

**Comments and Responses on SAP 4.5, "Effects of Climate Change on Energy Production and Use in the United States"**

<b>Comment</b>	<b>Chapter</b>	<b>Section</b>	<b>Page</b>	<b>Line</b>	<b>Expert Review Comments on SAP 4.5</b>	<b>Author Responses:</b>
G-01					<p><b>GENERAL COMMENTS ON WHOLE DOCUMENT</b></p> <p>I found it to be a good, thorough document.</p>	Thank you
G-02					The Report generally covers the topics laid out in the prospectus with appropriate noting of the very limited literature on this topic	Thank you
G-03					<p>There are topics that the report seems to neglect:</p> <p>1. For energy supply, the energy market is a key mechanism reducing vulnerability to a wide range of risks (whether due to climate or not). Price variation is of course part of the operation of the market. It is notable that there have not generally been supply shortages for decades in the US. It would be useful to consider energy markets' key role in reducing vulnerability, and any adaptation that may be needed in the functioning of such markets.</p> <p>2. The report is rather vague in terms of what timeframes and magnitudes are being considered with respect to anthropogenic climate change and emission mitigation effort. Associated with this the report does not compare the levels of demand change or adaptation from climate change to the extent of demand, technology and supply change that are expected to occur over such a timeframe (2100 or 2030?). Without putting estimated changes into context, it is difficult to understand priorities</p>	<p>Considered by all chapter authors in their revisions.</p> <p>Generally, the SAPs are not based on scenarios of climate change or climate change responses in particular time periods, because they draw from studies that make different assumptions about patterns of climate change. Where studies are available, they are included.</p>
G-04					The charge is clearly described at the beginning of the report and the authors have attempted to address the charge. The title of SAP 4.5 is appropriate and the overall organization of the report is also effective.	Thank you.
G-05					The intro/preface/exec sum should say that this report won't deal with what could become the largest effect of climatic change on energy production, i.e., changes in technologies due to mitigation.	This topic is considered briefly in Chapter 4.

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G-06					The conclusions and recommendations do not always track the discussion (more on this in the discussion of Chapter 5). Uncertainties and incompleteness are reasonably recognized, but occasionally overstated. Some value judgments are made (more on this in the discussion of Chapters 2 and 4).	Carefully checked and revised where appropriate.
G-07					Overall, the report is fair. However, particularly in Chapters 4 and 5, the tone of impartiality is lost.	Considered editorially; changes made, especially in Chapter 4.
G-08					The draft CCSP 4.5 Product represents a comprehensive compilation/survey of the literature regarding the effects of climate change on energy production and consumption in the United States. However, given the long-term nature of climate change, this Product would greatly benefit from the consistent consideration of the relation of effects to the rate at which climate change will occur. This will lead to the acknowledgement that there will be a relatively long-term period of time for adjustments to its effects. For example, a 3° to 5° C temperature increase to 2100 translates into a 0.3° to 0.5° C (or approximately a 0.6° to 1.0° F) temperature increase per decade. It would also benefit from the discussion of other relatively intermediate climate change scenarios in addition to, what can be characterized as, "worst-case" scenarios that seem to be the primary focus of this Product. In the remainder of this technical evaluation evaluation of the CCSP 4.5 Product, we provide general and specific comments for each Chapter to illustrate and further elaborate on these and other relevant and related issues--The Product reflects a great deal of skill and hard work by the authors. Yet it could benefit substantially from meeting the concerns of these comments.	SAPs are not scenario-based, as a general practice of CCSP for this process.
G-09					The analyses are patchy. As discussed later, Chapter 2 needs work, while Chapter 3 is reasonably well-written. Chapter 4 relies more on opinion than information	All chapters revised.
G-10					The draft was generally well-written and informative. Chapters 2 and 3 represent a very useful synthesis and assessment of available literature. Chapter 4, by its nature, is inherently more speculative, and certain parts could perhaps raise concerns regarding the fairness and impartiality of the document	All chapters revised.
G-11					The draft report is very well organized and presents a very good summary of the existing literature	Thank you.

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G-12					The following two papers published in the last few weeks should be included in the review: (1) Matthias Ruth and Ai-Chen Lin (2006) Regional energy demand and adaptations to climate change: Methodology and application to the state of Maryland, USA. Energy Policy 32: 2820-2833; and (2) Stanton W. Hadley et al. (2006) Responses of energy use to climate change: A climate modeling study. Geophysical Research Letters, VOL. 33, L17703.	Both references included.
G-13					In reviewing the various chapters, it seems as though the primary aspect to consider is the increase in temperature. Much of the comments talk about the increase, but true climate change could also involve a decrease in temperature. Ultimately, debating whether temperature is rising or falling may be unnecessary as much as considering the impact of either extreme of temperature on the various methods used to produce energy. High or low temperatures could have a dramatic impact on facilities originally designed for a certain temperature range and prolonged extremes could challenge facilities even if they were designed to meet short term extremes	The chapters summarize research literature currently available.
G-14					Some of the chapters make reference to weather extremes, frequently identifying coastal areas as being the primary recipients of these storms. Being in St. Louis, I can identify the area as definitely not coastal and yet a weather related storm had at one point almost half a million customers without power and some customers were without power for almost a week. Extreme weather as defined in the document may happen at any place in the nation and consideration of that should be included in priority setting.	Comment carefully considered, but coastal storms are the greatest concern based on current literatures.
G-15					The most significant improvement will be a serious editing job. The report clearly reads like a collection of essays. It's like someone "put a big staple" through a collection of individual reports. This is especially true with regard to Chapter 5. The conclusions there do not necessarily track information from Chapters 2 through 4.	Yes, edited, and Chapter 5 brought into line with preceding chapters.
S-01					<p><b>Comments on Individual Chapters</b></p> <p><b>Summary</b></p> <p><b>General Comments</b></p>	

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					The first comment that I would make involves an issue that I had raised about the draft Prospectus regarding the comments in the Summary on the limited availability of research to-date on this subject. As I had raised in the earlier comments, if the available sources are not available to meet the guidelines, then how will SAP 4.5 be able to provide the future direction and set priorities? I note that none of the Chapter authors raised this and in one case the authors of Chapter 4 actually referenced that the amount of available literature on one issue was "abundant" (pg. 63, line 30). Unfortunately some readers may only read the Summary and be left with the opinion that the report would not have the same level of technical backing as other reports.	We consider the statement to be accurate and informative. The assignment of SAP 4.5 is to summarize available knowledge, however limited.
S-02			x	4-5	<p><b>Specific Comments</b></p> <p>Suggest deleting this final clause, since climate change and energy security objectives can engender conflicts as well as synergies. For example, climate change may preclude greater reliance on domestic coal, including coal to liquids, and may also suggest different priorities for the use of biomass than energy security concerns.</p>	Clause revised to reflect this concern.
1-01	1				<p><b>General Comments</b></p> <p>None.</p>	Chapter substantially rewritten.
1-02	1			<p><b>Secific Comments</b></p> <p>None</p>		
2-01	2			<p><b>General Coments</b></p> <p>This chapter is the most poorly written. There are a lot of data that are simply thrown into paragraphs without real regard to what points the authors are trying to make</p>		

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2-02					One personal subjective comment is relevant to this chapter: One concludes from reading this chapter that energy end use is essentially a “wash” between increased cooling in the southern parts of the United States versus reduced heating requirements in the northern part of the country. Unless one gets rather far north in this country, the cooling demands on electricity outweigh the heating demands in the winter months. Further, the amount of carbon dioxide released per Btu for natural gas heating is about half the amount of carbon dioxide released from coal-fired power plants supplying the electricity for air conditioning. There is no real analysis or commentary about these numbers. What the authors did was to throw a pile of numbers at the reader without any real attempt to offer reasoned analysis or expert opinion as to the impact of the information that they were providing. This chapter needs a lot of work.	Chapter substantially reorganized and rewritten.
2-03					The Chapter essentially presents an overview of the literature that relates to the effects of climate change on energy use/consumption in the United States as the Chapter title indicates. Despite the statement in Chapter 1 that “This report avoids the use of highly technical terminology,...” (Page 7, Line 9), the main observation and comment is regarding the language used in the text referring to predictions and/or projections in the literature. The language in the Product often has the connotation of conclusions/proof or the use of relative terms which, statistically speaking, need to be qualified. Sample data or examples are used to make inferences about general effects. In the specific comments below, six examples of suggested revisions are provided. In addition, it is important to point out that the format of literature citations is extremely inconsistent, and serious editorial focus and attention on this Chapter is recommended. The literature review is generally comprehensive with one relevant omission indicated in specific comments below.	See above.
2-04					I did not have an opportunity to review the sources for Chapter 2, but it seemed that some of the data referenced in Table 2.1 do not completely support the assertion of net energy consumption being reduced by global warming (pg. 17, lines 27, 28). I suspect that this may be a true statement, but not necessarily for the entire nation and since there is not always the same energy product used to warm as to cool the reduction may be different from what was considered in the reports.	Clarified in the revised chapter.
2-05			8	13	<b>Specific comments</b> Add discussion about Peak Consumption (Summarize effect from page 21)	Introduction reorganized.

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2-06			9	5	This paragraph needs to be re-written, since it doesn't track what follows in the chapter's text.	See above.
2-07			9	20	Explain increase	Section rewritten.
2-08			9	24	I would dispute their thesis in this sentence. Information that follows does not allow for a rather half-baked opinion like this to be stated up front.	See above.
2-09			10	2	The authors are considered experts in end-use energy efficiency. Some expert observations as to end-use efficiency trends would be appropriate	Some information added, but limited to available literature.
2-10			10	6-21	Another relevant study which examines the impact of climate change on the energy demand for residential, commercial, industrial, and electric utility sectors is Considine (2000) and should be included in the discussion.	Reference added.
2-11			10	16	Although the authors do attempt to get into the data later in the chapter, it would be useful to summarize some observations upfront per the list of publications that they cited	Section reorganized and rewritten.
2-12			11	28	Sentence beginning with 'All locations are ...' does not make sense	Section rewritten.
2-13			12	12-15	The sentence is more accurately stated when revised as "...When natural gas is available, the marginal impact of a 1° C increase in January temperatures in their model is predicted to reduce residential electricity consumption by 3% for electricity only consumers and 2% for natural gas customers."	Section rewritten.
2-14			12	17	Delete repeated 'end uses'	Done.
2-15			13	8	A '29% to 58%' what? Increase?	Revised.
2-16			13	10	A '2% to 18%' what? Increase?	Revised.
2-17			13	1	Perhaps the authors should re-title or re-organize their sub-chapter headings. Parts of the discussion in this paragraph are clearly about air conditioning, although the section 2.3 is entitled "Effects on Energy Use for Space Heating." Given that the authors tack back and forth using many of the same references over and over, perhaps a better title might be "Effects on energy use for Space Conditioning." Similar comments will follow.	Chapter material reordered.

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2-18			13	19-21	The sentence is more accurately stated when revised as "With building equipment and shell efficiencies frozen at 1990 baseline levels, a 3.9° C temperature change generated a predicted decrease in annual space heating energy requirements by 29% to 35%, or about 7.4% to 9.0% per degree C,..."	Section revised.
2-19			13	26	Why the big drop in oil consumption? Is this due to some northeastern power plants being run on oil? A quick comment would be useful.	Clarified.
2-20			13	26	What type of oil? Heating? Diesel?	Clarified.
2-21			14	1	Perhaps the authors should re-title or re-organize their sub-chapter headings. Parts of the discussion in this paragraph are clearly about air conditioning, although the section 2.3 is entitled "Effects on Energy Use for Space Heating." Given that the authors tack back and forth using many of the same references over and over, perhaps a better title might be "Effects on energy use for Space Conditioning."	Chapter material reordered.
2-22			14	22-24	The sentence is more accurately stated when revised as "...In most studies, the effect with respect to temperature and humidity is generally non-linear such that the percentage impact increases with temperature".	Sentence edited.
2-23			14	25	The 21 <sup>st</sup> century has a long way to go. I disagree with their statement, particularly when coupled with data they have used as part of this chapter.	Clarified: a conclusion of a referenced study.
2-24			14	27	It's not clear what they are trying to say in this sentence.	Clarified.
2-25			14	30	Word or words appear to be missing between 'loads' and 'all regions'.	Edited.
2-26			15	7	It appears that there is a phrase missing from this sentence.	Edited.
2-27			15	10	What type of oil?	Clarified.

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2-28			15	12	The study of Mendelsohn (2003) for California did not use fuel or electricity consumption. Mendelsohn used total annual energy expenditures (natural gas plus electricity) in dollars so a more correct statement in line 13 is as follows "and the net overall energy expenditures increases with a 1 °C warming."	Clarified.
2-29			15	18	It may be useful to see where the scenarios are coming from. An increase of 9.1 Centigrade degrees is the same as an increase of about 18 degrees Fahrenheit. It's an interesting premise. Would this make places like Phoenix and Dallas uninhabitable by the end of the century?	Deleted.
2-30			15	30+	What is the historical trend?	Section revised.
2-31			16	1	How does the trend in home offices impact this?	Statement deleted.
2-32			16	3	This is an observation on space heating in the space cooling (Section 2.4) section	Moved.
2-33			16	17-18	In terms of addressing the increases in the market penetration of air conditioning in response to climate change, the authors of this Product indicate that "However, more recent studies have examined the effects directly". In doing so, it does not recognize the uncertainty of regional climate change projections. In other words, although regional climate projections exist, there is considerable disagreement among them as to regional effects and virtually no well-based projections as to specific localities.	Revised.
2-34			16	18	An editorial comment is in order. I agree with the analysis by Sailor and Pavlova. The use of air conditioning is increasing, even in states with moderate climates. Earlier in this chapter the authors said that no one knew the projections for air conditioning growth. It would probably be rather easy to make estimates using manufacturers' projections. States in which there has not normally been wide scale use of air conditioning (i.e., Hawaii and Northern California) are seeing dramatic growth in air conditioning in new homes. Similarly in the Midwest, most newer homes, even those that are moderately priced, have air conditioning. This is an opinion on my part, but I believe that a bit of digging – even some back-casting – would enlighten this discussion.	Revised, but limited by currently available analyses.
2-35			16	23-25	Sentence is pure speculation, as stated. Should be deleted.	Speculation deleted.



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2-36			17	3	It would be useful to see if empirical data back up the modeling done on the effects of increased humidity and precipitation on energy use. While I would agree that this is true for space cooling, a few words on how they come by the results for increased space heating would be informative.	Material added.
2-37			17	8	What type of oil?	Clarified.
2-38			17	27	Also see Table 2.1. The work cited clearly calls for more analysis. First the table is rather confusing as to understand. Is energy use going up or down? From these analyses, it would be suggested that energy use is going up. An interesting analysis would be to examine the assumptions and modeling that was done for 2010. After all, we're almost there. Since the numbers generated by Rosenfeld et al. and Linder and Inglis are substantively different, a comparison of how they got to their 2010 values would be useful. On the face of these numbers, it is not clear how a declarative statement at the start of this paragraph can be made	Revised and clarified.
2-39			18		Table 2.1: Suggest that the table be split, or a new column and/or prominent footnotes used, to clearly distinguish those studies that focus on electricity only, such as Linder and Inglis, from studies that consider all fuels and both heating and cooling. Without such a change, the table, which may sometimes be used as a standalone summary, could be unintentionally misleading	Table redone and clarified.
2-40			19	28	Delete "that." Does not make sense as written.	Deleted.
2-41			20	12	Describing HDDs and CDDs as "normal" is highly subjective and relative. The sentence is more accurately stated when revised as "country). They then compared these values with 1971-2000 average HDDs and CDDs"	Revised.
2-42			21	6-8	The sentence is more accurately stated when revised as "Studies published to date provide empirical evidence to consistently support the hypothesis that temperature increases with global warming would increase peak demand for electricity in most regions of the country, but the amount of the increase varies with the region or regions covered and the study methodology-in"	Revised.

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2-43			21	10	There is a lot of information available for the state of California. It would be useful to compare this 1992 analysis to what has transpired in the state through 2005	Some material added.
2-44			21	25	Is peak summer demand increasing from a particular date, or increasing relative to a base case for no climate change?	Clarified.
2-45			21	29	This entire paragraph should be deleted. The entire issue of how a Canadian utility would provide electricity to American consumers is beyond the scope of this report. Further, it makes use of only one citation to make the case that we can somehow take advantage of warmer weather in Quebec.	Revised and clarified.
2-46			22	15	This paragraph should include a discussion about maintenance (turn around) time requirements for power plants. Also, a discussion concerning shift in seasonal peak demand could be included.	Limited to currently available literatures.
2-47			22	26+	I recommend adding a discussion in section 2.6 (Adaptation: Increased Efficiency and Urban Form) about the options available to reduce the urban heat island effect.	Specific connections with heat island effects relative to climate change were not found in published literatures.
2-48			23	8	I believe that this refers to new construction only. What about the existing building stock?	Clarified.
2-49			23	10	The range of possible outcomes should only be used to make the point that additional research and assessment need to be done to get a better idea of impacts. These numbers are meaningless for any kind of decision.	Point added.
2-50			23	16	The implication of these analyses is that great strides can be made in insulating buildings from heat and very little can be done to better insulate buildings from the cold. I'd be curious what kinds of assumptions were made in these analyses. Typically in northern climates, there are a variety of ways to weatherproof houses. It would be useful to match these modeling runs with reality. The conclusion is that with an increase of about 7 degrees Fahrenheit, we can actually improve energy use in Phoenix!	Clarified.

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2-51		2.7	24		This Section does not recognize the fact that industries, commercial services, and businesses also air condition and may, potentially, also be sensitive to climate change.	Commercial sector is addressed above; literatures suggest that industrial sector is less sensitive to climate change
2-52			24	21	This statement is probably not correct. The growth in the southeastern and south central United States economy over the past half-century has a lot to do with space conditioning of manufacturing facilities. Some type of empirical study should be done to examine the change of electricity use in these census regions for the past 50 years. While more speculative, the need for energy for agriculture will probably increase. Most climate models forecast increasing drought in the crop growing regions of the country. Others simply point to more intense storm events. In any case, it is probably wrong to simply dismiss the need for American industry to use more energy for their production activities.	We summarize the available literatures, although further studies might lead to different conclusions.
2-53			25	9	This is another candidate for some empirical analysis. What is the change over the past "X" years of the percentage of personal vehicles that have air conditioning?	We agree. Needs research.
2-54			26	14	Pest control is not discussed. It is mentioned on page 29, line 4 and 6. It should be discussed here as climate effects could have a large impact on pest populations.	We do not find a published reference to energy implications.
2-55			26	29	Most of the current poultry production operations are in the South: Arkansas, North Carolina, and Georgia. It shouldn't be expected that heating and cooling would be balanced under this scenario.	Noted.
2-56		2.8			Comments on conclusions: They are okay in and of themselves. Most of them are obvious and could have been better supported by a cleaner discussion of what types of research and assessment are needed	Section reframed and revised.
2-57			28	19	The sentence is more accurately stated when revised as "Recent literature has identified a highly significant relationship between cooling degree days'	Revised.
					<b>General Comments</b>	Section expanded.

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3-01	3				This chapter is the best-written and not many comments follow. The only complaint that I had concerning this chapter was the lack of discussion of the impact on transmission and distribution systems from extreme weather events. This was handled well in the discussion on related impacts on oil and gas. The expansion of this discussion would be useful, since it can lead into the following chapter's discussion on other institutional impacts. In particular, the impacts on and the response from financial and insurance sectors are important to the overall economic health of the country	
3-02					Chapter 3 should include a discussion about distributive energy technologies. These could lead to less disruption due to the distributive nature of the supply	Considered and noted where appropriate.
3-03					It is important to consistently separate demand versus supply impacts of climate change as well as clearly indicate the supply-responses to demand changes. Two specific examples are cited below with proposed revisions	Considered below.
3-04			31	6-8	<b>Specific Comments</b> The sentence is more accurately stated when revised as "Climate change can affect fossil and nuclear energy production, conversion, and end-user delivery in a myriad of ways. Average ambient temperatures impact the supply response to changes in heating and cooling demand, generation cycle efficiency, and cooling water requirements in the electrical"	Change made.
3-05			36	28	Is the report referring here to the reference EPRI 2003?	Reference added.
3-06			38	4-18	Average plant sizes are less important than new plant sizes in considering climate changes over 25 years and more. Over the next 100 years, nearly all of the existing plants will be replaced. This is one example/result of this Product not currently considering the time horizon of climate change	Paragraph revised.
3-07			38	26-28	This is an example of the focus on "worst-case" scenarios. If the reference to the cited literature is correct, a 60 – 120 degree Fahrenheit change (implied increase) in temperature is beyond most projections (e.g. Sokolov et al., 2005) and not plausible	Clarified.

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3-08			39	25	This section is missing a discussion concerning how climatic change could lead to an increase in ice-free days in the arctic – shifting drilling activities from the winter time to the summer time	See reference to Alaska box.
3-09			39	29	The range of sea level rise estimated by the IPCC for the Third Assessment Report is now understood to be potentially in the low range. It would be important to mention that fact here and to add some of the references that have recently appeared in the technical literature suggesting that this is the case.	No consensus exists in this regard.
3-10			40	4	It is extremely important to make this point and I'm glad the authors did.	Thank you.
3-11			40	23	Given that the authors make use of vignette boxes, I would put the Florida example in a similar	Box added.
3-12			41		If the pictures are to be included, it would be good to describe the effect and vulnerability that they are meant to portray (e.g. increase in lake levels due to permafrost melt water?). Some comparison of expected rates of change to reserve lifetimes would be useful. The last paragraph states some numbers without reference (need reference); are these years representative of the trend or variability or both?	Photos deleted.
3-13			42	21-23	The relation between pipeline transport and power is an insightful one; shouldn't this lead to re	Considered for Chapter 5, although the report does not make recommendations.
3-14			43	11	Missing a discussion concerning pipeline movements. One pipeline, during Ivan, moved 3,000 ft. Another pipeline, during Katrina, moved 5,000 ft. This section should also include a discussion of the increase in sub-sea development in deepwater and the hurricane resiliency of these types of developments.	Lacked references.
3-15			44	21	Are the captions on the figures correct?	Checked.
3-16			51	12	Need to re-write this paragraph. For example, "showing how management of hydropower systems can be adapted to address climate variability impact."	Revised.

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3-17			51	13	This section should include a discussion about the following paper: Yao, H., and A. Georgakakos (2001) "Assessment of Folsom Lake response to historical and potential future climate scenarios 2. Reservoir management." Journal of Hydrology 249(1-4): 176-196. The researchers were able to show that the use of probabilistic hydrologic forecasts and modern decision support tools would be able to ameliorate some of the adverse impacts due to climate change for the Folsom reservoir in California. This is a very good example, where adaptation to climate variability now would also produce benefits under a changing climate. A follow up demonstration study for multiple reservoirs in California and dealing with climate variability is almost complete (see Georgakakos, K. P., Graham, N. E., Carpenter, T. M., Georgakakos, A. P., and H. Yao (2005) Integrating Climate-Hydrology Forecasts and Multi-Objective Reservoir Management for Northern California. EOS 86(12): 122, 127). Future research efforts will estimate how this system would be able help water managers cope with climate change.	Reference added.
3-18			52	2	It would be useful to add a sentence or two on the impact of invasive species associated with climate change. For example, the seasonal impact on bark beetles in Alaska is getting worse due to longer warm periods. While it can't be attributed to climate change, the forest fires in California in 2003 were fueled by dead trees killed by bark beetles.	Too speculative to be added at the current state of knowledge.
3-19			52	25	Change to "price-supported."	Done.
3-20			53	6	This does not take into account either reduced precipitation or the impact of extreme storm events (tornadoes and hailstorms, for example). The net effect may be a reduction in crop yield due to drought and storm damage.	Point added.
3-21			53	12-31	Cellulosic (e.g. switchgrass) biomass ethanol fuels has not yet been proven to be economic given that experiments with switchgrass have, thus far, been generally limited to laboratory experiments under controlled conditions.	Noted.
3-22			53	27	This paragraph is missing a discussion concerning the impact on fertilizer use when corn stover is harvested instead of being plowed under (more, and perhaps different types of, fertilizer will be needed).	No change considered necessary.
3-23			55	4	Texas now has the most wind energy systems installed.	Changed.

**Comments and Responses on SAP 4.5, "Effects of Climate Change on Energy Production and Use in the United States"**

<b>Comment</b>	<b>Chapter</b>	<b>Section</b>	<b>Page</b>	<b>Line</b>	<b>Expert Review Comments on SAP 4.5</b>	<b>Author Responses:</b>
3-24			55	19	Paragraph needs a discussion concerning the proximity of potential wind power locations to the	Not considered a high priority for a brief discussion.
3-25			55	26	A lot of relevant research and assessment has been done since 1991. I'd try to update this co	No basis found for change.
3-26		3.2.4	56	1	(Solar Energy) you may want to add a discussion about the postulated detrimental effect that aerosols may be having in reducing the amount of solar radiation that reaches the ground even in places such as California (Effects of Anthropogenic Aerosol Particles and Their Precursor Gases On California and South Coast Climate. Publication # CEC-500-2005-003. Posted December 21, 2004. <a href="http://www.climatechange.ca.gov/documents/pier_gcc_reports.html">http://www.climatechange.ca.gov/documents/pier_gcc_reports.html</a> ).	Added.
3-27			56	24	The ocean resources have both potential and downsides. It remains to be seen how these structures will handle being in a corrosive environment over long periods of time – a requisite for effective utility operation. Also, impacts on these technologies resulting from current existing storm events – not considering increased numbers of extreme events – must be taken into account.	Material added.
3-28			57	18	Section should include a discussion of combined heat and power (CHP) technologies. Also dis	Lacked literature to support such a discussion.
3-29		3.3.1	57		This discussion needs to be expanded. The discussion on the potential use of advanced composites and information systems to enhance T&D systems should be expanded beyond the single reference.	See above
3-30			57	25-	There is a very short discussion of electricity distribution. Power outages are often related to weather events and their improvement offers an important avenue to economic reduction in vulnerability. While power outages do not have the photogenic appeal of the destruction of large facilities, their effects can be widespread and have social and broad economic effects (e.g. recent blackouts in the US and Europe). Suggest augmenting this section	See above, but figure added.
3-31			60	3	It would be useful to have a map with the Henry Hub pointed out on the map.	Considered, but decided not to add a map for this.

**Comments and Responses on SAP 4.5, "Effects of Climate Change on Energy Production and Use in the United States"**

<b>Comment</b>	<b>Chapter</b>	<b>Section</b>	<b>Page</b>	<b>Line</b>	<b>Expert Review Comments on SAP 4.5</b>	<b>Author Responses:</b>
3-32			60	60	Despite some statements in the following chapter, much of the utility industry is not preparing for climate change. It would be useful to expand on the one sentence here. It is extremely important that systems be sited logically – not based on historical records of weather events – but on reasonable future scenarios.	Covered in Chapter 4.
3-33			62	16-18	The sentence is more accurately stated when revised as “The system-wide response by, and impact on, electricity transmission, distribution, and other energy system needs in response to increased demand-side use due to increased temperatures are generally not well understood at this time...”	We prefer the sentence as is.
4-01	4				<p><b>General comments</b></p> <p>This chapter seems to be in search of a focus. Its premise is that “there is some other stuff that might be important, so here it is.” Some of the points on state planning and insurance and financial institutions are useful. Some, such as those on utility planning, may be counter-productive. Other sections should be omitted.</p>	Scope defined by Prospectus.
4-02					Although this Chapter aims to address possible indirect effects, and uses the appropriate qualification “Possible”, it does not acknowledge many studies of climate change mitigation and impacts, particularly those which employ “global system models” (e.g. MIT’s Integrated Global System Model (IGSM), work of John Weyant at the Pew Center on Global Climate Change, The National Institute for Public Health and the Environment (RIVM)’s IMAGE model, among many others).	Revisions made.
4-03		4.2.1			<p><b>Specific comments</b></p> <p>The most useful part of this discussion is on specific states taking leadership positions on policy development related to climate change. For the most part, this is a good section</p>	Thank you.



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4-04			65		This Table essentially provides the structure for the subsequent discussion in the remainder of the Chapter, itemizing specific indirect effects on energy systems. However, the subjective classification system of double-X, X, and ?, can be questioned. Instead of imposing such a classification, we suggest the Table be reformulated, omitting this classification system and stressing (in the related text) those specific indirect effects which have been examined in the literature thus far, as well as indicating that the literature has yet to focus on energy security as a possible indirect effect. Although some indirect effects are reasonably well established, conclusions about others are premature given the limited work and the lack of actual uncertainty calculations in this area to date. It would be useful to make distinctions	Table significantly revised.
4-05			67	20-22	The stated price premium for IGCC with capture and sequestration, "may cost up to 20% more," seems much too low. This sounds more like IGCC without capture and sequestration	Sentence deleted.
4-06			67	30	Contrary to the suggestion of the text, the PTC for both solar and biomass were virtually unused.	Changed in final review draft.
4-07			68 69	thru 3	Suggest deleting these 2 sentences, since interpretation of the political aspects of the policy process seem beyond the scope of this assessment.	Section rewritten.
4-08			69	27-31	Suggest deleting the last sentence, which considers matters that are beyond the scope of the assessment.	Deleted.
4-09		4.2.2			I'd delete this section. It is already adequately discussed in Chapter 3 and it was attempted to be discussed in Chapter 2.	Called for by Prospectus.
4-10			70	14-16	It is not accurate that "...the best-documented case of indirect effects of climate change on energy production and use in the United States is effects of climate change policy on technology research and development and on technology preferences and choices." Relatively speaking, more research has been done in the area of technology preferences and choices than on technology research and development. In other words, the best-documented case of indirect effects should only refer to technology preferences and choices.	This is what the sentence says!

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<b>Comment</b>	<b>Chapter</b>	<b>Section</b>	<b>Page</b>	<b>Line</b>	<b>Expert Review Comments on SAP 4.5</b>	<b>Author Responses:</b>
4-11		4.2.3.1			Some additional words would have been appropriate here. Energy firms such as BP and Shell have clearly understood some of the challenges and (perhaps somewhat incrementally) are trying to do something about it. Others, such as Exxon and Tesoro, choose to fight any changes. At the same time, large multi-national energy technology providers, such as General Electric, Mitsubishi Heavy Industries, and Siemens are developing product lines that cover the waterfront for various eventualities in addressing climate change realities.	Lack literatures to support additions.
4-12		4.2.3.2			A couple of comments are necessary here. First, there are those who would disagree with the comment on the lessening of the importance of state regulatory bodies. The second comment is that re-structuring has definitely had an impact on O&M operations for their infrastructure. The impact of minimizing funding for environmental compliance and upgrading T&D systems is worthy of further evaluation and assessment	Lack literatures, but edited.
4-13		4.2.3.4			While there is probably not much information on the impact and behavior of the financial and insurance sectors, this clearly is an area for more analysis. Both sectors have shown increasing concern in a variety of energy related areas, such as energy security and climate change. Decisions that individual companies make in the future may do more to drive technology shifts and decision-making in more conservative institutions than any future set of regulations might.	Agreed, but supporting information from emerging research arrived too late to include in this report.
4-14			75	3-13	The primary reference to Jorgenson (2004) on sectoral effects omits other relevant and related studies. This is a specific example in lieu of our General Comments for this Chapter in which references to other global economy-wide models that examine sectoral effects for countries/regions throughout the world, including the United States, are omitted (e.g., Paltsev et al., 2005). {also, Jorgenson et[no period] al. studied [not study]}	References added elsewhere.
4-15			75	17	The authors of this chapter used Mendelsohn's work to come up with a different set of conclusions than those random thoughts in Chapter 2. I agree with these, particularly to the point of "unless starting climates are very cool."	Changed in final review draft.
4-16			75	28	The assumptions used in much of the CEPA, 2006 citation are pre-disposed toward the conclu	See above.

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<b>Comment</b>	<b>Chapter</b>	<b>Section</b>	<b>Page</b>	<b>Line</b>	<b>Expert Review Comments on SAP 4.5</b>	<b>Author Responses:</b>
4-17			76	9	This is a good point. It can be expanded (as well as in Chapter 3) to point out that development of renewable resources that are remote to load centers requires substantive upgrading of the T&D system.	Thank you.
4-18			76	27	This is also a good point. California looks relatively good on an emissions basis compared to the rest of the country because they utilize "coal-by-wire" for a good portion of their electricity. A better way must be found to allocate costs of eventual carbon control that is fair.	Thank you.
4-19		4.4.1	77		Delete section.	We disagree. Effects could be important.
4-20		4.4.2	78		Delete, already discussed in previous chapter. The only reason to leave this in would be to have a discussion on information and analysis needs in developing carbon taxes and/or policy incentives to reduce carbon emissions.	See above.
4-21		4.4.3	78		Delete or expand. For example, increased parasitic losses from carbon sequestration will almost certainly require increased controls, a loosening of regulations, or different set of units for calculating other pollutant emissions.	See above.
4-22			78-79	27-3	A more nuanced discussion would be appropriate, since many current control programs for non GHG emissions are now implemented using cap and trade programs. Under such programs, the increased penetration of emission-free technologies into the marketplace would not translate directly into a lower level of overall emissions from the energy sector	Discussion kept as brief as possible.
4-23		4.4.4	79		Delete Section.	We disagree. Effects could be important.
4-24		4.4.5	79		Delete section. Essentially covered in Section 4.2.3.1	See above.

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<b>Comment</b>	<b>Chapter</b>	<b>Section</b>	<b>Page</b>	<b>Line</b>	<b>Expert Review Comments on SAP 4.5</b>	<b>Author Responses:</b>
4-25			80	3-6	The following statement is not correct. "From the available research literature, it appears that the most salient indirect effects of climate change on energy production and use in the United States are likely to be changes in energy resource/technology preferences and investments, along with associated reductions in GHG emissions." Rather, the most salient indirect effects of climate change on energy will be transmitted through prices that will affect both production and consumption. With respect to energy production and consumption, the composition of both will change, possibly accompanied by changes in technology. In other words, consumer demands drive the composition of production	We do not find this statement in the draft.
5-01	5				<p><b>General Comments</b></p> <p>There are a lot of problems with this chapter. The conclusions do not necessarily reflect the information and conclusions developed in the preceding chapters. Further, new information and commentary were introduced in this chapter that were more appropriate for discussion (inclusion) in one of the previous chapters. As this chapter stands, it is more of an advocacy summation that really does not track the attempts in the other chapters to get at the status of information.</p>	Chapter carefully reviewed and substantially revised.
5-02					As indicated in the Introduction, "Accordingly, this final chapter of SAP 4.5 will sketch out what appear, based on the current knowledge base, to be the most likely types of effects on the energy sector." (Page 81 Lines 20-21). Throughout the remainder of the Chapter, the "degrees of likelihood" classifications for many of the "very likely" and "virtually certain" examples are essentially tautologies (i.e., stating the obvious). Thus, for many of these cases, it seems trivial to use any classification	Responds to CCSP guidance for all SAPs.
5-03					Chapter 5 is supposed to be about Conclusions and Research Priorities, but when the priorities are discussed in Section 5.4 they all appear to be equal. At a time when budgets are limited, it would seem that a greater attempt should be made to prioritize the future work effort to address the issues identified in the report. The priority setting process may not completely be based on the likelihood of something occurring, but should also include an aspect of the scope or size if the occurrence does happen.	We agree that proritzing will be a good idea, but we considered it beyond the scope of this preliminary literature review.
					<b>Specific Comments</b>	

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<b>Comment</b>	<b>Chapter</b>	<b>Section</b>	<b>Page</b>	<b>Line</b>	<b>Expert Review Comments on SAP 4.5</b>	<b>Author Responses:</b>
5-04			82	3-5	It is inaccurate to state that there exist "...widely accepted scenarios for climate change..." Rather, they are subject of an ongoing debate within the climate change community and, hence, it is inappropriate to accept them with "...relatively high levels of confidence,...".	Changed.
5-05			82	3-5	It is very vague what specifically is meant by this sentence. Suggest that an explicit statement with conclusions below that can be statistically justified be used. For example, no timeframe is stated; are we looking at change between 2006 and 2100? Some would say that any scenario with emissions leading to above 450 ppm would not be acceptable; what is meant by accepted? Suggest that the timeframe and scenario, or range of scenarios, be explicitly stated with detailed analysis in the chapters or that these statements be recast.	SAPs are not scenario-based.
5-06			82	7	Nothing in the preceding report says this. And it is certainly not virtually certain. Delete this ga	Revised (but true).
5-07			82	11	While I may personally believe this to be true, the materials developed in Chapter 2 really don't reflect this conclusion. These first two bullets (p. 82; line 7 and line 11) try to have it both ways, leading to the conclusion that climate change ain't so bad. It doesn't work	Revised.
5-08			82	15-19	This is very relative and, is another example of not addressing the adjustment to climate change over a relatively long-term time horizon.	Revised.
5-09			82	21	Oh brother!! The positive or negative line is a straight advocacy statement. There is nothing in the preceding chapters that implies that peak demand will be decreased. All the information contained in this report points to an increase in peak demand, primarily due to space cooling needs	Revised.
5-10			82	21-22	Given the current state of research in this area, it is not correct to state that we are "virtually certain" that climate change has implications for the peak demands for energy	Changed to "very likely".

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<b>Comment</b>	<b>Chapter</b>	<b>Section</b>	<b>Page</b>	<b>Line</b>	<b>Expert Review Comments on SAP 4.5</b>	<b>Author Responses:</b>
5-11			82-85		What is meant by significant; is this significant compared to year-to-year variability, or to expected changes over the unstated timeframe for the reference case? While I could imagine that for a 3 degree C global increase, many of the mean changes might be greater than year-to-year changes over a decade, but to be virtually certain of this might mean that this would be over a century (locally, there have been some very cold and warm winters looking over a century). Suggest that what is meant by significant be either stated and justified, or statistical claims removed	Terms defined in Chapter 1.
5-12			83	9	Delete "fact," insert "face." Also, these types of restrictions are already occurring in the West. This should be changed (and I'm being conservative here) to "very likely."	Done.
5-13			83	13	The authors of chapter 3 made the sufficiently compelling case (although not really discussing T&D impacts) that this should be listed as "very likely."	Changed.
5-14			83	17	Similar to the previous comment, "very likely."	Changed.
5-15			83	17-18	This is another specific example of the lack of expression and consideration as to the rate at which climate change will occur. Some energy facilities may be covered/flooded by sea-level rise. However, there will be a relatively long time horizon to provide for adjustments before it possibly occurs.	Changed.
5-16			83	20-22	Similar to a previous specific comment made in Chapter 3, it is not accurate to state that the "Effects on biomass for biofuels are likely to be considerable,..." given that research on the potential benefits of switchgrass have, thus far, been generally limited to laboratory experiments under controlled conditions	Deleted.
5-17			83	24	Probably can delete, as it is addressed in other conclusions	Changed.
5-18			85	16-17	The conclusion about institutions is too general. What institutions are being referred to? When and what changes are expected to happen?	Deleted.
5-19			85	22	Per previous comment, "very likely."	Changed.

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<b>Comment</b>	<b>Chapter</b>	<b>Section</b>	<b>Page</b>	<b>Line</b>	<b>Expert Review Comments on SAP 4.5</b>	<b>Author Responses:</b>
5-20			85	25-27	Suggest replacing this bullet with a discussion that recognizes that climate change and energy security objectives can engender conflicts as well as synergies. For example, climate change objectives may preclude greater reliance on domestic coal, including coal to liquids, that would otherwise be a possible strategy to enhance energy security. Climate change concerns may also suggest different priorities for the use of available biomass than energy security concerns – the former may favor use in electric generation to back out coal, while the latter often focuses on increasing the use of biomass-based transportation fuels.	Changed.
5-21			86	14	Should be changed to start “the California energy market crisis of 2000/2001....”	Changed.
5-22			86	21	This is an example of adding new information to the conclusion chapter that has not been addressed in previous chapters. In any event, this paragraph is simply a commercial for the utility industry. While electric utilities need to strategize on production and demand futures, their recent performances have been – in the main – abysmal. A cursory evaluation of many Integrated Resource Planning documents would demonstrate that they have not addressed either clearly emerging energy resource shortfalls or the potential for climate change legislation. In particular, the last point of Niemeyer’s presentation - the separation of “climate change signals from historic variability” - is the same excuse that the utilities continually give for doing nothing. Discussion related to this entire reference should be deleted as it has not been vetted by any of the authors of the earlier chapters, was simply an advertisement presentation at a meeting, and certainly does not reflect discussions from the previous two chapters.	Paragraph deleted.
5-23			87		In the Katrina box it would useful to describe what were the effects on energy supply. My understanding is that there were not widespread shortages. It may also be useful to discuss the roles of strategic oil and product reserves that came into play. And it may be useful to discuss the role of power supply to the region and connect to the statement elsewhere in the report on the effects of power supply loss in pipeline transport (and that associated with refinery restarts).	Reader referred to Chapter 3 for further information.
5-24			87		Box 5.2: Within the climate modeling community, it is highly debatable whether or not extreme weather events are more likely to become more intense. Generally and relatively speaking, Hurricane Katrina was not a very intense storm. The destructive impact was primarily attributed to faulty/poor engineering of levees.	We disagree.

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<b>Comment</b>	<b>Chapter</b>	<b>Section</b>	<b>Page</b>	<b>Line</b>	<b>Expert Review Comments on SAP 4.5</b>	<b>Author Responses:</b>
5-25			88	1	Delete "peakiness" and insert "peak demand."	Changed.
5-26			88	23	Need to define slower rates of change of ?.	We think the point is clear.
5-27			89	18-22	This point is a valid one in that it indicates the need for improved projections at relative low spatial/scales. However, in order to provide such projections, first there must be more and better spatially distributed climate projections. Those depend on improvements in climate modeling and computer speeds/capabilities. In addition, greater development of spatial databases for socioeconomic and other climate-related data are required. Because such spatial data is relatively limited at this time, the geographic scale of projections is also limited. Thus, this paragraph should be revised to indicate that the development of comprehensive spatial databases for all climate-related data is a priority and critical element to improving the quantity and quality of climate predictions/projections.	Beyond the scope of SAP 4.5.
5-28			89	24	Research should also include implications for energy system recovery.	Added.
5-29			89		Re third and fourth bullets: Add "and assessment" after research for both bullets.	Added.
5-30			90	5	Paragraph should also include adaptation of existing technologies to new regions, not just deployment of new technologies. For example, when can offshore technologies from the North Sea and the Gulf of Mexico be used in the Arctic – that is, when we will switch over from winter time exploration to summertime exploration?	Added.
5-31			91		Re bullet starting on line 2: Another new thought here, although one that I agree with. Chapter 3 should be expanded to include a discussion of the need for improved energy storage systems. This would provide the justification for including this bullet in the conclusion.	Revised.
5-32			91	7	This is the only place where distributed generation is mentioned. It should be discussed elsewhere in the report if it is to be included here.	We consider it a priority for research.



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					<b>Expert Review Comments on SAP 4.5</b>	<b>Author Responses:</b>
<b>Comment</b>	<b>Chapter</b>	<b>Section</b>	<b>Page</b>	<b>Line</b>		
5-33			91	9	An important priority of research that is not mentioned is the need to understand the impact of severe events on sub-sea pipeline movement in the Gulf of Mexico. This is a major, critical issue that needs to be investigated.	We consider this an aspect of bullet #4.
R-01					<p><b>References Cited in Comments</b></p> <p>Paltsev, S., J.M. Reilly, H.D. Jacoby, R.S. Eckaus, J. McFarland, M. Sarofim, M. Asadoorian &amp; M. Babiker (2005). <i>The MIT Emissions Prediction and Policy Analysis (EPPA) Model: Version 4</i>, MIT Joint Program on the Science and Policy of Global Change, Report 125, Cambridge MA (<a href="http://web.mit.edu/globalchange/www/MITJPSPGC_Rpt125.pdf">http://web.mit.edu/globalchange/www/MITJPSPGC_Rpt125.pdf</a>).</p>	Added.
R-02					<p>Sokolov, A.P., C.A. Schlosser, S. Dutkiewicz, S. Paltsev, D.W. Kicklighter, H.D. Jacoby, R.G. Prinn, C.E. Forest, J. Reilly, C. Wang, B. Felzer, M.C. Sarofim, J. Scott, P.H. Stone, J.M. Melillo &amp; J. Cohen (2005). <i>The MIT Integrated Global System Model (IGSM) Version 2: Model Description and Baseline Evaluation</i>, Report 124, MIT Joint Program on the Science and Policy of Global Change, Cambridge, MA (<a href="http://web.mit.edu/globalchange/www/MITJPSPGC_Rpt124.pdf">http://web.mit.edu/globalchange/www/MITJPSPGC_Rpt124.pdf</a>).</p>	Considered less relevant than the preceding reference.