.6	534.7	-0.4	5.9	-10.5	24.8	22.7
	Wyoming	299.9	296.4	295.8	288.1	285.3	303.7	300.1	296.2	286.5	285.0	3.8	3.7	0.5	-1.6	-0.3
WRAP Total		14,900.6	15,353.8	10,836.1	10,999.7	11,813.0	14,883.2	16,915.1	10,643.0	10,827.9	11,616.9	-17.3	1,561.4	-193.1	-171.9	-196.0
CAIR Plus Policy States		54,006.6	56,372.3	43,392.9	40,774.1	41,540.3	54,062.9	64,529.1	42,664.6	40,876.5	41,821.7	56.3	8,156.8	-728.3	102.4	281.4
National		71,683.5	74,667.0	56,390.5	53,755.4	55,245.1	71,724.5	85,067.7	55,493.0	53,794.2	55,477.4	41.0	10,400.7	-897.5	38.8	232.3

Note: To convert year 1999 dollars to year 2006 dollars, use a conversion factor of 1.1856

Table A5.8: State Level Total Production Costs in MARAMA Base Case and MARAMA CAIR Plus Policy Case (1999 Million Dollars)

		MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
RPO	State	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018	2008	2009	2012	2015	2018
MANE-VU	Connecticut	1,347.2	1,388.4	1,105.9	1,172.0	1,288.5	1,322.4	1,663.0	1,137.3	1,198.7	1,277.8	-24.8	274.6	31.4	26.7	-10.7
	Delaware	219.3	221.6	246.2	251.0	264.9	216.9	226.9	210.1	171.9	190.0	-2.4	5.3	-36.1	-79.2	-75.0
	District of Columbia	16.8	20.6	31.7	82.1	109.4	16.9	21.1	49.7	86.3	102.2	0.1	0.5	18.0	4.2	-7.2
	Maine	719.9	706.5	400.0	417.7	446.0	710.2	703.6	408.0	444.8	456.5	-9.7	-3.0	8.1	27.1	10.5
	Maryland	1,202.6	1,306.6	1,497.8	2,184.0	2,547.0	1,218.3	1,328.3	1,750.7	2,243.4	2,453.2	15.6	21.7	253.0	59.4	-93.8
	Massachusetts	3,325.5	3,134.9	2,601.7	2,350.3	2,497.5	3,332.3	3,260.2	2,598.2	2,417.8	2,585.8	6.8	125.3	-3.5	67.5	88.4
	New Hampshire	476.1	570.5	667.8	732.8	804.0	486.3	586.2	640.1	734.6	772.4	10.2	15.7	-27.7	1.8	-31.6
	New Jersey	1,763.5	1,821.4	1,754.7	1,738.7	1,887.5	1,759.2	2,206.6	1,737.2	1,806.9	2,039.0	-4.3	385.2	-17.5	68.2	151.4
	New York	4,784.0	4,800.2	4,693.6	4,909.6	5,114.7	4,827.8	5,194.5	4,832.3	4,980.0	5,316.4	43.8	394.3	138.7	70.4	201.7
	Pennsylvania	5,159.8	5,414.5	5,348.8	5,311.7	5,367.7	5,230.6	6,123.6	5,280.0	5,386.3	5,563.3	70.8	709.1	-68.8	74.6	195.6
	Rhode Island	162.2	351.6	116.1	138.5	157.1	164.6	387.3	120.8	143.7	152.1	2.4	35.7	4.7	5.2	-5.0
	Vermont	160.7	161.6	202.6	216.5	230.0	163.3	163.8	200.7	220.1	225.1	2.6	2.2	-1.8	3.6	-4.9
MANE-VU Total		19,337.5	19,898.4	18,666.9	19,505.1	20,714.4	19,448.7	21,865.2	18,965.2	19,834.6	21,133.8	111.2	1,966.8	298.3	329.5	419.4
LADCO	Illinois	4,147.6	4,136.3	4,381.3	4,591.8	5,485.4	4,175.0	4,132.7	4,411.8	4,678.6	5,556.0	27.3	-3.7	30.5	86.7	70.7
	Indiana	2,619.9	2,796.4	2,781.3	2,993.8	2,954.7	2,648.3	3,065.4	2,904.4	3,207.2	3,379.2	28.5	269.0	123.1	213.3	424.5
	Michigan	2,801.9	2,912.5	2,758.8	3,059.1	3,900.6	2,810.8	3,302.1	3,017.6	3,289.1	3,572.2	8.9	389.6	258.8	230.0	-328.4
	Ohio	3,735.4	4,142.0	4,385.5	4,609.5	4,619.2	3,780.2	4,363.3	4,248.7	4,707.2	4,886.2	44.8	221.3	-136.8	97.7	267.0
	Wisconsin	1,410.2	1,431.4	1,483.3	1,594.0	1,742.3	1,440.7	1,509.2	1,542.0	1,680.0	1,870.8	30.5	77.8	58.7	86.0	128.5
LADCO Total		14,715.0	15,418.6	15,790.2	16,848.2	18,702.1	14,855.0	16,372.7	16,124.5	17,562.0	19,264.4	140.1	954.1	334.3	713.8	562.3
VISTAS	Alabama	3,577.1	3,878.8	3,708.1	3,969.3	4,348.8	3,570.6	4,556.2	3,915.6	4,022.1	4,498.1	-6.4	677.4	207.5	52.9	149.3
	Florida	7,908.1	7,996.4	7,399.0	8,079.4	8,774.7	7,908.4	9,061.2	7,361.4	8,317.4	8,828.2	0.3	1,064.7	-37.7	238.0	53.5
	Georgia	4,151.0	4,387.6	3,860.7	4,805.1	5,554.2	4,130.0	4,484.8	4,472.1	5,024.2	5,855.2	-20.9	97.2	611.4	219.1	301.0
	Kentucky	1,838.6	1,862.3	1,946.7	2,118.8	2,188.4	1,845.8	1,801.4	2,041.3	2,300.0	2,383.2	7.2	-60.9	94.6	181.1	194.8
	Mississippi	1,249.2	1,364.6	1,131.8	1,449.8	1,633.9	1,248.8	2,140.6	1,279.0	1,474.2	1,662.1	-0.4	776.0	147.2	24.4	28.2
	North Carolina	2,927.7	2,804.4	3,362.7	3,807.0	4,251.9	2,903.5	2,892.3	3,448.5	3,837.0	4,229.9	-24.2	87.8	85.8	30.1	-22.1
	South Carolina	2,374.7	2,563.2	2,846.1	3,133.3	3,533.1	2,361.9	2,828.2	2,920.9	3,207.1	3,686.3	-12.9	265.0	74.8	73.8	153.2
	Tennessee	1,661.8	1,691.3	1,811.2	1,796.3	1,902.1	1,642.0	1,560.5	1,864.9	1,947.0	1,959.9	-19.8	-130.8	53.7	150.8	57.9
	Virginia	1,909.2	2,356.4	2,414.2	2,680.1	3,021.9	1,908.7	2,463.7	2,441.8	2,723.1	3,054.2	-0.6	107.3	27.6	42.9	32.3
	West Virginia	1,880.1	1,912.5	2,108.0	2,315.6	2,351.3	1,928.9	1,967.1	2,154.7	2,395.7	2,495.2	48.8	54.6	46.7	80.1	143.9
VISTAS Total		29,477.4	30,817.5	30,588.5	34,154.7	37,560.2	29,448.6	33,755.9	31,900.0	35,247.7	38,652.3	-28.8	2,938.4	1,311.5	1,093.1	1,092.1
CENRAP	Arkansas	1,453.8	1,662.8	1,603.6	1,713.7	1,857.4	1,458.9	2,239.3	1,552.5	1,725.7	1,884.7	5.1	576.5	-51.1	12.0	27.3
	Iowa	977.6	1,048.0	1,014.5	1,022.7	1,093.2	994.4	1,213.3	1,055.7	1,078.1	1,116.2	16.8	165.4	41.2	55.5	23.0
	Kansas	896.4	894.0	890.8	956.2	1,077.4	894.4	947.4	898.9	952.8	984.3	-2.1	53.5	8.0	-3.3	-93.0
	Louisiana	1,690.2	1,743.3	1,679.8	1,826.5	2,148.0	1,762.3	2,312.9	1,728.8	1,839.8	2,174.2	72.1	569.6	48.9	13.3	26.2

RPO	State	MARAMA Base Case (MARAMA_5c)					MARAMA CAIR Plus Policy Case (MARAMA_4c)					MARAMA_4c - MARAMA_5c				
		2008	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**	**2008**	**2009**	**2012**	**2015**	**2018**
	Minnesota	1,110.8	1,143.3	1,105.8	1,090.6	1,092.4	1,115.1	1,141.4	1,138.8	1,156.4	1,150.1	4.3	-1.9	32.9	65.8	57.7
	Missouri	1,520.9	1,626.1	1,656.3	1,768.2	2,001.8	1,520.2	1,572.9	1,671.5	1,730.7	1,970.5	-0.6	-53.2	15.1	-37.6	-31.3
	Nebraska	612.7	620.4	614.9	678.6	672.7	614.4	623.9	616.6	681.0	673.2	1.8	3.6	1.8	2.4	0.5
	Oklahoma	2,477.0	2,651.6	2,220.1	2,219.9	2,327.9	2,477.8	3,284.6	2,234.9	2,337.4	2,506.0	0.8	632.9	14.8	117.5	178.1
	Texas	13,924.8	14,165.7	12,215.7	12,245.8	13,464.5	13,945.9	15,450.9	12,445.1	12,601.0	13,694.0	21.1	1,285.2	229.4	355.3	229.5
CENRAP Total		24,664.2	25,555.2	23,001.6	23,522.2	25,735.3	24,783.4	28,786.7	23,342.6	24,103.1	26,153.3	119.2	3,231.5	341.0	580.8	418.0
WRAP	Arizona	4,461.7	4,326.5	3,774.7	3,555.8	4,132.5	4,446.0	4,664.2	3,799.9	3,556.4	4,223.0	-15.7	337.8	25.2	0.6	90.5
	California	9,562.6	9,975.4	7,393.3	8,753.4	9,752.2	9,594.0	10,897.9	7,211.2	8,582.0	9,474.6	31.4	922.5	-182.1	-171.4	-277.6
	Colorado	799.5	993.2	880.3	960.9	1,074.3	798.0	1,064.3	880.7	956.7	1,068.8	-1.5	71.1	0.4	-4.2	-5.5
	Idaho	178.4	171.4	143.3	142.7	142.1	178.4	185.2	154.5	153.6	153.0	0.0	13.8	11.3	11.0	10.9
	Montana	296.0	301.0	351.2	348.1	350.0	298.0	304.3	357.2	354.5	356.8	2.1	3.2	6.1	6.4	6.8
	Nevada	1,471.5	1,423.5	1,217.0	1,165.8	1,272.3	1,471.6	1,553.4	1,239.5	1,199.5	1,313.4	0.1	130.0	22.5	33.7	41.1
	New Mexico	667.3	673.1	749.3	765.4	922.9	667.1	683.8	769.1	783.1	961.3	-0.1	10.7	19.9	17.7	38.4
	North Dakota	466.9	466.7	465.9	532.0	527.2	461.4	465.9	459.1	504.7	519.5	-5.5	-0.9	-6.8	-27.3	-7.8
	Oregon	1,204.9	1,153.8	1,372.0	1,301.8	1,280.5	1,204.9	1,253.3	1,434.4	1,366.8	1,344.8	0.0	99.5	62.4	65.0	64.3
	South Dakota	85.9	85.5	85.4	104.7	110.6	86.6	87.2	85.9	105.8	106.6	0.7	1.6	0.4	1.2	-4.0
	Utah	480.8	474.6	468.6	464.0	493.8	480.8	474.4	469.8	462.7	493.6	0.0	-0.1	1.2	-1.3	-0.2
	Washington	1,335.7	1,478.7	2,082.1	2,033.2	2,015.5	1,335.3	1,483.7	2,164.6	2,153.8	2,133.9	-0.4	5.0	82.5	120.5	118.4
	Wyoming	645.4	641.9	649.5	641.8	691.2	649.4	645.7	650.1	640.4	692.8	3.9	3.8	0.6	-1.4	1.6
WRAP Total		21,656.5	22,165.3	19,632.4	20,769.5	22,765.1	21,671.5	23,763.4	19,676.1	20,820.0	22,842.1	15.0	1,598.1	43.6	50.5	76.9
CAIR Plus Policy States		84,208.1	87,523.7	84,321.4	90,175.5	98,634.0	84,549.2	95,924.6	86,582.0	92,776.0	101,040.3	341.1	8,400.9	2,260.6	2,600.6	2,406.2
National		109,850.7	113,855.0	107,679.7	114,799.8	125,477.2	110,207.3	124,543.9	110,008.4	117,567.4	128,045.9	356.6	10,688.9	2,328.8	2,767.6	2,568.7

Note: To convert year 1999 dollars to year 2006 dollars, use a conversion factor of 1.1856

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