Assessing ExxonMobil's climate change communications (1977-2014)

SUPPLEMENTARY INFORMATION

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S1. Details of Content Analysis and Coding Scheme

We here provide details on various steps of our content analysis, as delineated by Metag, Neuendorf, and Rose, Spinks, and Canhoto [1–3].

S1.1 Research questions

As described in the main text, our analysis takes up the challenge made by ExxonMobil to "read the documents" it has produced on AGW [4], in order to determine whether the corporation misled consumers and/or shareholders by making public statements that cast doubt on climate science and its implications, and which were at odds with available scientific information and with what the company knew. These research questions are motivated by earlier analyses of ExxonMobil's communication practices [5–14], qualitative accounts of the company's AGW communications [15–19], and the broader history of corporate misinformation strategies [20–24].

S1.2 Sampling strategy

Our units of analysis comprise the relevant, publicly available internal documents that have led to recent allegations against ExxonMobil, as well as all peer-reviewed and non-peer-reviewed documents offered by the company in response. We also include as units of analysis all discovered ExxonMobil advertorials in the *NYT* discussing AGW. These are included because, as discussed in the main text, advertorials are an unequivocally public form of communication and come directly from ExxonMobil, permitting a clear private-versus-public comparison of the company's AGW communications.

S1.3 Coding units

The coding units used by the lead coder are, initially, the complete documents. The lead coder reads each document's abstract, introduction, and conclusion, and either skims or reads thoroughly the rest as necessary. In the case of long documents (over ~30 pages) in which executive summaries were provided, we rely on those summaries. Following Campbell *et al.*, the lead coder then identifies all meaningful units of analysis within each document; namely, content pertaining to AGW [25].

S1.4 Coding scheme development
The primary codes for our content analysis of document types (see section S1.5.1 and S2) are defined so as to reflect the diversity of document types investigated.

The primary codes for our content analysis of document topics (see section S1.5.2 and S3) are based on those defined by Cook *et al.* and Oreskes [26,27]. To those topics we add *Policy, Economics & Miscellaneous Opinions*, reflecting the broader topical focus of the documents investigated here.

The primary codes for our content analysis of document positions on AGW (see sections S1.5.3–1.5.5) are defined along four axes, as discussed in the main text, representing positions on AGW as real, human-caused, serious, and solvable, respectively. We define these axes *a priori* – rather than inductively – because there is a strong observational basis for these delineations in the literature of climate change communication and behavioral science [28–32], and because these four elements have been found to underpin most narratives of AGW skepticism and denial [33–36]. Similar axes have previously been used in content analyses by Feldman *et al.* and by Elsasser and Dunlap [34,37]. The primary codes we use (table 2) are an adapted version of those defined by Cook *et al.* and Feldman *et al.* [26,37]

Once an initial coding scheme (codebook and code form) was developed, it was piloted on a subset of the documents [3]. Iteratively, through case-by-case discussions between authors, the codebook and code form were refined to minimize ambiguities and maximize intracoder reliability (see section S3.6). These refinements included the following:

S1.4.1 Revised codes. Revising the definitions of codes to ensure that they are exhaustive and mutually exclusive.

S1.4.2 Clarified codebook and code form. Tentative words such as "potential," "possible," "may," "could," and "if" appear frequently in the documents analyzed. Their implications are subjective: sometimes they simply acknowledge inevitable scientific uncertainties, other times they serve to cast undue doubt on scientific consensus. To ensure consistent interpretation, we apply two designations to tentative words. First, we designate as reasonable the use of tentative words with regards to AGW as real in documents published on or before 1990. Second, we designate as reasonable the use of tentative words with regards to AGW as human-caused in documents published on or before 1995. As discussed in the main text, these thresholds are consistent with the conclusions of the first and second IPCC reports, respectively. The application of these designations is indicated by a note, "[pre/post-1990/5]", preceding relevant quotations in table S4.

To be clear, tentative wording does not necessarily imply intent to promote doubt or mislead; it is commonplace in academic literature, not least in the IPCC [38]. But accounting for cautious language helps accurately and consistently compare the doubt communicated, intentionally or not, across document categories. Moreover, some of the analyzed documents demonstrate that ExxonMobil's use of tentative wording to emphasize uncertainty was, at least sometimes, intentional. Accounting for their use is therefore important. For example, edits made by Exxon's Henry Shaw to a draft of the 1980 National Commission on Air Quality CO_2 Workshop's "Findings and Recommendations" introduce four instances of tentative wording in two pages [39]. These include inserting "possibly," replacing "almost surely will" with "may," and replacing "potential direct" with "postulated possible." Similarly, some documents use font formatting to emphasize tentative wording: an internal company memo says that "the <u>potential</u> problem is great and urgent" [40] and a non-peer-reviewed Exxon pamphlet refers to "the *potential* for climate change caused by elevated levels of carbon dioxide…." [41]

Note that with the exceptions of the 1990 and 1995 filters described in the main text and above, the definitions in table 2 address whether documents add or detract from a growing consensus, rather than whether they agree with a specific consensus statement. The "Acknowledge" and "Doubt" labels are therefore applicable to documents regardless of their publication year.

As defined in table 2 of the main text, we classify acknowledgments and articulations of AGW's negative impacts as IP1, but generic references to AGW simply as a "risk" (including variants such as "potential risk," "effect," "possibly serious", etc.) as IP2, because the latter are open to subjective interpretation and frequently accompany even documents that obviously promote doubt about the seriousness of AGW. Such instances are indicated by a note, "[generic "risk"]", preceding relevant quotations in table S4. There are a handful of borderline cases that could be interpreted as either weak/imprecise acknowledgments of negative impacts or as generic expressions of risk. It is judged on a case-by-case basis whether each implies any negative consequences or not.

S1.4.3 Adoption of secondary codes. To aid the consistent, systematic assignment of primary codes, secondary codes were adopted. Specifically, because doubt about whether AGW is real, human-caused, serious, and solvable can take many forms and be expressed in many ways, we draw on the method of Elsasser and Dunlap [34] to code content expressing AGW skepticism according to 34 individual arguments – enumerated by SkepticalScience.com – commonly made by climate skeptics, contrarians, and deniers [33]. These 34 arguments are grouped by SkepticalScience.com according to the four axes above[1]. We note that while this detailed taxonomy offers guidelines (section S1.5.3–1.5.5) to help ensure consistent primary codings, it is unnecessarily granular and cognitively burdensome to itself serve as a primary coding scheme [25].

Similarly, to ensure consistent coding of Endorsement Points EP1-3, we used the secondary codes defined by Cook *et al.* [42].

S1.5 Finalized codes
The finalized codes and their guidelines for assignment are as follows:

S1.5.1 Document Type
Type1: *Academic Journal*
Type2: *Conference/Workshop Proceeding*
Type3: *Government Report*
Type4: *Book (or book chapter)*
Type5: *Industry White Paper*
Type6: *Internal Document*
Type7: *Advertorial*
Type8: *Miscellaneous Opinion* (e.g. speech transcripts and opinion articles in journals, newspapers, and company pamphlets)

S1.5.2 Document Topic
Topic1: *Methods & Climate Science*

[1] In fact, SkepticalScience.com delineates 33 individual arguments. We add a 34th argument to the "It's not happening" (AGW as *real*) coding axis; namely, that no global warming has been detected – a (sometimes reasonable) statement that is common particularly in ExxonMobil's internal documents. Otherwise, we follow the groupings laid out by SkepticalScience.com, with one further exception: In our analysis, the "It's not urgent" argument grouped by SkepticalScience.com along the "It's too hard" (AGW as *solvable*) coding axis was regrouped along the "It's not bad" (AGW as *serious*) coding axis.

- Measurements or modeling methods, or discussion of climate science (irrespective of novelty of work or positions on AGW) not included in other topics.
- If a paper describes methods but no actual results, assign it to *Methods & Climate Science*. If it goes on to results, then assign it to whatever the results are relevant to (e.g. *Impacts*, *Mitigation*, *Paleoclimate*).

Topic2: *Impacts*

- Effects or impacts of climate change on the environment, ecosystems or humanity.

Topic3: *Mitigation*

- Ways to lower CO_2 emissions or atmospheric CO_2 levels or mitigate global warming, including applied modeling (e.g. of emissions scenarios, technological/economic/emission-reduction potential of different mitigation strategies, etc.) and lifecycle analysis. Does not need to explicitly mention AGW.
- Discussion of carbon cycles, unless explicitly related to carbon sequestration, should be coded as *Methods & Climate Science*.
- For discussion of policies/economics: if the goal of such discussions is to help reduce emissions/CO_2 levels/global warming (e.g. by improving a mitigation strategy), code as *Mitigation*; if focus is otherwise on policies/economics, code as *Policy, Economics & Miscellaneous Opinions*.

Topic4: *Paleoclimate*

- Examines climate in periods predating the instrumental period (~1750).

Topic5: *Policy, Economics & Miscellaneous Opinions*

- Policies, politics, laws, economic forecasts (e.g. dire economic projections concerning climate policies), financial matters, and other miscellaneous non-science/technology aspects of AGW not relevant to the other topics.

S1.5.3 Document Position – AGW as Real & Human-Caused

EP1: *Explicit Endorsement with quantification*

- Supports the position that human activity is a dominant influence or has caused most of recent global warming (>50%).
- Must implicitly (by endorsing human contribution to AGW) or explicitly acknowledge the *reality* of global warming, otherwise code as EP4b-1.

EP2: *Explicit Endorsement without quantification*

- Mentions *anthropogenic global warming* or *anthropogenic climate change* as a given fact.
- Mention of increased CO_2 leading to higher temperatures without including "anthropogenic" or reference to human influence/activity relegates to EP3a.
- Must implicitly (by endorsing human contribution to AGW) or explicitly acknowledge the *reality* of global warming, otherwise code as EP4b-1.

EP3a: *Implicit Endorsement*

- Mitigation papers that examine GHG emission reduction or carbon sequestration, linking it to climate change.
- Climate modeling papers that discuss emission scenarios and subsequent warming or other climate impacts from increased CO_2 in the abstract implicitly endorse that GHGs cause warming.
- Paleoclimate papers that link CO_2 to climate change.
- Papers about climate policy (specifically mitigation of GHG emissions) unless they restrict their focus to non-GHG issues like CFC emissions, in which case EP4a.
- Modeling of increased CO_2 effect on regional temperature – not explicitly saying global warming but implying warming from CO_2.
- Must implicitly (by endorsing human contribution to AGW) or explicitly acknowledge the *reality* of global warming, otherwise code as EP4b-1.

EP3b: *Implicit endorsement of consensus*

- Acknowledgment or reference to "consensus", "agreement among most scientists", or equivalent that climate change is primarily human-caused.
- Must implicitly (by endorsing human contribution to AGW) or explicitly acknowledge the *reality* of global warming, otherwise code as EP4b-1.

EP4a: *No position*

- If a paper merely mentions *global climate change* or *global warming*, this is not sufficient to imply endorsement.
- If a paper merely acknowledges the *reality* of global warming, this is not sufficient to imply endorsement. If it challenges the reality of global warming, code as EP4b-1.
- Mitigation papers talking about non-GHG pollutants are not about AGW.
- Research into the direct effect of CO_2 on plant growth without including the warming effect of CO_2.
- Anthropogenic impact studies about direct human influence like urban heat island and land use changes (e.g. not about GHG emissions).
- Research into metrics of climate change (surface temperature, sea level rise) without mention of causation (e.g. GHGs).

EP4b-1: *Uncertain of reality of AGW*

- Explicitly or implicitly questions whether global warming is occurring, including by suggesting one or more of [33]:
  - Temperature record is unreliable
  - No warming detected
  - It's cooling
  - Ice isn't melting
  - Climategate CRU emails suggest conspiracy
  - Sea level rise is exaggerated
  - There is no consensus
  - Springs aren't advancing
  - Melting ice isn't warming the Arctic

EP4b-2: *Uncertain of human contribution to AGW*

- Explicitly or implicitly questions whether humans are the primary cause of global warming, including by suggesting one or more of [33]:
  - There's no empirical evidence
  - Increasing CO_2 has little to no effect
  - Climate has changed before
  - There's no correlation between CO_2 and temperature
  - It's the sun
  - Other planets are warming
  - CO_2 is not the only driver of climate
  - It's the ocean
  - Humans are too insignificant to affect global climate
  - Models are unreliable
  - Extreme weather isn't caused by global warming
  - Mt. Kilimanjaro's ice loss is due to land use
  - Nuclear testing is causing global warming

S1.5.4 Document Position – AGW as Serious

IP1: *Acknowledgment that AGW is serious*

- Acknowledges and/or articulates known or predicted negative impacts of global warming e.g. geophysical, economic, socio-political.

- Generic references to AGW simply as a "risk" (including variants such as "potential risk," "effect," "possibly serious", etc.) are IP2.

IP2: *No position on AGW as serious*

- Does not address the negative impacts of global warming (beyond generic references to climate change as a "risk").

IP3: *Uncertain that AGW is serious*

- Explicitly or implicitly claims that the reality of negative impacts of global warming is uncertain/undefined/exaggerated, including by suggesting one or more of [33]:
  - Climate sensitivity is low
  - Animals and plants can adapt
  - Greenland ice sheet won't collapse
  - CO_2 is not a pollutant
  - Sea level rise predictions are exaggerated
  - Greenland has only lost a tiny fraction of its ice mass
  - It's only a few degrees
  - It's not urgent

S1.5.5 Document Position – AGW as Solvable

SP1: *Uncertain that AGW is solvable*

- Explicitly or implicitly argues that the difficulties of mitigating global warming are potentially insurmountable and/or exceed the benefits, including by suggesting one or more of [33]:
  - CO_2 limits will harm the economy
  - CO_2 limits will hurt the poor
  - CO_2 limits will make little difference
  - Renewables can't provide baseload power

S1.5.6 Stranded Fossil Fuel Assets

Assets1: *Alludes to stranded fossil fuel assets*

- Implicit, qualitative connections between fossil fuel reserves/resources/use and either greenhouse gas limits or possible climate mitigation policies.
- Explicit quantifications of "cumulative emissions" and/or "carbon budgets" consistent with greenhouse gas stabilization.

S1.6 Coding

With the coding scheme finalized, one of the authors coded all of the documents, and ambiguities were resolved through discussion between authors. Codings for all 187 documents are reported in sections S5, S7, and S8. There are several reasons for a single coder approach, including resource limitations, the high intercoder reliability, intercoder agreement, and intracoder reliability of our content analyses (see section S1.7), our reporting of all codings (sections S5, S7, and S8), and the recognition of this method by, for example, Burla *et al.* (2008), Campbell *et al*. (2013), and Katz-Kimchi *et al.* (2015) [25,43,44].

S1.7 Reliability and agreement testing

To verify intercoder reliability, two coders (for document position and stranded assets – the two authors; for document type and topic – the lead coder and a graduate student) independently coded a random subset of 36 documents (approximately 19% of the total number of documents in each category). In the main text we report intercoder reliability in terms of percentage agreement and Krippendorff's α coefficient for each variable, calculated using ReCal2 online software [45–47]. Through "negotiated agreement" of discrepancies between coders, intercoder agreement was then calculated [25].

To assess the lead coder's coding stability over time, intracoder reliability was likewise calculated in terms of percentage agreement and Krippendorff's α [3]. The lead coder coded a random subset of 36 documents (distinct from the 36 above) at two points in time roughly two months apart, and changes in coding were identified.

Table S1 summarizes all reliability and agreement test results.

Table S1. Intercoder reliability, intercoder agreement, and intracoder reliability test results for each variable coded by content analysis, in terms of percentage agreement and Krippendorff's α coefficient.

	Intercoder Reliability		Intercoder Agreement		Intracoder Reliability	
Variable	%	Kripp. α	%	Kripp. α	%	Kripp. α
Document Type	87	0.81	87	0.81	–	–
Document Topic	83	0.76	94	0.92	–	–
Endorsement Points	93	0.84	98	0.96	99	0.98
Endorsement Levels	89	0.85	97	0.96	97	0.96
Impact Points	94	0.86	100	1.0	98	0.96
Impact Levels	89	0.77	100	1.0	97	0.94
Solvable Levels	97	0.84	100	1.0	97	0.90
Stranded Assets	100	1.0	100	1.0	97	0.84

S2. Document Types

As outlined in section S1.5.1, we characterize each document as one of eight types: *Academic Journal*; *Conference/Workshop Proceeding*; *Government Report*; *Book (or book chapter)*; *Industry White Paper*; *Internal Document*; *Advertorial*; and *Miscellaneous Opinion* (intercoder reliability: 87%; Kripp. $\alpha = 0.81$). Results of document sources and types are summarized in table 1 of the main text, and codings of all documents are provided in section S8.

50 of the 53 documents labeled "Peer-Reviewed Publications" by ExxonMobil are found to be peer-reviewed. Combined with the 19 "Additional Publications" verified to be peer-reviewed (of a total of 48 unique and retrievable documents) and 3 peer-reviewed publications found by us ("Other"), we identify a total of 72 peer-reviewed documents. 53 of these are academic journal publications. The remainder are mostly government reports (13, including several chapters from Intergovernmental Panel on Climate Change reports) and book chapters (4). The 47 non-peer-reviewed documents comprise 3 of the "Peer-Reviewed Publications" from ExxonMobil, 29 of the "Additional Publications", and 15 documents found by us or made public by *InsideClimate News*. The majority of these documents are conference reports/proceedings (24) or miscellaneous/opinion speeches, opinion articles, etc. (13). The remainder (5) are contributions to government reports; for example, industry essays and comments on draft reports.

S3. Document Topics

As defined in section S1.5.2, we distinguish between communications focused on *Methods & Climate Science*, *Impacts*, *Mitigation*, *Paleoclimate* and *Policy, Economics & Miscellaneous*

Opinions (intercoder reliability: 83%; Kripp. $\alpha = 0.76$, see section S8 for codings of all documents). For documents with multiple themes, the coder judges its primary focus [26].

Peer-reviewed publications focus almost exclusively on *Methods & Climate Science* (29/72) and *Mitigation* (38/72), transitioning from the former to the latter over time (figure S1a). ExxonMobil's *Methods & Climate Science* research involved highly technical fundamental and applied climate science. Researchers focused on modeling the global carbon cycle, and especially on the role of carbon uptake by oceans. One 2003 paper describes its goal to "close the global carbon budget" by "constraining the oceanic CO_2 sink." [48] Other work investigates global heat exchange, temperature/climatic responses, and the anthropogenic contribution to global warming. *Mitigation* research touches on a large number of technologies and strategies, but mostly in a cursory manner. The exceptions are ocean storage of carbon dioxide (via deep ocean injection or ocean neutralization) and carbon, capture, and sequestration. *Methods & Climate Science* and *Mitigation* research therefore complement one another. ExxonMobil scientist and spokesman, Brian Flannery, affirmed this at an academic workshop: "We [ExxonMobil scientists] have paid particular attention to questions of carbon sequestration and the carbon cycle." [49]

Non-peer-reviewed communications are dominated by *Mitigation* (30/47) discussion of a similar sort (figure S1b). *Methods & Climate Science* and (unlike peer-reviewed papers) *Policy, Economics & Miscellaneous Opinions* receive roughly equal attention (8/47 and 7/47, respectively).

The main topics of internal documents are a concurrent combination of *Methods & Climate Science* (12/32) and *Policy, Economics & Miscellaneous Opinions* (12/32) (figure S1c). The former summarize the positions of the scientific community, including ExxonMobil scientists. *Policy, Economics & Miscellaneous Opinions* comprise a diverse mixture of business and research strategy discussions, political and economic commentaries, and other opinions.

Advertorials are dominated by *Policy, Economics & Miscellaneous Opinions* (20/36), which rose rapidly in the run up to the 1997 United Nations Kyoto summit on climate change (figure S1d). Coverage of other topics, *Mitigation* (11/36) and *Methods & Climate Science* (5/36), grew after 1997.

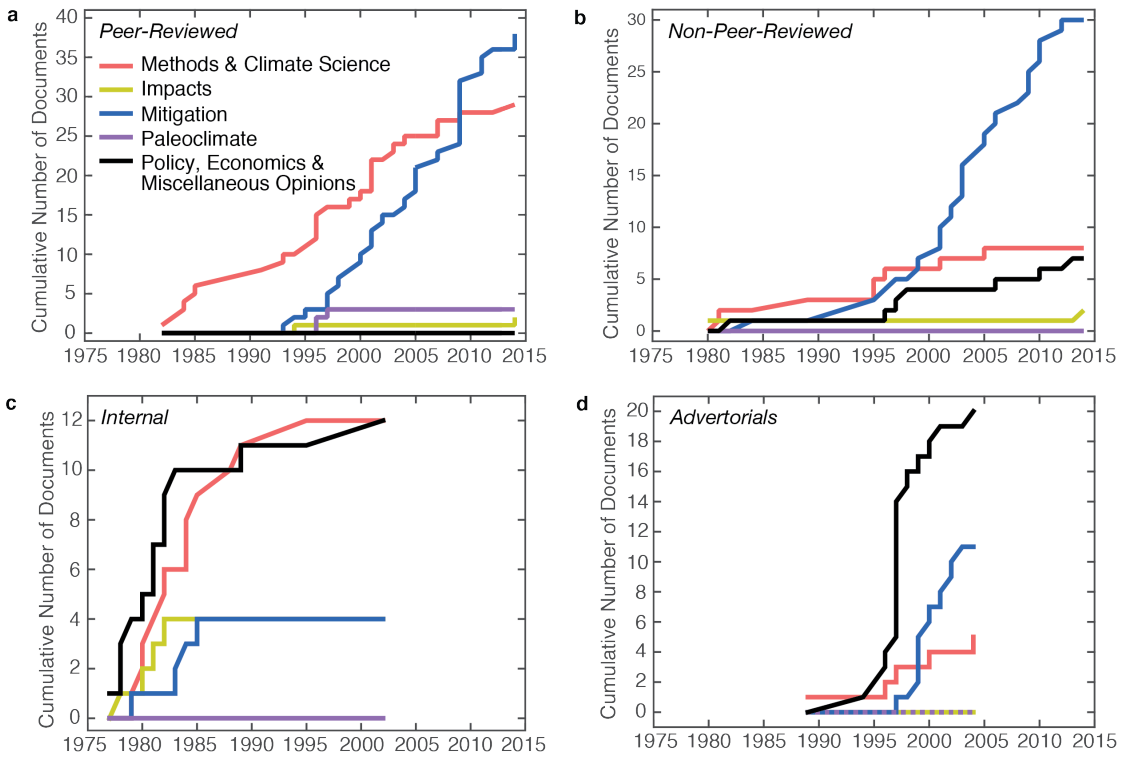


Figure S1. Cumulative number of (a) peer-reviewed publications, (b) non-peer-reviewed publications, (c) internal documents, and (d) advertorials focused on each of five topics: *Methods & Climate Science*; *Impacts*; *Mitigation*; *Paleoclimate*; and *Policy, Economics & Miscellaneous Opinions*.

S4. Figure 2 re-plotted, based only on documents with overlapping publication periods
As described in the main text (section 3.1), figure 2 is based on all documents in figure 1. In figure S2, we re-plot figure 2 using only peer-reviewed publications, non-peer-reviewed publications, and advertorials with the overlapping publication period 1989-2004. Since most of the internal documents analyzed were published before this period, all internal documents (1977-2002) are included in figure S2. The trends in Figures 2 and S2 are consistent.

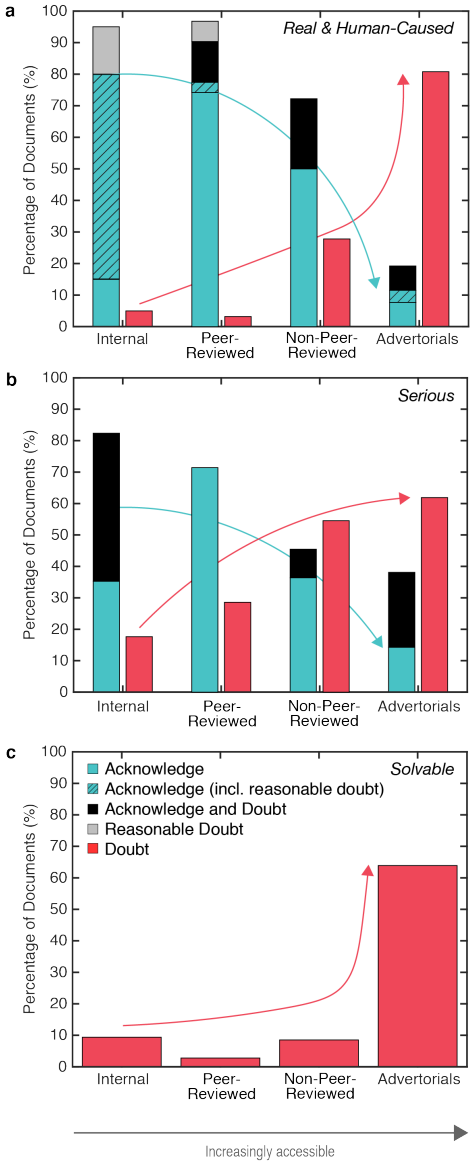


Figure S2. Percentage of documents taking each overall position on AGW as (a) real and human-caused, (b) serious, and (c) solvable. For each document category and for all included documents that express a position in figure 1, the cumulative fractions of documents taking that position are shown. The included documents are: peer-reviewed publications, non-peer-reviewed publications, and advertorials published between 1989 and 2004; and all internal documents (published between 1977 and 2002). The trends observed are consistent with those in figure 2, in which documents of all publication years are included.

S5. Quotations from all documents alluding to stranded fossil fuel assets

Table S2. Quotations (coding units) from all 24 documents alluding to stranded fossil fuel assets: 7 peer-reviewed publications, 10 non-peer-reviewed publications, and 7 internal documents. No advertorials address the issue. A seventh peer-reviewed publication is tabulated, labeled [a], whose authors were not ExxonMobil employees at the time of publication. As described in the main text (Discussion section), co-author Andrew Callegari joined Exxon a few months later and his work was frequently cited in company publications. Asterisks indicate explicit quantifications of "cumulative emissions" and/or "carbon budgets" consistent with greenhouse gas stabilization, as defined in the main text. These quantitative examples are comparable to contemporary estimates; specifically, the IPCC indicates a carbon budget of 442 GtC (or 651 GtC) between 2015 and 2100 for limiting CO_2-induced AGW to below 2 °C relative to 1861-1880 with a probability greater than 66% (or 50%) [50].

INTERNAL	**1977** [51]	"Present thinking holds that man has a time window of five to ten years before the need for hard decisions regarding changes in energy strategies might become critical." Vugraphs show that rapid growth in fossil fuel use will lead to 4 to 5 times as much CO_2 in the atmosphere, and that this would likely lead to substantial climatic effects (such as a global temperature increase, sea level rise, etc.). Vugraphs also show that rapid fossil fuel use curtailment would be necessary to limit CO_2 levels such that climate effects would be less likely. These vugraphs therefore join the dots between fossil fuel burning and climate change and its potential climate impacts.
	1979 [40]	"The major conclusion from this report is that, should it be deemed necessary to maintain atmospheric CO_2 levels to prevent significant climatic changes, dramatic changes in patterns of energy use would be required. World fossil fuel resources other than oil and gas could never be used to an appreciable extent...Removal of CO_2 from flue gases does not appear practical due to economics and lack of reasonable disposal method. If it becomes necessary to limit future CO_2 emissions without practical removal/disposal methods, coal and possibly other fossil fuel resources could not be utilized to an appreciable extent." * "The fossil fuel resource is very large compared to the quantity of carbon in the atmosphere. Therefore, if one half of the CO_2 released by combustion of fossil fuels remains in the atmosphere, only about 20% of the recoverable fossil fuel could be used before doubling the atmospheric CO_2 content."
	1981 [52]	"If this indeed turns out to be the case, it is very likely that we will unambiguously recognize the threat by the year 2000 because of advances in climate modeling and the beginning of real experimental confirmation of the CO_2 effect. The effects of such a recognition on subsequent fossil fuel combustion are unpredictable, but one can say that predictions based only on our knowledge of availability and economics become hazardous."
	1981 [53]	"Legislation Related to CO_2 Controls. There is no near term threat of legislation to control CO_2. One reason for this is that it has not yet been proven that the increases in atmospheric CO_2 constitute a serious problem that requires immediate action. In addition, even if some action were to be taken, the options for reducing CO_2 build-up in the atmosphere are relatively limited. It has been shown, for example, that the cost of scrubbing large quantities of CO_2 from flue gases is exorbitant. Indirect control measures, such as energy conservation or shifting to renewable energy sources, represent the only options that might make sense."
	1982 [54]	"Mitigation of the "greenhouse effect" would require major reductions in fossil fuel combustion." On an MIT study: "The CO_2 problem was considered as the major potential constraint on fossil fuel use. It was estimated in the study that the CO_2 problem may curtail fossil fuel use before physical depletion occurs...The study appears to be based on reasonable assumptions but has an inherent bias towards the accelerated development of non-fossil energy sources..." * "Table 4 presents the estimated total quantities of CO_2 emitted to the environment as GtC, the growth of CO_2 in the atmosphere in ppm (v), and average global temperature increase in °C over 1979 as the base year." (Note that temperate anomalies appear to be calculated based on equilibrium climate sensitivity.) It also shows "cumulative" CO_2 "emitted, GtC" as a function of time. Given roughly 0.3 °C warming by 1979 relative to 1861-1880, we read off (by interpolation) the cumulative emissions in Table 4 (of ref. [54]) corresponding to a further 1.7 °C warming, yielding a carbon budget for <2 °C of 624 GtC. Adjusting for emissions between 1979 and 2015, we obtain a carbon budget for <2 °C of 373 GtC between 2015 and 2100, which is comparable with contemporary estimates of roughly 442-651 GtC (see caption).
	1984 [55]	"Society must carefully study the problem in order to establish a desirable course of action. We can either adapt our civilization to a warmer planet or avoid the problem by sharply curtailing the use of

		fossil fuels. The general consensus is that society has sufficient time to technologically adapt to a CO_2 greenhouse effect."
	1989 [56]	"["Strategies to limit CO_2 growth"] would have substantial impact on society and our industry - near term from reduced demand for current products, long term from transition to entirely new energy systems. Obviously, the issue directly affects Exxon's long-term planning including many R&D programs." "Impacts on Exxon will come sooner from society's efforts to reduce potential risks from climate change than from change itself." "Recognizing the potential for such responses to alter profoundly the strategic direction of the energy industry..." "While uncertainty exists, science supports the basic idea that man's actions pose a serious potential threat to climate. Efforts to minimize that risk will influence the future direction of the energy industry."
PEER-REVIEWED	**1979** [57]	*[a] "It has become clear, however, that the global fossil fuel reserve, estimated to contain more than ten times the amount of carbon which exists as CO_2 in today's atmosphere, could raise the current concentrations of atmospheric CO_2 by large factors if burned, and that this enhancement of CO_2 could have serious climatic consequences by virtue of the tropospheric warming...Consider the situation if a significant fraction of the fossil fuel reserve is burned. Siegenthaler and Oeschger (1978) have recently computed that a 100% injection of CO_2 into the atmosphere, as the entire fossil fuel reserve is depleted as a logistic function of time, could create peak levels as high as 2800 ppm. The corresponding temperature increase is roughly 8 K, a climatically huge value comparable to the peak-to-trough variations from ice ages to warm periods of major climate cycles in the paleoclimatic record. The situation is potentially of importance to the long-term development of the planetary ecology..."
	1985 [58]	"More complex scenarios...can be envisioned in which fossil fuel use is rapidly phased out by taxing or other policies, or in which fossil fuel use is decreased by societal feedbacks based on observations of global warming."
	1999 [59]	"The stabilization of CO_2 concentration below current levels is expected to require extreme reductions (or the creation of net CO_2 sinks) in CO_2 emissions, and the stabilization of CO_2 concentration at any level will require eventual reduction of net fossil CO_2 emissions to a fraction of a Gt C yr^{-1}."
	2000 [60]	"This review examines the role that fuels from renewable biomass might play as a strategic option to address concerns of climate change by replacing fossil fuels, and thus the CO_2 that is emitted when they are used...This review focuses on the potential scale of biomass as a substitute for fossil fuels in order to offset CO_2 emissions, particularly on the role of biomass as a substitute for petroleum-based transportation fuels...We do not focus on the potential near-term commercial viability of biomass but envision that public policy factors might influence the penetration of biofuels if, for example, concern about global climate change leads to policies to limit atmospheric emissions of carbon dioxide."
	2001 [61]	"Even for the higher stabilization levels considered, the developing world would not be able to use fossil fuels for their development in the manner that the developed world has used them."
	2003 [62]	* Fig. 9 (of ref. [62]) shows that temperature anomalies of less than or equal to 2 °C (note that these appear to be calculated based on equilibrium climate sensitivity) are consistent with CO_2 stabilization at concentrations of 450 ppm or 550 ppm. Table 3 (of ref. [62]) explicitly quantifies fossil fuel "carbon budgets...for CO_2 stabilization" at these concentrations, with reference values of 485 GtC (450 ppm scenario) and 820 GtC (550 ppm scenario) between 2000 and 2099. Adjusting for emissions between 2000 and 2015, this yields carbon budgets for <2 °C of 357 GtC and 692 GtC, respectively, between 2015 and 2100, which are comparable with contemporary estimates of roughly 442-651 GtC (see caption).
	2004 [63]	* Author introduces the idea of "cumulative fossil fuel use" and "cumulative CO_2 emissions." Fig. 3 (of ref. [63]) shows that a "550 ppm stabilization trajectory" requires a rapid decline in annual CO_2 emissions, with cumulative emissions between 2015 and 2100 (integrating area beneath curve) of roughly 490 GtC. This is comparable to contemporary carbon budget estimates for <2 °C of roughly 442-651 GtC (see caption). Author also notes that "cumulative fossil fuel use of 2000 Gt C might not exhaust global fossil fuel reserves, but limits to fossil fuel use might be driven by better alternatives that emerge over the next century." He refers to "notional scenarios for a fossil fuel era of limited duration."
	2005 [64]	* "Equilibrium [CO_2] concentration level...depends only on the cumulative CO_2 emissions and the cumulative carbon uptake by oceans." Table 1 (of ref. [64]) indicates carbon budgets through 2100 (presumably since 2003, the manuscript's submission year) of 358 GtC (for 359 ppm CO_2 in 2100), 595 GtC (for 450 ppm CO_2 in 2100), and 823 GtC (for 541 ppm CO_2 in 2100). Adjusting for emissions between 2005 and 2015, this yields carbon budgets of 251 GtC, 488 GtC, and 716 GtC, respectively, between 2015 and 2100, which are comparable with contemporary estimates for <2 °C of roughly 442-651 GtC (see caption). Authors use an equilibrium climate sensitivity of 2.5 °C for CO_2 doubling.

NON-PEER-REVIEWED	**1980** [39]	"...it has been estimated that the amount of carbon stored in the fossil fuels/shale reservoir and in forests (including their soils) represents approximately seven and three, respectively, the amount held in the atmosphere."
	1984 [65]	"Few people doubt that the world has entered an energy transition away from dependence upon fossil fuels and toward some mix of renewable resources that will not pose problems of CO_2 accumulation...since fossil fuels, and liquid chemical fuels, are really the heart of the energy and the CO_2 problem, I will focus on those."
	1989 [66]	Author lays out a detailed fossil fuel burning scenario that "represent[s] a case where emissions exhaust roughly the world's supply of recoverable fossil fuels." This is then input into a model that produces "projected atmospheric CO_2 " (see Figs. 2a-b. of ref. [66])
	1997 [67]	"The question is whether we can continue to use fossil fuels but ensure that carbon byproducts end up other than in the atmosphere as CO_2."
	2003 [68]	"Existing technologies can contribute to global warming mitigation. However, projected levels of emission-free power needed later this century to stabilize climate change appear to be so unprecedented that it would be foolhardy not to assess a broad spectrum of advanced energy sources, converters, and enabling technologies." "...a 2 °C warming target (which can still produce adverse climate impacts) requires non-CO_2-emitting primary power in the 10 to 30 TW range by 2050." "...holding global warming to <2 °C requires 10 to 30 TW emission-free power in 50 years for plausible economic growth, regardless of power sources."
	2003 [69]	* Author introduces the idea of “cumulative fossil fuel use” and “cumulative CO_2 emissions.” Fig. 3 (of ref. [69]) shows that a “550 ppm stabilization trajectory” requires a rapid decline in annual CO_2 emissions, with cumulative emissions between 2015 and 2100 (integrating area beneath curve) of roughly 490 GtC. This is comparable to contemporary carbon budget estimates for <2 °C of roughly 442-651 GtC (see caption). Author also notes that "cumulative fossil fuel use of 2000 Gt C might not exhaust global fossil fuel reserves, but limits to fossil fuel use might be driven by better alternatives that emerge over the next century." He refers to "notional scenarios for a fossil fuel era of limited duration."
	2005 [70]	"If the concentration of CO_2 in the atmosphere were to be limited to an as-of-yet-undetermined level, then cumulative global CO_2 emissions would ultimately also have to be limited as well."
	2005 [71]	"...stabilizing at 550ppm would require a phase out in the use of fossil fuels by the middle of the century in the Annex I countries. That's a huge step."
	2006 [72]	Summary of presentations given at SPE CCS workshop: "The “lock in” of coal-based electricity generation capacity was at the center of the environmental NGO presentation by D. Hawkins (NRDC)."
	2006 [73]	"If the concentration of CO_2 in the atmosphere were to be limited to an as-of-yet-undetermined level, then cumulative global CO_2 emissions would ultimately also have to be limited as well."

S6. Comparing non-peer-reviewed and internal documents to peer-reviewed publications
Although the contrast is greatest between advertorials and all other documents, non-peer-reviewed and internal documents also contain somewhat more mixed messaging than peer-reviewed documents on AGW as real and human-caused, serious, and solvable (figure 2). (The significance of these differences varies considerably; Fisher's exact test results for all combinations are shown in table S3.)

These trends reflect two competing features of non-peer-reviewed and internal documents: (i) balanced scientific discussions about understandings and uncertainties; and (ii) strategy/business discussions that tend to prioritize uncertainties. These dual interests – science and business – are reflected in the concurrence of topics that the documents focus on (figure S1b,c): *Mitigation* and *Methods & Climate Science* alongside *Policy, Economics & Miscellaneous Opinions* in non-peer-reviewed publications; and *Methods & Climate Science* alongside *Policy, Economics, & Miscellaneous Opinions* in internal documents. This tension is exemplified by a 1996 internal report from Mobil's Leonard Bernstein to an advocacy group of the fossil fuel industry, which argues that the conclusion of Chapter 8 of the IPCC's second report ("that there is a discernable human influence on global climate") "goes beyond what can be justified by current scientific knowledge" and "is not right." [74] Likewise, a 1998 non-peer-reviewed ExxonMobil pamphlet, whose preface was written by then CEO Lee Raymond, stated that the IPCC's "discernible human influence" conclusion was "not peer-reviewed" (though it was) [41,75]. This was despite the fact that ExxonMobil's chief climate researcher, Haroon Kheshgi, was a contributing author to the IPCC chapter in question.

Table S3. Fisher's exact test results for all combinations of document categories. In each cell, probability values are given with respect to: (first row) Endorsement Levels; (second row) Impact Levels; (third row) Solvable Levels; and (fourth row) stranded assets discussions. Greyed cells indicate duplicate values. In Fisher's exact tests of Endorsement Level statistics, we bin document positions into three groups: (1) "Acknowledge" and "Acknowledge (including reasonable doubt)"; (2) "Acknowledge and Doubt"; and (3) "Doubt". We omit documents expressing only "Reasonable Doubt". In tests of Impact Level statistics, we use original document positions: (1) "Acknowledge"; (2) "Acknowledge and Doubt"; and (3) "Doubt". In tests of Solvable Level statistics, we use two groups: (1) "Doubt" and (2) no "Doubt". In tests of stranded assets discussions, we use two groups: (1) discussed and (2) not discussed.

	Peer-Reviewed	Non-Peer-Reviewed	Internal Documents	Advertorials	All
Peer-Reviewed	—	0.044 0.87 0.0065 0.11	0.27 0.20 0.17 0.12	4.1×10^{-13} 0.045 2.8×10^{-12} 0.093	—
Non-Peer-Reviewed		—	0.077 0.23 0.34 1.0	1.2×10^{-6} 0.10 4.2×10^{-5} 0.0041	—
Internal Documents			—	6.5×10^{-8} 0.35 3.7×10^{-6} 0.0035	—
Advertorials				—	—
All	—	—	—	—	3.7×10^{-13} 0.11 3.4×10^{-12} 0.0042

S7. Catalog of documents and their coded Endorsement, Impact, and Solvable Points

All analyzed *advertorials* can be downloaded at: https://perma.cc/8XHW-5GZE.

All analyzed *internal documents* can be downloaded at one (or more) of: (ExxonMobil) https://perma.cc/D862-KB2N; (*InsideClimate News*) https://perma.cc/26Q3-FL6F; (Other) https://perma.cc/YWD4-UFVN.

Most analyzed *peer-reviewed documents* are cited in full by ExxonMobil: https://perma.cc/3QEV-KLFP.
Exceptions are references [76–78].

Most analyzed *non-peer reviewed documents* are cited in full by ExxonMobil: https://perma.cc/3QEV-KLFP.
Exceptions are references [39,41,65,79–90].

Table S4. Catalog of all 187 documents analyzed, sorted by publication year and into document categories: peer-reviewed publications, non-peer-reviewed publications, internal documents, and advertorials. Coded Endorsement (EP), Impact (EP), and Solvable (EP) Points are indicated by "1" (see Method section and table 2 of the main text for definitions), and substantiating quotations (coding units) are provided beneath each citation. See section S1.4.2 for explanations of the "[pre/post-1990/5]" and "[generic "risk"]" notes that precede some quotations.

Peer-Reviewed Documents

Year	Authors	Title	Journal	Conference	EP1	EP2	EP3a	EP3b	EP4a	EP4b-1	EP4b-2	IP1	IP2	IP3	SP1
1982	Garvey, E. A., Prahl, F., Nazimek, K., Shaw, H.	Exxon global CO_2 measurement system	IEEE Transactions on Instrumentation and Measurement	N/A		1							1		

EP2: "Many scientists have expressed concern over the recent observed growth of atmospheric carbon dioxide (CO_2) [1], [2]..."N2O and CH4...are "greenhouse" gases capable of producing climatic change similar to CO_2. Some scientists believe the atmospheric concentration of these gases are increasing via man-made sources and thus should be monitored." This, combined with the fact that references 1 and 2 are explicitly about human-caused growth in atmospheric CO_2, imply acknowledgment of human-induced "climatic change."

IP2: No position

1983	Hoffert, M.I., Flannery, B. P., Callegari, A. J., Hseih, C. T., Wiscombe, W.	Evaporation-limited tropical temperatures as a constraint on climate	Journals of the Atmospheric Sciences	N/A			1						1		

		sensitivity			

EP3a: Context is key to this paper. Paper does not explicitly mention fossil fuels or human-emissions. But, it is focused on refuting the claims of a specific paper by Newell (1979), "Questions concerning the possible influence of anthropogenic CO_2 on atmospheric temperature", which is itself focused on the proposed AGW. Thus, although Flannery et al. don't explicitly mention fossil fuels, they are clearly referring to the AGW theory when they corroborate the scientific community's critique/objection to Newell and Dopplick (1979)'s lower AGW projection. "Global warming from atmospheric carbon dioxide increases" is taken as given, citing Newell, whose work was explicitly focused on AGW. The authors use Hoffert's 1980 work (Hoffert is one of authors of this paper) on "logarithmic scaling of carbon dioxide doubling estimates" to estimate "corresponding...greenhouse warming of 7-9 K."

IP2: No position

1984	Flannery, B. P.	Energy balance models incorporating transport of thermal and latent energy	Journals of the Atmospheric Sciences	N/A	

EP3b: Authors use climate sensitivity of 3 +/- 1.5 K, which they call the "consensus" value: "We examine climate sensitivity to variations in solar constant and the concentration of atmospheric CO_2..." Authors use "a term logarithmically dependent on the concentration of CO_2 (Hoffert et al. 1980): I [infrared radiation] = $A + BT + C\ln[F(CO_2)]$. We assigned a value to C that corresponds roughly with "consensus" values for the increase in global mean temperature expected to arise from doubled CO_2, i.e. dT = 3 +/- 1.5 K (NRC, 1982)."

EP3a: Citation and application of NRC 1982 and Hoffert 1980 results of climate sensitivity (due to AGW) are implicit acknowledgment of AGW.

IP2: No position

1984	Flannery, B. P., Callegari, A. J., Hoffert M. I.	Energy balance models incorporating evaporative buffering of equatorial thermal response	Climate Processes and Climate Sensitivity, Geophysical Monograph Series	N/A	

EP3a/b: "Here we extend the TEC model to the case of forcing by changes in the concentration of atmospheric CO_2." They follow Hoffert et al. (1980) in "includ[ing] a logarithmic dependence on the atmospheric concentration of CO_2 relative to its present value, and we adjust C to agree with consensus values for global mean temperature rise from CO_2 doubling, d<T> = 2.5 K."

EP3a: Context is key to this paper. Paper does not explicitly mention fossil fuels or human-emissions. But, it is focused on refuting the claims of a specific paper by Newell (1979, "Questions concerning the possible influence of anthropogenic CO_2 on atmospheric temperature"), which is itself focused on the proposed AGW. Thus, although Flannery et al don't explicitly mention fossil fuels, they are clearly referring to the AGW theory when they corroborate the scientific community's critique/objection to Newell and Dopplick (1979)'s lower AGW projection, showing that it "it not justified when its global consequences are considered."

EP3a: They run different models and compare results to CO_2 forcing: "Note that, for CO_2 doubling, all models produce a rise in global mean temperature of about 2.5 K, as tuned by the choice of C in the parameterization of CO_2 effects, Eq. (4)."

IP2: No position

1985	Hoffert, M. I., Flannery, B. P.	Model Projections of the Time-Dependent Response to Increasing Carbon Dioxide	Projecting the Climatic Effects of Increasing Carbon Dioxide, United States Department of Energy	N/A	

EP3a: Authors discuss locked-in climate effect: "for some scenarios of fossil fuel use in which CO_2 emissions are drastically cut back early in the next century, it is possible for global warming to continue beyond the point of emission cutoff as a result of the nonequilibrium transient."

EP3a/b: Authors use a climate sensitivity of 2.5 °C and note that it is in agreement with NRC's 3 +/- 1 °C.

EP3a: In Fig. 5.6, authors use different future CO_2 emissions scenarios to simulate equilibrium temperature rise, showing 2-6 °C rise by 2100. They are sure to emphasise uncertainties and simplicity of their model, yet note that "the qualitiative conclusions of this analysis, however, apparently carry over to numerical models that include these [complicating] effects."

EP2: Authors note the irreversibility (on meaningful timescales) of climate effects: "the (warming) fossil fuel CO_2 in the atmosphere would remain at elevated levels for the thousands of years needed for mixing and reequilibration with the deep oceans. If a significant fraction of the fossil fuel reserve is burned, then even after the reequilibration with the oceans, the atmospheric CO_2 concentration would not return to its preindustrial level, but would remain at an elevated concentration associated with a new (higher) atmosphere-ocean buffer factor."

EP2: Authors note the "plausible, but still speculative, mitigating strategy" of "intentionally seed[ing] the stratosphere with a reflecting aerosol layer from high-altitude aircraft to compensate for CO_2 and trace gas warming."

EP2: Authors are "not very convinc[ed]" by "the argument by some authors (a minority) that a major driver of planetary cooling is anthropogenic aerosol particles produced by industrial activity, which compensates for, and may even overwhelm, the fossil-fuel CO_2 greenhouse warming."

EP2/3b: Authors identify it to be "important in confronting the CO_2 climate problem to ask: How, according to these models, is the change in global mean surface air temp likely to vary with projected increases in the atmospheric CO_2 concentration? How, moreover, are these predictions affected by the uncertainties in climate sensitivity that are evident in present GCMs?" They model future temperatures for different CO_2 forcing scenarios (Fig. 5.16), showing a range of 1.5-6 °C warming by 2100. "The foregoing results, with all their caveats, can be construed as an approximate bracketing of the consensus of transient model predictions for the next century's CO_2 greenhouse effect. In this restricted sense, they are consistent with the EPA's estimate of a 2 °C warming from fossil fuel CO_2 and other GHG by the middle of the next century. More complex scenarios than the reference one of Wuebbles et al. can be envisioned in which fossil fuel use is rapidly phased out by taxing or other policies, or in which fossil fuel use is decreased by societal feedbacks based on observations of global warming."

EP2/3b/4b-2: Conclusion: "Consensus CO_2 Warming: Transient climate models currently available, when run with standard scenarios of fossil fuel CO_2 emissions, indicate a global warming of the order of 1 °C by the year 2000, relative to the year 1850, and an additional 2-4 °C warming over the next century. However, the sensitivity of such predictions to known uncertainties of the models - that is, the robustness of CO_2 warming predictions - has not yet been extensively explored."

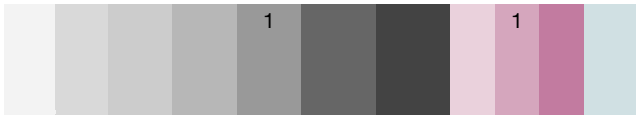
IP2: No position

1985	Flannery, B. P., Callegari, A. J., Hoffert, M. I., Hseih,	CO_2 driven equator-to-pole paleotemperatures:	The Carbon Cycle and Atmospheric CO_2: Natural	N/A	

	C. T., Wainger, M. D.	predictions of an energy balance model with and without a tropical evaporation buffer	Variations Archean to Present, Geophysical Monograph 32		

EP4a: Academic predictions of a climate model, but does show numerous warming predictions as a function of CO_2 concentration that appear to corroborate consensus position. No explicit mention of AGW and fossil fuels - study is mostly focused on reproducing paleo-temperature records (when CO_2 was higher).

IP1: "Note that enhanced CO_2 causes warming to amplify in polar regions." [See figure 6.] "...sea ice disappears when CO_2 increases about 20 times". [See figure 7.]

1988	Thomas, E. R., Denton, R. D.	Conceptual studies for CO_2/natural gas separation using the controlled freeze zone (CFZ) process	Gas Separation and Purification	N/A	

EP4a: No mention of climate change, AGW, GHG, etc. Pure technical paper on CFZ process of separating CO_2 from methane.

IP2: No position

1991	Kheshgi, H. S., Hoffert, M. I., Flannery, B. P.	Marine biota effects on the compositional structure of the world oceans	J. Geophys. Res.	N/A	

EP4a: No position.

IP2: No position

1993	Kheshgi, H. S., White, B. S.	Effect of climate variability on estimation of greenhouse parameters: usefulness of a pre-instrumental temperature record	Quaternary Science Reviews	N/A	

EP4b-2: "There have been many attempts...to separate the signals of greenhouse forcing from the noise of climate variability, and thus ascribe the recent global warming trend apparent in the instrumental temperature record (Jones and Wigley, 1990) primarily to one or the other. The answer, however, is highly dependent (Kheshgi and White, 1993) on the assumed statistical characteristics of climate variability."

IP2: No position

1993 Flannery, B. P., Kheshgi, H. S., Hoffert, M. I., Lapenis, A. G. | Assessing the effectiveness of marine CO_2 disposal | Energy Convers. Mgmt | N/A

EP3a: "We consider the relative effectiveness of systems for collection and marine disposal of CO_2 from fossil fuel fired power plants using comparisons of the trend with time of CO_2 concentration in the atmosphere from systems with and without marine disposal...Global Wanning Potential can be used to compare systems. This highlights the difficult issues involved in determining what time scales are important in considering options to reduce concerns about global warming."

EP3a: "To slow or reduce human emissions of greenhouse gases Marchetti (1977) proposed that CO_2 emissions from power plants might be captured and stored in deep oceans...We combine the models to describe the buildup of atmospheric CO_2 for illustrative cases including pulse and continuous injection of CO_2, and to evaluate relative Global Warming Potential as a diagnostic of performance."

IP2: No position

1993 Kheshgi, H. S., White, B. S. | Does recent global warming suggest an enhanced greenhouse effect? | Climatic Change | N/A

EP4b-2: Investigates whether recent warming can be attributed to the greenhouse effect, implying a lack of consensus.

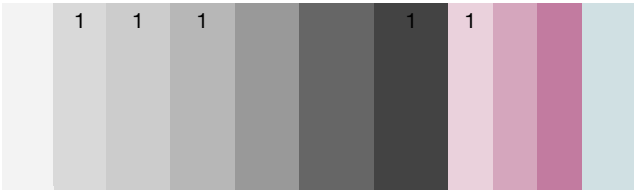
IP2: No position

1994 Kheshgi, H. S., Flannery, B. P., Hoffert, M. I., Lapenis, A. G. | The effectiveness of marine CO_2 disposal | Energy | N/A

EP3a: "We consider the relative effectiveness of systems for collection and marine disposal of CO_2 from fossil fuel fired power plants..." Authors find that "atmospheric concentrations from systems with marine disposal ultimately exceed those from systems without controls. In some circumstances they do so rapidly, making marine disposal less favorable than direct atmospheric release." They use Global Warming Potential to assess systems on different time scales.

IP2: No position

1994 Jain, A. K., Kheshgi, H. S., Wuebbles, D. J. | Integrated Science Model for Assessment of Climate Change | 94-TP59. 08, Air and Waste Management Assoc.; also Lawrence Livermore Nat. Lab., UCRL-JC-116526, Natl. Technical Info Service, US Dept. of Commerce | Proceedings of the 87th Annual Meeting of the Air & Waste Management Association



EP3a: "This report describes a scientific model relating emissions to global temperature and sea level."

EP2: "The emission of fossil fuel CO_2 is modeled to have the largest long term effect on climate. Results do show the importance of expected changes of trace greenhouse gases other than CO_2 in the near future."

EP3b: "Past measurements show that greenhouse gas concentrations, many of which are affected by human related activities, are increasing in the atmosphere. There is wide consensus that this increase influences the earth's energy balance and concern that this will cause significant change in climate."

EP3b: Reference 2 is to: W. M. Kellogg's "Response to skeptics of global warming", Bull. Am. Met. Soc., 74 (4), 499-511.

EP3a: "A fully integrated assessment model that spans the many aspects of climate change, including economics, energy options, effects of climate, and impacts of climate change, would be a useful tool [for climate policy]. This is a report of the current characteristics and performance of an Integrated Science Model which consists of coupled modules for carbon cycle, atmospheric chemistry of other trace gases, radiative forcing by greenhouse gases, energy balance model for global temperature, and a model for sea level response." "The process of global climate change and its possible ecological, economic and social impacts involves interactions between physical, ecological, economic and social systems."

EP2/4b-2: "In this report we address...the relation between emissions and climate." "This model is used to estimate the relation between the time-dependent rate of greenhouse gas emissions and quantitative features of climate - global temperature, the rate of temperature change, and sea level - that are thought to be indicators of human impact on climate and ecosystems. Notwithstanding, there remains significant uncertainty in the modeled relation between emissions and climate."

EP2: "The following greenhouse gases contributing to the additional man-made greenhouse effect are used as input: CO_2..."

EP2/3b: "The response of the climate system to the changes in radiative forcing is principally determined by the climate sensitivity, dT_{2x}, defined as the equilibrium surface temperature increase for doubling of atmospheric CO_2 concentration...Recent general circulation model estimates for dT_{2x} range from 1.5 to 4.5 °C. Lindzen proposed the value of dT_{2x} could be as low as 0.5 °C. Based on the observed temperature record, Schlesinger and Jiang found the value of dT_{2x} =1.2 °C; but as discussed by Kheshgi and White, there is large uncertainty in dT_{2x} estimated from the observed temperature record because of the unknown contribution from the climate's natural variability. dT_{2x}= 2.5 °C is considered by some as the best estimate of climate sensitivity. In the present study, the calculations have been performed for the three values of the climate sensitivity, namely 1.5, 2.5 and 4.5 °C."

EP3a: "Assessing Emissions and Stabillization Scenarios: We also estimate the buildup of greenhouse gas concentrations, global temperature and its rate of change, and sea level implied by Emissions Scenarios...We use our Integrated Science Model to perform an inverse carbon cycle calculation to estimate the time variation fossil fuel emissions of CO_2, shown in Fig. 5b, required to match the five concentration stabilization scenarios. These calculations are considered in the IPCC 1994 Report on Radiative Forcing of Climate for which the results of our Integrated Science Model was contributed. All the calculations show that stabilization requires a reduction in emissions at some time in the future. Moreover, in case S350 an immediate reduction is required followed by a rising trend..."

EP2: "Fig. 7a shows estimates of the global temperature change from its preindustrial value for Emissions Scenarios IS92a and IS92c. Estimates are, of course, highly dependent on the value of climate sensitivity. Results for dT_{2x} = 1.5 and 4.5 °C are shown. This range in climate sensitivities results in a range of estimated temperature rise comparable to that caused by the difference between scenarios. The results indicated that both IPCC scenarios are sufficient to keep the increase the global temperature below the illustrative warming ceiling of 2 °C (for times up to 2095) for a climate sensitivity of 1.5 °C. Both scenarios lead to greater than 2 °C warming for a climate sensitivity of 4.5 °C. In scenario IS92a, a warming of 2 °C is exceeded as early as 2030, 2055, and 2095 for climate sensitivities of 4.5, 2.5, and 1.5 °C, respectively."

EP2: Model diagram (Fig. 1) explicitly links human CO_2 to climate impacts.

EP2: Projected future AGW under different scenarios (Fig. 7).

EP2: Projected future SLR under different scenarios (Fig. 8).

IP1: "A fully integrated assessment model that spans the many aspects of climate change, including economics, energy options, effects of climate, and impacts of climate change, would be a useful tool [for climate policy]. This is a report of the current characteristics and performance of an Integrated Science Model which consists of coupled modules for carbon cycle, atmospheric chemistry of other trace gases, radiative forcing by greenhouse gases, energy balance model for global temperature, and a model for sea level response." "The process of global climate change and its possible ecological, economic and social impacts involves interactions between physical, ecological, economic and social systems."

IP1: "Sea Level Rise Model: The effects of global warming on sea level are determined by four processes: (i) thermal expansion of the ocean water (ii) melting of mountain glaciers, (iii) ablation of the Greenland Ice Sheet, and (iv) ablation or accumulation of the Antarctic Ice Sheet (notably the West Antarctic Ice Sheet). The sea level model shown in Fig. 1 uses the calculated transient temperature changes to estimate sea level changes due to thermal expansion and melting ice."

IP1: "Concern over the potential impacts of climate change caused by increases in greenhouse gases...The impacts of climate change are likely to be more closely related to properties of the climate system, such as sea level or global temperature, than to emission rates of greenhouse gases."

IP1: "Defining Requirements For Limiting Climate Change And Protecting Ecosytems: One way of developing criteria for climate and ecosystem protection would be to determine the maximum rate at which ecosystems can adapt to changes in temperature and precipitation patterns. At the Viuach and Bellagio Climate Conferences it was suggested that a global rate of temperature change of 0.1 °C per decade change be taken as an initial target value, which would allow for the adaptation of ecosystems. However, decadal changes in global temperature greater than 0.1 °C are evident in the instrumental record (see Fig. 3). We use 0.1 °C per decade and a mean global warming of 2 °C from preindustrial time to 2100 as Illustrative Reference Values for climate and ecosystem protection."

IP1: "The rate of the climate change is thought to exert stress on ecosystems. While changes in, for example, precipitation or infrequent events such as droughts or storms may be more directly related to this stress, there remains great uncertainty in estimating these characteristics of climate."

1995 Jain, A. K., Kheshgi, H. S., Hoffert, M. I., Wuebbles, D. J.

Distribution of radiocarbon as a test of global carbon cycle models

Global Biogeochem. Cycles

N/A

EP4a: No position.

IP2: No position

1995 Kheshgi, H. S.

Sequestering atmospheric carbon dioxide by increasing ocean alkalinity

Energy

N/A

EP3a: "We present a preliminary analysis of a geoengineering option based on the intentional increase of ocean alkalinity to enhance marine storage of atmospheric CO_2. Like all geoengineering techniques to limit climate change, with today's limited understanding of the climate system, this approach must be regarded as a potential strategic option that requires ongoing assessment to establish its potential benefits and side effects."

EP4a: "A number of response options have been proposed to limit concerns that increasing concentrations of greenhouse gases may lead to future climate change. Among the options that might become necessary to deploy at some time in the future, should climate change prove to be serious, are those that involve geoengineering techniques to control greenhouse gas concentrations or to limit potential impacts. While scientific understanding of climate change is far too limited today to contemplate deploying response options based on geoengineering, they should be investigated to improve our understanding of their potential to contribute to development of a portfolio of strategic options to address climate change. In this paper we consider geoengineering approaches to increase ocean alkalinity in order to draw CO_2 from the atmosphere to the

oceans." Contextually, the doubt expressed here is mild, and, in part, this statement implicitly acknowledges AGW. On balance, we code as EP4a.

IP3: "A number of response options have been proposed to limit concerns that increasing concentrations of greenhouse gases may lead to future climate change. Among the options that might become necessary to deploy at some time in the future, should climate change prove to be serious, are those that involve geoengineering techniques to control greenhouse gas concentrations or to limit potential impacts. While scientific understanding of climate change is far too limited today to contemplate deploying response options based on geoengineering, they should be investigated to improve our understanding of their potential to contribute to development of a portfolio of strategic options to address climate change. In this paper we consider geoengineering approaches to increase ocean alkalinity in order to draw CO_2 from the atmosphere to the oceans."

1996	Santer, D. B.,…, Kheshgi, H. S., *et al.*	Detection of Climate Change and Attribution of its Causes	Intergovernmental Panel on Climate Change Second Assessment Report, Working Group 1, Chapter 8	N/A	

Note: There is significant discussion of uncertainties, this being a comprehensive review of the current state of the field. However, the authors have a clear view that the weight of evidence points towards likely AGW. The discussion of uncertainty concerns the strength of this view, but is not presented in such a way as to suggest their view is wrong - only that their view is not "unambiguous."

EP2: "Several recent studies have compared observed patterns of temperature change with model patterns from simulations with simultaneous changes in carbon dioxide (CO_2) and anthropogenic sulphate aerosols...While there are concerns regarding the relatively simple treatment of aerosol effects in model experiments that attempt to define an anthropogenic signal, all such pattern comparison studies show significant correspondences between the observations and model predictions...the probability is very low that these correspondences could occur by chance as a result of natural internal variability...Increasing confidence in the emerging identification of a human-induced effect on climate comes primarily from such pattern-based work."

EP2: "In addition to these quantitative studies, there are areas of qualitative agreement between observations and those model predicrions..."

EP2: "Viewed as a whole, these results indicate that the observed trend in global mean temperature over the past 100 years is unlikely to be entirely natural in origin. More importantly, there is evidence of an emerging pattern of climate response to forcings by greenhouse gases and sulphate aerosols in the observed climate record...Taken together, these results point towards a human influence on global climate. Our ability to quantify the magnitude of this effect is presentiy limited by uncertainties in key factors, such as..."

EP2: "The gradual emergence of an anthropogenic climate change signal from the background noise of natural variability guarantees that any initial pronouncement that a change in the climate has been detected and attributed to a specific cause will be questioned by some scientists. Nevertheless, if the current rate of increase of anthropogenic emissions is maintained and if the sensitivity of the climate system to anthropogenic perturbations is within the range predicted by current climate theory, it should become increasingly easy to eliminate natural variability and other natural external forcings as causes for most of the observed changes."

EP2: "[F]ew would be willing to argue that completely unambiguous attribution of (all or part of) this change has already occurred, or was likely to happen in the next few years. However, evidence from the pattern-based studies reported on here suggests that an initial step has now been taken in the direction of attribution...The body of statistical evidence in Chapter 8, when examined in the context of our physical understanding of the climate system, now points towards a discernible human influence on global climate. Our ability to quantify the magnitude of this effect is currently limited by uncertainties in key factors, including..."

IP2: No position

1996 Kheshgi, H. S., White, B.S. | Modelling ocean carbon cycle with a nonlinear convolution model | Tellus | N/A

EP4a: Only brief mention of climate change, very mathematical paper.

IP2: No position

1996 Kheshgi, H. S., Lapenis, A. G. | Estimating the accuracy of Russian paleotemperature reconstructions | Palaeogeography, Palaeoclimatology, Palaeoecology | N/A

EP2: "Three applications of ancient climate reconstructions have been proposed to better understand the potential magnitude and effects of global warming induced by the increase in greenhouse gases. The first proposal is to use paleoclimate data on warm epochs as analogs for future global warming." Note that "potential" refers to magnitude and effects, not to AGW as real and human-caused, which is implicitly taken as fact.

EP4b-2 [post-1995] "However, the paleo-analog concept is seriously flawed because potential future climate change due to an enhanced greenhouse effect would likely occur over time scales shorter than are focused on in paleclimate reconstructions..." Contextually, the doubt expressed here by tentative wording is particularly mild. The sentence might otherwise be read as mild implicit acknowledgment of AGW. However, to ensure consistent identification of tentative wording across all documents, we code as EP4b-2.

IP2: No position

1996 Kheshgi, H. S., Jain, A. K., Wuebbles, D. J | Accounting for the missing carbon sink with the CO_2 Fertilization Effect | Climatic Change | N/A

EP4a: No position.

IP2: No position

1996 Jain, A. K., Kheshgi, H. S., Wuebbles, D. J | A globally aggregated reconstruction of cycles of carbon and its isotopes | Tellus | N/A

EP2: "The emission of carbon dioxide to the atmosphere by the burning of fossil fuels and changes in land use has led to an increase in the atmospheric concentration of carbon dioxide, a greenhouse gas, which can affect the global climate. However, the ability to predict how the carbon cycle responds to the emission of carbon dioxide, changes in land use, and changes in climate, relies on the understanding of the global carbon cycle..."

IP2: No position

1996	Prince, R. C., Kheshgi, H. S. EP4a: No position IP2: No position	Longevity in the deep	Trends in Ecology & Evolution	N/A	
1997	Jain, A. K., Kheshgi, H. S., Wuebbles, D. J. EP4a: No position. IP2: No position	Is there an imbalance in the global budget of bomb-produced radiocarbon?	Journal of Geophysical Research	N/A	
1997	Archer, D., Kheshgi, H., Maier-Reimer, E. EP4a: No position. IP2: No position	Multiple Timescales for the Neutralization of Fossil Fuel CO_2	Geophysical Research Letters	N/A	
1997	Kheshgi, H. S., Schlesinger, M. E., Lapenis, A. G. EP2: Refer to "the potential magnitude and effects of greenhouse-gas-induced global warming." Note that "potential" refers to magnitude and effects, not to AGW as real and human-caused, which is implicitly taken as fact. IP2: No position	Comparison of Paleotemperature Reconstructions as Evidence for the Paleo-Analog Hypothesis	Climatic Change	N/A	
1997	Kheshgi, H.S., Jain, A. K., Wuebbles, D. J.	Analysis of proposed CO_2 emission reductions in the	Proceedings of the Air & Waste Management	Air & Waste Management	

		context of stabilization of CO_2 concentration	Association's 90th Annual Meeting & Exhibition	Association's 90th Annual Meeting & Exhibition	

EP2: "To make projections of global temperature, sea level and CO_2 concentration, we use the ISAM model. In this model, emissions of major greenhouse gases and aerosols lead to changes in atmospheric concentration, which leads to a radiative forcing of climate, which results in a change in temperature and an effect on sea level. The six combinations of CO_2 emissions scenarios shows in Figure 2 serve as input for this model. Additional climate forcings by aerosols, CO_2 from land use changes, and other greenhouse gases consistent with IPCC scenario IS92a are common inputs to every model projection presented here."

IP1: Authors model "effects of emissions to 2010 on temperature, sea level and CO_2 concentration." Table 1 shows projected sea level rise.

1998	Archer, D., Kheshgi, H., Maier-Reimer, E.	The dynamics of fossil fuel CO_2 neutralization by marine $CaCO_3$	Global Biogeochemical Cycles	N/A	

EP3a: "Mankind releases CO_2 to the atmosphere by combustion of fossil fuels and by deforestation, which converts relatively high biomass forests, mostly in the tropics, into lower biomass grasslands and farm lands, resulting in a net release of CO_2." "Stabilization of Atmospheric CO_2 Concentration. The objective of the Framework Convention on Climate Change (FCCC) is, in part, to "achieve ... stabilization of greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system" (text available from UNEP/WMO Information Unit on Climate Change). Implementing such a stabilization will require a means of translating atmospheric concentrations into corresponding emission rates by predicting uptake by the oceans and the biota. The Intergovernmental Panel on Climate Change (IPCC) [Schimel et al., 1994] has tailored a series of illustrative CO_2 concentration time pathways in order to study the implications of the FCCC objective. Various carbon cycle models have been used to estimate the rate of emissions that result in these CO_2 concentration time pathways [Entingetal., 1994; Wigleyetal., 1996] by taking account of ocean and, in some cases, biospheric uptake of carbon."

EP3a: "Deep Ocean Disposal of CO_2. A number of geoengineering techniques have been proposed to control atmospheric greenhouse gas concentrations or to limit potential impacts [Panel on Policy Implications of Greenhouse Warming, 1992]. Marchetti [1977] proposed capturing CO_2 emissions from power plants and disposing of it in the deep sea. Relative to human emissions, oceans have an immense capacity for CO_2, so that the added burden of CO_2 will be relatively small. Also, we will see in section 5 that the ultimate fate of most of the fossil fuel CO_2 will be to dissolve in the oceans eventually anyhow, so direct injection would only be catalyzing the transition to an already inevitable condition."

IP2: No position

1998	Hayhoe, K. A. S., Kheshgi, H. S., Jain, A. K., Wuebbles, D. J.	Trade-Offs in Fossil Fuel Use: The Effects of CO_2, CH_4 and SO_2 Aerosol Emissions on Climate	World Resource Review	N/A	

EP4b-2 [post-1995]: "Increasing concentrations of greenhouse gases in the atmosphere have raised concerns over the potential effect of emissions from human activities on climate." Contextually, the doubt expressed here by tentative wording is particularly mild and reflects common academic parlance. However, to ensure consistent identification of tentative wording across all documents, we code as EP4b-2.

EP2: "Carbon dioxide, methane, and sulfur dioxide emissions resulting from coal, oil and gas use are studied here. Changes in the radiative forcing of climate and global mean annual temperature resulting form the substitution of natural gas for coal in electrical power generation are modeled by the Integrated Science Assessment Model."

EP2: "Atmospheric concentrations of greenhouse gases, including carbon dioxide...have increased over the past century. Much of this rise is attributed to escalating levels of human activity in agriculture, biomass burning, and particularly fossil fuel consumption...If current trends in greenhouse gas and aerosol emissions continue as projected, the resulting global warming is expected to lead to an increase in global-mean temperature of 0.9 to 3.5 °C above current values by the year 2100. In efforts to avert climate change induced by human activities..."

EP1: "Carbon dioxide has been responsible for approximately 65% of the increased greenhouse effect since pre-industrial times, and is expected to continue as the dominant greenhouse gas in the next century."

EP2: "Analysis of the change in global mean-annual temperature resulting from a pulse of CO_2, CH4 and SO2 emissions due to the use of 100 EJ of coal, oil, and natural gas shows that emissions from fossil fuel energy use result in a net long-term warming of climate that can be reducing by using natural gas rather than coal or oil."

IP2: No position

1999 Kheshgi, H. S., Jain, A. K., Kotamarthi, V. R. Wuebbles, D. J. | Future Atmospheric Methane Concentrations in the Context of the Stabilization of Greenhouse Gas Concentrations | J. Geophys. Res. | N/A

EP2: "It is understood that the emissions targets laid out in the Kyoto agreement, if met, extend over too short a time span to mitigate climate change...and would have to be viewed as a first step toward deeper long-lasting reductions in emissions if radiative forcing of climate by greenhouse gases were to be halted. It is also understood that if the increase in radiative forcing is to be halted, CO_2 emissions would need to be virtually eliminated..."

EP3a: "Considerable attention has been paid to the stabilization of CO_2 concentration in the atmosphere in response to concerns about the impacts of global climate change and the objective of the Framework Convention on Climate Change." "The stabilization of CO_2 concentration below current levels is expected to require extreme reductions (or the creation of net CO_2 sinks) in CO_2 emissions [Enting et al., 1994], and the stabilization of CO_2 concentration at any level will require eventual reduction of net fossil CO_2 emissions to a fraction of a Gt C yr^{-1}."

IP2: No position

1999 Kheshgi, H. S., Jain, A. K., Wuebbles, D. J. | Model-based estimation of the global carbon budget and its uncertainty from carbon dioxide and carbon isotope records | J. Geophys. Res. | N/A

EP3a: "Projections of future global climate change have led to the consideration of actions intended to limit the buildup of greenhouse gases in the atmosphere (UN, 1992). Uncertainty in projections of the climate response to future emissions of greenhouse gases remains a critical factor in determining when and what actions are taken." The word “uncertainty” is here used in a factually correct way, and indeed implies mild implicit acknowledgment of the basic reality of AGW.

IP2: No position

2000	Kheshgi, H. S., Prince, R. C., Marland, G.	The Potential of Biomass Fuels in the Context of Global Change: Focus on Transportation Fuels	Annual Review of Energy and the Environment	N/A		

EP1/EP4b-2 [post-1995]: "In response to the concern that increases in atmospheric greenhouse gases may lead to adverse climate change (for a recent review see 1), a number of proposals have been made to stabilize and ultimately reduce anthropogenic emissions of greenhouse gases...Fossil-fuel emissions thus appear to be responsible for most of the observed increase in CO_2 concentration...When greenhouse gases are tabulated in terms of their CO_2 equivalent emissions, CO_2 itself comprises 80% of the total emissions of greenhouse gases...Currently, global anthropogenic emissions of CO_2 occur primarily from burning of fossil fuels (83%)..." Contextually, the doubt expressed here by tentative wording is particularly mild and reflects common academic parlance. However, to ensure consistent identification of tentative wording across all documents, we code as EP4b-2 (as well as EP1).

EP2: "The Kyoto Protocol would not limit emissions from developing countries. Longer-term goals could require a much larger decrease in the use of fossil fuels. For example, the ultimate objective of the UNFCCC (article 2) is "...stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system..." "

EP2: "This review examines the role that fuels from renewable biomass might play as a strategic option to address concerns of climate change by replacing fossil fuels, and thus the CO_2 that is emitted when they are used...This review focuses on the potential scale of biomass as a substitute for fossil fuels in order to offset CO_2 emissions, particularly on the role of biomass as a substitute for petroleum-based transportation fuels...We do not focus on the potential near-term commercial viability of biomass but envision that public policy factors might influence the penetration of biofuels if, for example, concern about global climate change leads to policies to limit atmospheric emissions of carbon dioxide."

IP3: "Although science cannot yet provide reliable guidance on what, if any, levels of greenhouse gas concentrations might be judged "dangerous," studies of the processes that control levels of atmospheric CO_2 make it clear that massive reductions in future global CO_2 emissions would be required to achieve stabilization of atmospheric CO_2 at levels even two or three times the pre-anthropogenic level." Contextually, the doubt expressed here most likely reflects only common academic parlance. However, strictly speaking, "if any" implies that there may be *no* level of greenhouse gases that is dangerous, which we interpret as an expression of doubt about the seriousness of AGW. We therefore code as IP3.

2000	Watson, R.,…, Kheshgi, H. *et al.*	Land Use, Land-Use Change, and Forestry	A Special Report of the Intergovernmental Panel on Climate Change	N/A		

EP3a: No explicit discussion of AGW, but "climate change mitigation" mentioned frequently as the implicit motivation of the entire report and the report's effort to address the Kyoto Protocol.

IP2: No position

2000	Hayhoe, K. A. S., Jain, A. K., Kheshgi, H. S., Wuebbles, D. J.	Contribution of CH_4 to Multi-Gas Reduction Targets: The Impact of Atmospheric Chemistry on GWPs	Non-CO_2 Greenhouse Gases: Scientific Understanding, Control and Implementation, 425-432.	Proceedings of the Second International Symposium, Noordwijkerhout, The Netherlands, 8–10		

September 1999

EP3a: Authors acknowledge "the overall contribution of CH_4 and other non-CO_2 GHGs to both short-term and long-term strategies focused on the mitigation of climate change impacts."

EP3a: It is implicit in the authors' calculation of GWP of CH_4, CO_2 etc. that these gases cause global warming. And since they also refer to emission reduction targets and Kyoto, they are implying human caused global warming.

IP2: No position

2001 Bolin, B., Kheshgi, H. S. | On strategies for reducing greenhouse gas emissions | Proceedings of the National Academy of Sciences | N/A | 1 | 1 | 1

EP2: "In the long term, the net carbon dioxide emissions from human activities would have to be reduced to well below current emission levels to stabilize greenhouse gas radiative forcing and thereby to limit the extent of climate change. Although the relation between an enhanced concentration level and climate change is not firmly established, it is of interest to examine the required reductions of future net emissions to arrive at alternative stable concentration levels." We interpret the observation that “the relation between an enhanced concentration level and climate change is not firmly established” to be the treatment of reasonable scientific uncertainty using common academic parlance.

EP2: "Uncertainties in carbon cycle and carbon dioxide emissions from land use translate into uncertainty in the deduced global fossil emissions for stabilization in Figs. 3 and 4...Despite the uncertainties of our present knowledge, the conclusions reached above are rather robust."

SP1: "Even for the higher stabilization levels considered, the developing world would not be able to use fossil fuels for their development in the manner that the developed world has used them."

SP1: "...fossil fuels will be an increasing main source for primary energy for the needed development of non-Annex 1 countries for quite some time to come. Need and equity have provided strong arguments for developing countries to request that the developed world takes the lead in controlling its emissions, while permitting the developing countries in the meantime to use primarily fossil fuels for their development."

2001 Kheshgi, H. S., B. S. White | Testing Distributed Parameter Hypotheses for the Detection of Climate Change | Journal of Climate | N/A | 1 | 1

EP4b-2: "Many previous claims that anthropogenically caused climate change has been detected have utilized models in which uncertainties in the values of some parameters have been neglected...we have incorporated known parameter uncertainties for an illustrative example by using the proposed methodology for distributed parameter hypothesis testing. The results clearly show that incorporation of parameter uncertainty can greatly affect the conclusions of a statistical study. In particular, inclusion of uncertainty in aerosols forcing would likely lead to rejection of the hypothesis of anthropogenically caused climate change for our illustrative model..."

EP4b-2: "A general statistical methodology, based on testing alternative distributed parameter hypotheses, is proposed as a method for deciding whether or not anthropogenic influences are causing climate change."

EP4b-2: "...typical climate change questions such as should we trust climate projections, how will climate change in the future, or have we damaged the climate system are

not posed in a form that is directly amenable to statistical testing."

IP2: No position

2001 Prentice, C., Farquhar, G., Fasham, M., Goulden, M., Heimann, M., Jaramillo, V., Kheshgi, H., Quéré, C. L., Scholes, R., Wallace, D. | The carbon cycle and atmospheric CO_2 | Intergovernmental Panel on Climate Change Third Assessment Report, Working Group 1, Chapter 3 | N/A

EP3a: No explicit discussion of AGW, but mention of "methane (CH4) which has a global warming potential (GWP) about 23 times that of CO_2 (Chapter 6)."

EP3a: Implicit acknowledgment of AGW through discussion of climate sensitivity: "The effect of increasing climate sensitivity to 4.5 °C (increasing the climate feedback) is much larger than the effect of reducing climate sensitivity to 1.5 °C."

IP2: No position

2001 Mitchell, J. F. B.,..., Kheshgi, H. S. (Contributing Author), et al. | Detection of Climate Change and Attribution of its Causes | IPCC TAR WGI Ch12 | N/A

Note: There is significant discussion of uncertainties, this being a comprehensive review of the current state of the field. However, the authors have a clear view that the weight of evidence points towards likely AGW. The discussion of uncertainty concerns the strength of this view, but is not presented in such a way as to suggest their view is wrong - only that their view is not completely unambiguous.

EP2: "New reconstructions of the surface temperature record of the last 1,000 years indicate that the temperature changes over the last 100 years are unlikely to be entirely natural in origin, even taking into account the large uncertainties in palaeo-reconstructions."

EP2: "Detection studies to date have shown that the observed large-scale changes in surface temperature in recent decades are unlikely (bordering on very unlikely) to be entirely the result of internal variability."

EP2: "Assessments based on physical principles and model simulations indicate that natural forcing alone is unlikely to explain the increased rate of global warming since the middle of the 20th century or changes in vertical temperature structure."

EP2: "Statistical assessments confirm that natural variability (the combination of internal and naturally forced) is unlikely to explain the warming in the latter half of the 20th century."

EP2: "...detection of the influence of greenhouse gas increases on the surface temperature changes over the past 50 years is robust."

EP2: "Nevertheless, all studies since the SAR have found a significant anthropogenic contribution is required to account for surface and tropospheric trends over at least the last 30 years."

EP2: "There is a wide range of evidence of qualitative consistencies between observed climate changes and model responses to anthropogenic forcing, including global

warming, increasing land-ocean temperature contrast, diminishing Arctic sea-ice extent, glacial retreat and increases in precipitation in Northern Hemisphere high latitudes."

EP2: "A major advance since the SAR is the increase in the range of techniques used...Evidence of a human influence on climate is obtained using all these techniques."

EP2: "...to be consistent with the signal observed to date, the rate of anthropogenic warming is likely to lie in the range 0.1 to 0.2 °C/decade over the first half of the 21st century under the IS92a (IPCC, 1992) emission scenario."

EP2: "The warming over the past 100 years is very unlikely to be due to internal variability alone, as estimated by current models. Reconstructions of climate data for the past 1,000 years also indicate that this warming was unusual and is unlikely to be entirely natural in origin."

EP2: "Detection and attribution studies consistently find evidence for an anthropogenic signal in the climate record of the last 35 to 50 years."

EP2: "Simulations of the response to natural forcings alone...do not explain the warming in the second half of the 20th century."

EP2: "The warming over the last 50 years due to anthropogenic greenhouse gases can be identified despite uncertainties in forcing due to anthropogenic sulphate aerosol and natural factors...Changes in natural forcing during most of this period are also estimated to be negative and are unlikely to explain the warming."

EP1: "In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations."

EP2: "The observed warming is inconsistent with model estimates of natural internal climate variability...It is therefore unlikely (bordering on very unlikely) that natural internal variability alone can explain the changes in global climate over the 20th century."

EP2: "The observed warming in the latter half of the 20th century appears to be inconsistent with natural external (solar and volcanic) forcing of the climate system."

EP2: "The observed change in patterns of atmospheric temperature in the vertical is inconsistent with natural forcing."

EP2: "Anthropogenic factors do provide an explanation of 20th century temperature change."

EP2: "The effect of anthropogenic greenhouse gases is detected, despite uncertainties in sulphate aerosol forcing and response."

EP2: "Studies of the changes in the vertical patterns of temperature also indicate that there has been an anthropogenic influence on climate over the last 35 years."

EP2: "The additional warming in the second half-century is most likely to be due to a substantial warming due to increases in greenhouse gases, partially offset by cooling due to aerosols, and perhaps by cooling due to natural factors towards the end of the period."

IP1: "There is a wide range of evidence of qualitative consistencies between observed climate changes and model responses to anthropogenic forcing, including global warming, increasing land-ocean temperature contrast, diminishing Arctic sea-ice extent, glacial retreat and increases in precipitation in Northern Hemisphere high latitudes."

2001	Albritton, D. L.,..., Kheshgi, H.S. (Contributing Author), et al.	Technical Summary	Intergovernmental Panel on Climate Change Third Assessment Report, Working Group 1, Summary for Policymakers	N/A

EP1: "there is new and stronger evidence that most of the observed warming observed over the last 50 years is attributable to human activities."

EP2: "Emissions of greenhouse gases and aerosols due to human activities continue to alter the atmosphere in ways that are expected to affect the climate."

EP1: "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."

EP2: "There is a longer and more closely scrutinised temperature record and new model estimates of variability. The warming over the past 100 years is very unlikely to be due to internal variability alone..."

EP2: "Detection and attribution studies consistently find evidence for an anthropogenic signal in the climate record of the last 35 to 50 years."

EP1: "In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations."

EP2: "Anthropogenic climate change will persist for many centuries."

IP1: "Both temperature and sea level are projected to continue to rise throughout the 21st century for all scenarios studied."

IP1: "Global average temperature and sea level are projected to rise under all IPCC SRES scenarios."

IP1: "The globally averaged surface temperature is projected to increase by 1.4 to 5.8 °C (Figure 5d) over the period 1990 to 2100...The projected rate of warming is much larger than the observed changes during the 20th century and is very likely to be without precedent during at least the last 10,000 years, based on palaeoclimate data."

IP1: "For some other extreme phenomena, many of which may have important impacts on the environment and society..."

IP1: "Higher maximum temperatures and more hot days over nearly all land areas: Very likely"

IP1: "More intense precipitation events: Very likely, over many areas"

IP1: "Increased summer continental drying and associated risk of drought: Likely, over most mid-latitude continental interiors"

IP1: "Increase in tropical cyclone peak wind intensities: Likely, over some areas"

IP1: "Increase in tropical cyclone mean and peak precipitation intensities: Likely, over some areas"

IP1: "It is likely that warming associated with increasing greenhouse gas concentrations will cause an increase of Asian summer monsoon precipitation variability."

IP1: "Beyond 2100, the thermohaline circulation could completely, and possibly irreversibly, shut-down in either hemisphere if the change in radiative forcing is large enough and applied long enough."

IP1: "Northern Hemisphere snow cover and sea-ice extent are projected to decrease further."

IP1: "Glaciers and ice caps are projected to continue their widespread retreat during the 21st century."

IP1: "Global mean sea level is projected to rise by 0.09 to 0.88 metres between 1990 and 2100, for the full range of SRES scenarios."

IP1: "Global mean surface temperature increases and rising sea level from thermal expansion of the ocean are projected to continue for hundreds of years after stabilisation of greenhouse gas concentrations (even at present levels)..."

IP1: "Ice sheets will continue to react to climate warming and contribute to sea level rise for thousands of years after climate has been stabilised...Ice sheet models project that a local warming of larger than 3 °C, if sustained for millennia, would lead to virtually a complete melting of the Greenland ice sheet with a resulting sea level rise of about 7 metres. A local warming of 5.5 °C, if sustained for 1,000 years, would be likely to result in a contribution from Greenland of about 3 metres to sea level rise."

2001 Kauppi, P.,..., Kheshgi, H. S. (Contributing Author), et al. | Technical and Economic Potential of Options to Enhance, Maintain and Manage Biological Carbon Reservoirs and Geo-Engineering | Intergovernmental Panel on Climate Change Third Assessment Report, Working Group 3, Chapter 4 | N/A

EP3a: No explicit discussion of AGW, but repeatedly implies that the "carbon mitigation" strategies discussed in this chapter (using terrestrial ecosystems) and also the geo-engineering options discussed are a means of "climate change mitigation" and ways to "stabilize the climate system." i.e. AGW is implicitly acknowledged as the motivation of this work [most of all because this chapter is part of the IPCC's WGIII climate change Mitigation volume].

IP2: No position

2001 Toth, F. L,..., Flannery, B. (Lead Author), et al. | Decision Making Frameworks | Intergovernmental Panel on Climate Change Third Assessment Report, Working Group 3, Chapter 10 | N/A

EP2: Not much explicit discussion of AGW, but it is clearly taken as given that AGW is real and human-caused when discussing "climate change mitigation strategies" [most of all because this chapter is part of the IPCC's WGIII climate change Mitigation volume].

EP2: "Climate change is profoundly different from most other environmental problems with which humanity has grappled."

EP2: "...human activities associated with climate change are so widespread that..."

EP2: "How global climate change unfolds will be determined by the total amount of GHG emissions that, in turn, reflects nations' willingness to undertake mitigation measures."

EP3a: "Options to mitigate climate change include actual emission reductions and CO_2 sequestration..."

IP2: No position

2002	Hayhoe, K. A. S., Kheshgi, H. S., Jain, A. K., Wuebbles, D. J.	Substitution of natural gas for coal: climatic effects of utility sector emissions	Climatic Change	N/A	1 1 1

EP1: "Much of the increase in carbon dioxide and other emissions is attributed to intensified human activity in agriculture, biomass burning, and fossil fuel consumption. This increase has caused a corresponding change in atmospheric composition, which is projected to lead to increases in global temperature (IPCC, 2001). Limiting carbon dioxide emissions is thought to be essential to the long-term mitigation of climate change because carbon dioxide is expected to continue as the dominant anthropogenic greenhouse gas well into the future (e.g., Hansen et al., 2000; IPCC, 2001). Since energy use is the primary source of anthropogenic emissions of carbon dioxide, many strategies for greenhouse gas abatement focus on energy-related emissions."

EP1: "Future climate change will be the result of a combination of human-induced and natural forcings...However...the total anthropogenic effect on climate is projected to far exceed past climate variability (IPCC, 2001)."

EP2: Authors explicitly compute temperature changes arising from coal versus natural gas burning.

IP2: No position

2002	Hoffert, M. I., Caldeira, K., Benford, G., Criswell, D. R., Green, C., Herzog, H., Jain, A. K., Lackner, K. S., Lewis, J. S., Lightfoot, H. D., Manheimer, W., Mankins, J. C., Mauel, M. E., Perkins, L. J., Schlesinger, M. E., Volk, T., Wigley, T. M. L.	Advanced technology paths to global climate stability: energy for a greenhouse planet	Science	N/A	1 1 1 1

EP2: "Stabilizing the carbon dioxide-induced component of climate change is an energy problem. Establishment of a course toward such stabilization will require the development within the coming decades of primary energy sources that do not emit carbon dioxide to the atmosphere, in addition to efforts to reduce end-use energy demand."

EP3b: "The fossil fuel greenhouse theory has become more credible as observations accumulate and as we better understand the links between fossil fuel burning, climate change, and environmental impacts. Atmospheric CO_2 has increased from 275 to 370 parts per million (ppm). Unchecked, it will pass 550 ppm this century. Climate models and paleoclimate data indicate that 550 ppm, if sustained, could eventually produce global warming comparable in magnitude but opposite in sign to the global cooling of the last Ice Age...Atmospheric CO_2 stabilization targets as low as 450 ppm could be needed to forestall coral reef bleaching, thermohaline circulation shutdown, and sea level rise from disintegration of the West Antarctic Ice Sheet."

EP3b: "Even as evidence for global warming accumulates, the dependence of civilization on the oxidation of coal, oil, and gas for energy makes an appropriate response difficult."

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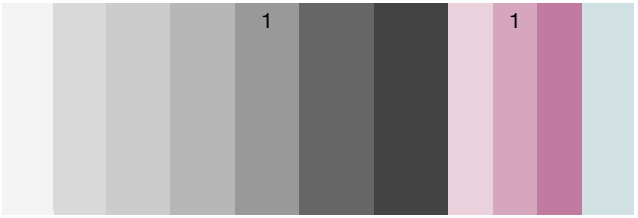
SP1: "Even as evidence for global warming accumulates, the dependence of civilization on the oxidation of coal, oil, and gas for energy makes an appropriate response difficult."

2003	Kheshgi, H. S., Jain, A. K.	Projecting future climate change: implications of carbon cycle model intercomparisons	Global Biogeochemical Cycles	N/A	

EP3a: Authors identify the carbon cycle as a key contributor to uncertainty in climate projections. They note that "climate projections communicated by the IPCC TAR did not account for uncertainty in future carbon cycle behavior." This work incorporates that uncertainty, based on the authors' work contributing to the IPCC TAR, and revise temperature and CO_2 projections accordingly. They find that the uncertainties/error bars get wider. However, the paper does in fact model temperature rise for different scenarios and demonstrate warming (with larger error bars). We do not code this as doubt, since it is reasonable scientific work that in fact reduces uncertainty around the consensus position.

EP4b-2: "Currently, our ability to forecast future climate is in question. Models are used to make projections of future climate, based on scenarios of future human activities and emissions, by simulating each link in the causal chain relating these scenarios to changes in climate. The estimation of the uncertainty of this causal chain remains an important scientific challenge."

IP2: No position

2003	Le Quéré, C., Aumont, O., Bopp, L., Bousquet, P., Ciais, P., Francey, R., Heimann, M., Keeling, C. D., Keeling, R. F., Kheshgi, H., Peylin, P., Piper, S. C., Prentice, I. C., Rayner, P. J.	Two decades of ocean CO_2 sink and variability	Tellus	N/A	

EP4a: No position.

IP2: No position

2004	Kheshgi, H. S., Archer, D.	A non-linear convolution model for the evasion of CO_2 injected into the deep ocean	Journal of Geophysical Research	N/A	

EP2: "The evasion of captured CO_2 released into the deep oceans is an important factor in determining the effectiveness of marine CO_2 disposal as an option to mitigate climate change from an enhanced greenhouse effect."

EP3a: "Deep ocean storage of CO_2 captured from, for example, flue gases is being considered as a potential response option to global warming concerns."

IP2: No position

2004 Kheshgi, H. S. | Evasion of CO_2 injected into the ocean in the context of CO_2 stabilization | Energy | N/A

EP3a: "The eventual evasion of injected CO_2 to the atmosphere is one consideration when assessing deep-sea disposal of CO_2 as a potential response to climate change concerns."

EP3a: Author introduces the idea of “cumulative fossil fuel use” and “cumulative CO_2 emissions.” Fig. 3 shows that a “550 ppm stabilization trajectory” requires a rapid decline in annual CO_2 emissions, with cumulative emissions between 2015 and 2100 (integrating area beneath curve) of roughly 490 GtC. This is comparable to contemporary carbon budget estimates for <2 °C of roughly 442-651 GtC (see caption of table S2). Author also notes that "cumulative fossil fuel use of 2000 Gt C might not exhaust global fossil fuel reserves, but limits to fossil fuel use might be driven by better alternatives that emerge over the next century." He refers to "notional scenarios for a fossil fuel era of limited duration."

IP2: No position

2004 Kheshgi, H. S. | Ocean carbon sink duration under stabilization of atmospheric CO_2: a 1,000-year time-scale | Geophysical Research Letters | N/A

EP2: "The fraction of anthropogenic CO_2 emissions that remains in the atmosphere, and contributes to the radiative forcing of climate, depends on carbon uptake by the oceans, plants and soils [Kheshgi et al., 1996]."

IP2: No position

2005 Kheshgi, H. S., Prince, R. | Sequestration of fermentation CO_2 from ethanol production | Energy | N/A

EP2: "Concern about an enhanced greenhouse effect, and the climate change risks that it poses, has led to consideration of both renewable energy and carbon sequestration as means for controlling the atmospheric concentration of CO_2. Over the past 100 years, atmospheric CO_2 concentration has increased as a consequence of fossil fuel emissions, and the oxidation of plant and soil carbon that has resulted from forest clearing and agriculture."

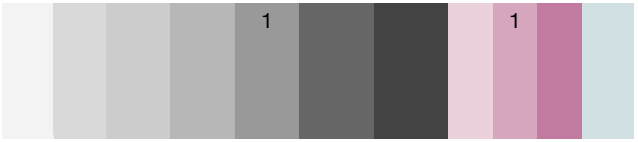
IP2: No position

2005 Kheshgi, H.S., Smith, S.J., Edmonds, J.A. | Emissions and Atmospheric CO_2 Stabilization: Long-term Limits and Paths | Mitigation and Adaptation Strategies | N/A

EP3a: "Ocean surface temperature anomalies calculated with equilibrium climate sensitivities of 1.5 to 4.5 °C for CO_2 doubling (shaded region in Figure 1). Higher climate sensitivity is associated with higher the (sic) equilibrium concentration. Results in Table I were performed using a sensitivity of 2.5 °C for CO_2 doubling (thick line in Figure 1). In this analysis, temperature is assumed to be driven solely by CO_2."

IP3: "These scenarios illustrate the possibility that atmospheric CO_2 concentrations, at least over the very long term, can return to levels far lower than previously considered. A decline toward zero emissions might, for example, be part of a long-term strategy, could be the result of a change in climate goals, or could be the result of an economically driven energy transition to non-emitting technologies...The desirability of such paths will depend on the impacts on climate, human and natural systems."

2005 Prince, R.C., Kheshgi, H.S. | The photobiological production of hydrogen: potential efficiency and effectiveness as a renewable fuel | Critical Reviews in Microbiology | N/A



EP4a: No position.

IP2: No position

2005 Caldeira, K., Akai, M., Brewer, P., Chen, B., Haugan, P., Iwama, T., Johnston, P., Kheshgi, H., Li, Q., Ohsumi, T., Poertner, H., Sabine, C., Shirayama, Y., Thomson, J. | Ocean storage (Chapter 6) | IPCC Special Report on Carbon Dioxide Capture and Storage | N/A

EP3a: No explicit discussion of AGW, but there is implicit acknowledgment of it [in part because this special report was written by the IPCC's WGIII climate change Mitigation authors - see Foreword]: "Captured CO_2 could be deliberately injected into the ocean at great depth, where most of it would remain isolated from the atmosphere for centuries...The increase in atmospheric CO_2 concentrations due to anthropogenic emissions has resulted in...It is not known whether the public will accept the deliberate storage of CO_2 in the ocean as part of a climate change mitigation strategy."

IP2: No position

2007 Barker, T., Bashmakov, I., Alharthi, A., Amann, M., Cifuentes, L., Drexhage, J., Duan, M., Edenhofer, | Mitigation from a cross-sectoral perspective | Intergovernmental Panel on Climate Change Fourth Assessment Report, Working Group 3, Chapter | N/A

	O., Flannery, B., Grubb, M., Hoogwijk, M., Ibitoye, F. I., Jepma, C. J., Pizer, W. A.		11			

EP3a: No explicit discussion of AGW, but the entire chapter is focused on the "cross-sectoral approach to mitigation options and costs" and on a couple of occasions, refers to "human-induced climate change" and "mitigating climate change" as the implicit motivations of this work. Notably, this chapter is part of the IPCC's WGIII climate change Mitigation volume.

IP2: No position

2007	Schlesinger, M. E., Kheshgi, H. S. (Editor; Coordinating Editor for Part 1), et al.	Probabilistic estimates of climate change: methods, assumptions and examples (p. 49-61)	Human-Induced Climate Change: An Interdisciplinary Assessment	N/A	1 1 1 1	

EP2: the containing book is entitled "Human-Induced Climate Change"

EP3a: Chapter 4 (Kheshgi), Fig. 4.1 presents computed AGW due to IPCC emission scenarios that specifically forecast future human GHG emissions.

EP4b-2: This book chapter focuses on providing "a catalog of uncertain factors." Nothing strictly incorrect, but it communicates a sense of substantial uncertainty. "State-of-the-art climate models are subject to well-known uncertainties and gaps in our understanding of the climate system that prevent confident estimates of future climate based on their a-priori results...unrelenting uncertainties in climate simulations."

IP2: No position

2007	Ribeiro, S. K.,..., Kheshgi, H. (Review Editor), et al.	Transport and its infrastructure	Intergovernmental Panel on Climate Change Fourth Assessment Report, Working Group 3, Chapter 5	N/A	1 1	

EP3a: Doesn't explicitly discuss AGW, but clear implicit assumption that climate mitigation is the motivation of this work on "mitigating greenhouse gas emissions" of the transportation sector [this chapter is part of the WGIII IPCC climate Mitigation volume].

EP3a: [In a box entitled "Non-CO_2 climate impacts"]: "When considering the mitigation potential for the transport sector, it is important to understand the effects that it has on climate change. Whilst the principal GHG emitted is CO_2, other pollutants and effects may be important and control/mitigation of these may have either technological or operational trade-offs."

EP3a: "Another type of operational system/mitigation potential is to consider the total climate impact of aviation."

EP3a: "Since benefits of biofuels for CO_2 mitigation mainly come from the well-to-tank part, incentives for biofuels are more effective climate policies if they are tied to the whole well-to-wheels CO_2 efficiencies."

EP3a: "Policies to address the full climate impact of aviation. A major difficulty in developing a mitigation policy for the climate impacts of aviation is..."

EP3a: [under the subheading of "Non-climate policies"]: "Climate change is a minor factor in decision making and policy in the transport sector in most countries. "

IP2: No position

2007 Schlesinger, M. E., Kheshgi, H. S. (Editor; Coordinating Editor for Part 1), et al. | Part 1, Climate System Science (p. 2-3) | Human-Induced Climate Change: An Interdisciplinary Assessment | N/A

EP2: the book as a whole is entitled "Human-Induced Climate Change"

EP2: "Part 1, Climate System Science" (Kheshgi): "The Earth sciences form core disciplines contributing to the interdisciplinary assessment of human-induced climate change."

EP2: "Part 1, Climate System Science" (Kheshgi): "From the earliest integrated assessments of climate change that sought to balance, to (sic) costs of mitigation with the benefits of avoiding climate change, climate sensitivity was seen as a key uncertainty in such analyses...While the accurate determination of climate sensitivity has withstood continued efforts by climate scientists, there are a growing number of studies that document that climate sensitivity is, indeed, highly uncertain...In particular, recent estimates include the possibility that climate sensitivity may be high, presenting challenging questions on how to plan for such an outcome should it prove true."

EP2: "Part 1, Climate System Science" (Kheshgi): "The long-term accumulation of carbon dioxide remains central to the concern for human-induced climate change."

IP2: No position

2009 Lively, R. P., Chance, R. R., Kelley, Deckman, H. W., Drese, J. H., Jones, C. W., Koros, W. J. | Hollow fiber adsorbents for CO_2 removal from flue gas | Ind. Eng. Chem. Res. | N/A

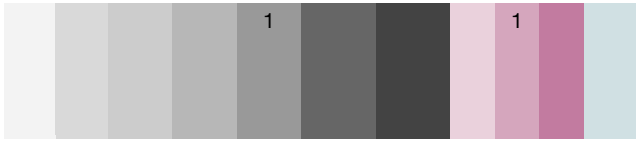
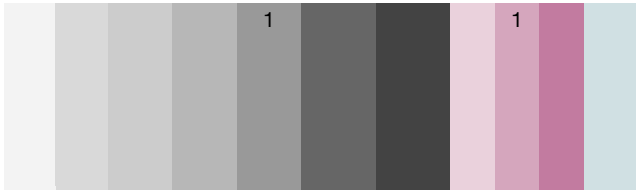
EP4a: No position.

IP2: No position

2009 Jain, A., Yang, X., Kheshgi, H., McGuire, A. D., Post, W., Kicklighter, D. | Nitrogen attenuation of terrestrial carbon cycle response to global environmental factors | Global Biogeochemical Cycles | N/A

EP4a: No position.

IP2: No position

2009	Benge, G. EP4a: No position IP2: No position	Improving wellbore seal integrity in CO_2 injection wells	Energy Procedia	N/A	
2009	Hershkowitz, F., Deckman, H. W., Frederick, J. W., Fulton, J. W., Socha, R. F. EP4a: No position IP2: No position	Pressure swing reforming: a novel process to improve cost and efficiency of CO_2 capture in power generation	Energy Procedia	N/A	
2009	Kheshgi, H. S., Crookshank, S., Cunha, P., Lee, A., Bernstein, L., Siveter, R. EP4a: No position IP2: No position	Carbon capture and storage business models	Energy Procedia	N/A	
2009	Northrop, P. S., Valencia, J. A. EP4a: No position IP2: No position	The CFZTM process: a cryogenic method for handling high-CO_2 and H_2S gas reserves and facilitating geosequestration of CO_2 and acid gases	Energy Procedia	N/A	

2009 Parker, M. E., Meyer, J. P., Meadows, S. | Carbon dioxide enhanced oil recovery injection operations technologies | Energy Procedia | N/A

EP4a: No position

IP2: No position

2009 Ritter, K., Siverter, R., Lev-On, M., Shires, T., Kheshgi, H. | Harmonizing the quantification of greenhouse gas emission reductions through oil and gas industry project guidelines | Energy Procedia | N/A

EP3a: Authors refer to this CCS work as "application of CCS toward climate change mitigation" and repeatedly refer to "effective GHG emissions mitigation."

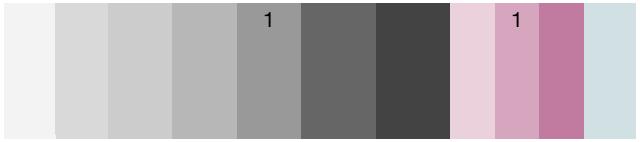
IP2: No position

2009 Wilkinson, J., Szafranski, R., Lee, K. -S., Kratzing, C. | Subsurface design considerations for carbon dioxide storage | Energy Procedia | N/A

EP4a: No position

IP2: No position

2009 Xiao, Y., Xu, T., Pruess, K. | The effects of gas-fluid-rock interactions on CO_2 injection and storage: insights from reactive transport modeling | Energy Procedia | N/A



EP4a: No position

IP2: No position

2011	Flannery, B.P. EP4a: No position. IP2: No position	Comment	Energy Economics	N/A	
2011	Burgers, W. F. J., Northrop, P. S., Kheshgi, H. S., Valencia, J. A. EP4a: No position IP2: No position	Worldwide development potential for sour gas	Energy Procedia	N/A	
2011	Parker, M. E., Northrop, S., Vaencia, J. A., Foglesong, R. E., Duncan, W. T.	CO_2 management at ExxonMobil's LaBarge field, Wyoming, USA	Energy Procedia	N/A	
	EP4a: Although authors make several references to "mitigating GHG emissions," no mention of AGW. For consistency, such cases are coded EP4a. IP2: No position				
2012	Kheshgi, H., Thomann, H., Bhore, N. B., Hirsh, R. B., Parker, M. E., Teletzke, G. F. EP4a: No position. IP2: No position	Perspectives on CCS cost and economics	SPE Economics & Management	N/A	
2014	Allen, R. J., Landuyt, W.	The vertical distribution of black carbon in CMIP5 models: Comparison to observations and the importance of convective transport	J. Geophys. Res. Atmos.	N/A	

EP2: "Aerosols play an important role in Earth's radiative balance, in particular by scattering and absorbing solar radiation and indirectly by affecting the formation, lifetime, and albedo of clouds...Further understanding of these quantities and processes is essential for determining the subsequent impact of aerosols on regional and global climate...An important aerosol constituent is black carbon (BC)...Emissions sources for BC include open biomass burning as well as combustion of fossil and bio-based fuels [Bond et al., 2004]. A distinguishing feature of BC is that it strongly absorbs solar radiation, and this direct effect on radiative forcing (RF) leads to warming of the atmosphere...These estimates of BC RF suggest that it is the second largest climate warming agent, behind only carbon dioxide...Open biomass burning, for example, constitutes the largest single source in most BC emission inventories."

IP2: No position

2014 Song, Y., Jain, A. K., Landuyt, W., Kheshgi, H. S., Khanna, M.

Estimates of Biomass Yield for Perennial Bioenergy Grasses in the United States

BioEnergy Research

N/A

EP4a: No position.

IP2: No position

2014 Fischedick M., Roy, J., Abdel-Aziz, A., Acquaye, A., Allwood, J. M., Ceron, J. -P., Geng, Y., Kheshgi, H., Lanza, A., Perczyk, D., Price, L., Santalla, E., Sheinbaum, C., Tanaka, K.

Industry

Intergovernmental Panel on Climate Change Fifth Assessment Report, Working Group 3, Chapter 10

N/A

EP3a: No explicit discussion of AGW, but AGW is the clear implicit motivation of this paper's focus on industry approaches to climate mitigation [in part because this chapter is part of the IPCC's WGIII climate change Mitigation volume]: "An absolute reduction in emissions from the industry sector will require deployment of a broad set of mitigation options beyond energy efficiency measures...Long-term step-change options can include a shift to low carbon electricity, radical product innovations (e.g., alternatives to cement), or carbon dioxide capture and storage (CCS). Once demonstrated, sufficiently tested, cost-effective, and publicly accepted, these options may contribute to significant climate change mitigation in the future...While the largest mitigation potential in industry lies in reducing CO_2 emissions from fossil fuel use, there are also significant mitigation opportunities for non-CO_2 gases."

IP2: No position

2014 Arent, D. J.,..., Kheshgi, H. (Review Editor), et al.

Key economic sectors and services

Intergovernmental Panel on Climate Change Fifth Assessment Report, Working Group 2, Chapter 10

N/A

EP2: A large number of statements assume AGW is real and human caused - it is the fundamental premise of this chapter that investigates the "key economic sectors and services" vulnerable to climate change [this chapter is part of the IPCC's WGIII climate Mitigation volume].

EP2: "This chapter assesses the implications of climate change on economic activity in key economic sectors and services, on economic welfare, and on economic development."

EP2: "For most economic sectors, the impact of climate change will be small relative to the impacts of other drivers."

EP2: "Climate change will reduce energy demand for heating and increase energy demand for cooling in the residential and commercial sectors"

EP2: "Climate change will affect different energy sources and technologies differently, depending on..."

EP2: "Climate-induced changes in the availability and temperature of water for cooling are the main concern for thermal and nuclear power plants."

EP2: "Climate change may influence the integrity and reliability of pipelines and electricity grids...Climate change may require changes in design standards for the construction and operation of pipelines and power transmission and distribution lines."

EP2: "Climate change will have impacts, positive and negative and varying in scale and intensity, on water supply infrastructure and water demand (robust evidence, high agreement), but the economic implications are not well understood."

EP2: "Climate change may negatively affect transport infrastructure"

EP2: "Climate change will affect tourism resorts, particularly ski resorts, beach resorts, and nature resorts (robust evidence, high agreement) and tourists may spend their holidays at higher altitudes and latitudes"

EP2: "Climate change will affect insurance systems"

EP2: "Climate change will affect the health sector"

EP2: "The impacts of climate change may decrease productivity and economic growth, but the magnitude of this effect is not well understood (limited evidence, high agreement). Climate could be one of the causes why some countries are trapped in poverty, and climate change may make it harder to escape poverty."

IP3: "For most economic sectors, the impact of climate change will be small relative to the impacts of other drivers."

IP1: "Climate change will reduce energy demand for heating and increase energy demand for cooling in the residential and commercial sectors."

IP1: "Climate change will affect different energy sources and technologies differently, depending on..."

IP1: " Climate-induced changes in the availability and temperature of water for cooling are the main concern for thermal and nuclear power plants."

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IP1: "Climate change will have impacts, positive and negative and varying in scale and intensity, on water supply infrastructure and water demand (robust evidence, high agreement), but the economic implications are not well understood."

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IP1: "Climate change will affect tourism resorts, particularly ski resorts, beach resorts, and nature resorts (robust evidence, high agreement) and tourists may spend their holidays at higher altitudes and latitudes"

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Non-Peer-Reviewed Documents

Year	Authors	Title	Journal	Conference	EP1	EP2	EP3a	EP3b	EP4a	EP4b-1	EP4b-2	IP1	IP2	IP3	SP1
1980	Shaw, H.	Draft statement of findings and recommendations	N/A	National Commission on Air Quality CO_2 Workshop			1	1			1	1		1	1

Note: This source document is, strictly speaking, an internal ExxonMobil memorandum. However, the document in question, contained within the memorandum, is a draft of a public report by a national commission on air quality. On balance, we therefore classify this document as a non-peer-reviewed publication rather than an internal document.

Note: edits ("ADDED" and "DELETED") show mark-ups by Shaw to this draft statement.

EP3b/4b-2 [pre 1995]: "Climate models indicate that if atmospheric CO_2 levels continue to increase at existing or accelerated rates, a globally-averaged warming of the lower atmosphere, [ADDED: possibly] leading to changes in world climate (such as changes in the distribution of precipitation) [ADDED: may] [DELETED: almost surely will] occur. For example, an [ADDED: ad hoc] group of the National Academy of Sciences' Climate Research Board recently [ADDED: evaluated the results from a number of climatological models, and indicated that based on the current state-of-the-art (which is quite rudimentary),] [DELETED: predicted that] a global increase of 3 °C +/- 1.5 °C in the annual average temperature [ADDED: is the best estimate that can be made for] [DELETED: will probably result from] a doubling of the atmospheric concentration of CO_2."

EP4b-2: "Despite the [ADDED: large] scientific uncertainties, however, some members of the scientific community [ADDED: and others] have advocated that actions be taken to prevent or mitigate CO_2-induced climate change...[ADDED: It should be noted, however, that Congressional testimony by key scientific experts in the relevant disciplines dealing with the CO_2 question recommended that our energy options not be narrowed at this time.]"

EP3a: "...the following statement represents a general consensus among the participants. Findings. 1. While CO_2-induced changes in global climate may have certain beneficial effects, it is believed that the net consequences of these changes will be adverse to the stability of human and natural communities...3. In (sic) policy actions to control the increased CO_2 loading of the atmosphere are delayed until climate changes resulting from such an increase are discernible, then it is likely that they will occur too late to be effective. 4. In light of finding #3, it is likely that policy actions to control the long-term growth of atmospheric CO_2 levels will need to be taken with imperfect knowledge of the probability and consequences of CO_2-induced climate change."

IP3: "Among the [ADDED: postulated possible] [DELETED: potential direct] results of such alterations in world climate due to a global temperature increase are changes in agriculture..."

IP3: "...changes resulting from man-induced increases in the CO_2 content of the atmosphere are of special concern because they can occur [ADDED: within a century] [DELETED: over decades], rather than over millennia,..."

IP3: "...it will be very difficult, [ADDED: but important] [DELETED: yet-it-is-essential] to place the CO_2 issue on the nation's public policy agenda."

IP3: "The U.S. should consider an increase in the rate of CO_2 emissions [ADDED: as probably] undesirable and should explicitly seek [DELETED: to control the long-term growth of CO_2 emissions in] [ADDED: to develop discussions on] national and international policies..."

IP3: "During deliberations concerning these policies, the differences in CO_2 emissions per unit of energy output of the different fossil fuels should be weighed [DELETED: heavily]. [ADDED: However, the market penetration of new technologies that would produce more net CO_2 per unit of useful energy, such as synfuels, is sufficiently slow to cause relatively minor concern about accelerating the CO_2 build-up over the century.]"

IP1: "Over the past twenty years, an increase in the global atmospheric concentration of carbon dioxide (CO_2) has been observed. This increase has been attributed primarily

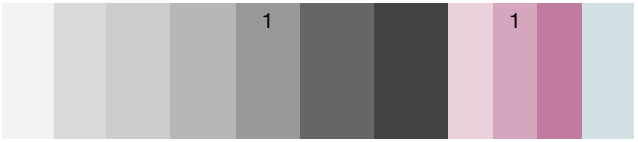
to the combustion of fossil fuels...Climate models indicate that if atmospheric CO_2 levels continue to increase at existing or accelerated rates, a globally-averaged warming of the lower atmosphere, possibly leading to changes in world climate (such as changes in the distribution of precipitation) may occur. For example, an ad hoc group of the National Academy of Sciences' Climate Research Board recently evaluated the results from a number of climatological models, and indicated that based on the current state-of-the-art (which is quite rudimentary), a global increase of 3 °C +/- l.5 °C in the annual average temperature is the best estimate that can be made for a doubling of the atmospheric concentration of CO_2."

IP1: "Among the postulated possible results of such alterations in world climate due to a global temperature increase are changes in agriculture; in the stability, distribution, and productivity of natural ecosystems; and eventually; the sea level (due to the collapse of a portion of the West Antarctic ice sheet). Although changes in climate have occurred naturally since the earth was formed, changes resulting from man-induced increases in the CO_2 content of the atmosphere are of special concern because they can occur within a century, rather than over millennia, and because the increases are expected to persist for hundreds of years."

IP1: "...the following statement represents a general consensus among the participants. Findings. 1. While CO_2-induced changes in global climate may have certain beneficial effects, it is believed that the net consequences of these changes will be adverse to the stability of human and natural communities...3. In (sic) policy actions to control the increased CO_2 loading of the atmosphere are delayed until climate changes resulting from such an increase are discernible, then it is likely that they will occur too late to be effective. 4. In light of finding #3, it is likely that policy decisions to control the long-term growth of atmospheric CO_2 levels will need to be taken with imperfect knowledge of the probability and consequences of CO_2-induced climate change."

SP1: "Despite the [ADDED: large] scientific uncertainties, however, some members of the scientific community [ADDED: and others] have advocated that actions be taken to prevent or mitigate CO_2-induced climate change...[ADDED: It should be noted, however, that Congressional testimony by key scientific experts in the relevant disciplines dealing with the CO_2 question recommended that our energy options not be narrowed at this time.]"

1981 Hoffert, M. I., Callegari, A. J., Hsieh, C. -T. | A box-diffusion carbon cycle model with upwelling, polar bottom water formation and a marine biosphere | Carbon Cycle Modeling, Scope 16 | Follow-up report from 1979 SCOPE Workshop on Global Carbon Cycle Modeling in La Jolla, CA



EP4a: Authors run the model "under un-steady conditions to predict the build-up of atmospheric carbon dioxide using the fossil fuel burning source function of Siegenthaler and Oeschger." They introduce carbon cycle models: "The current generation of carbon cycle models focus on addressing a number of questions which are being asked with regard to the well-documented build-up of atmospheric carbon dioxide from fossil fuel burning, and on the climatological implications of this build-up by the CO_2 "greenhouse effect". To understand the increase in atmospheric carbon dioxide observed worldwide thus far, and to attempt to forecast the future changes associated with different scenarios of fuel utilization, it is necessary to understand and model first the natural distribution of carbon in the environment under unperturbed conditions."

IP2: No position

1981 Hansen, J.,...Flannery, B. (Atmospheric Panel Member), et al. | The Atmosphere, Chapter 2, Proceedings of the Workshop on First Detection of Carbon Dioxide | N/A | Workshop on First Detection of Carbon Dioxide, U.S. Department of Energy

EP4b-2: "Climate is never constant, but has changed in the past from a variety of natural causes. Now the scientific community is faced with a new challenge - the detection of a potential climate change arising from increasing atmospheric carbon dioxide derived mainly from human activity, and the differentiation of this particular climate change from changes caused by other factors...It is fair to say, however, that there will always remain an element of uncertainty in any determination that the observed climate change can be attributed to increasing carbon dioxide released by human activities. This is not a new situation, of course. In the end it must be the purpose of the scientific community to present its understanding of the facts, together with uncertainties, as clearly as possible so that the public and its leaders can draw their own conclusions about the

significance of the climate change and what it means in human terms."

EP4b-2: "There have been some studies asserting that the climate change due to carbon dioxide is already demonstrable, but there are reasons for reserving judgment on these claims until we understand the situation better. The consensus of the panel was that...more theoretical and empirical work have to be done to enhance our capability for demonstrating convincingly the existence (or nonexistence) of a CO_2-induced climate change."

EP3b: "The conviction in the scientific community that the observed trend of increasing carbon dioxide, if it continues, will cause a global warming is based on a variety of theoretical studies. These studies have involved a hierarchy of mathematical models of the climate system, ranging from one-dimensional radiative-convective models and latitudinally dependent energy-balance models to three-dimensional and time-dependent general circulation models (GCMs) coupled to a model ocean. Each of these kinds of models is useful in its own way, but the coupled-GCM type of model obviously describes the global climate in more detail...Such climate model experiments have been repeated many times and with different models, and the results are now fairly consistent. For a carbon dioxide doubling the calculated mean surface-air temperature increase is approximately 2° to 3° C. The warming is 2 to 3 times larger in the northern polar regions. The stratosphere is considerably cooler. Other model-predicted features are shifts of precipitation and soil moisture, retreat of polar snow and sea ice, and changes of large-scale circulation patterns."

IP1: "The conviction in the scientific community that the observed trend of increasing carbon dioxide, if it continues, will cause a global warming is based on a variety of theoretical studies. These studies have involved a hierarchy of mathematical models of the climate system, ranging from one-dimensional radiative-convective models and latitudinally dependent energy-balance models to three-dimensional and time-dependent general circulation models (GCMs) coupled to a model ocean. Each of these kinds of models is useful in its own way, but the coupled-GCM type of model obviously describes the global climate in more detail...Such climate model experiments have been repeated many times and with different models, and the results are now fairly consistent. For a carbon dioxide doubling the calculated mean surface-air temperature increase is approximately 2° to 3° C. The warming is 2 to 3 times larger in the northern polar regions. The stratosphere is considerably cooler. Other model-predicted features are shifts of precipitation and soil moisture, retreat of polar snow and sea ice, and changes of large-scale circulation patterns."

1982 Warner Jr., R. (Chairman, Mobil Corp) | Energy and the environment: the next decade | Industry and Environment, The Next Decade (by UNEP) | N/A

EP4a: "The switch to heavier fossil fuels has already caused much popular concern, primarily seen in some nations' fear of the effects of acid rain and the general fear that excessive use of these fuels may so build up carbon dioxide in the atmosphere that the earth's temperature may increase, with some disastrous consequences. Each of these fears should be seriously addressed..."

IP3: "As for the so-called "greenhouse effect" of carbon dioxide buildup, I recognize that this too may become a serious issue for the future. But I believe such international efforts as UNEP's Earthwatch international surveillance network, and studies by government agencies and such prestigious institutions as the National Academy of Sciences in the United States, can supply us with the information to deal with this problem well before the catastrophic consequences which some predict can happen."

IP2 [generic "risk"]: "New issues, such as acid rain and the danger of carbon dioxide buildup, need to be carefully monitored, and action taken if necessary."

SP1: "...I believe we can continue to protect our environment for future generations, while providing the energy on which improvement in world living standards depends." This is only a mild expression that “it’s too hard”, but it reinforces the “CO_2 limits will harm the economy” and “CO_2 limits will hurt the poor” narratives [33]. Therefore, on balance, we code as SP1.

1984 David Jr., E. E. (President, Exxon Research and Engineering Company) | Inventing the Future: Energy and the CO_2 "Greenhouse" Effect | Geophysical Monograph Series, Climate Processes and Climate Sensitivity | Remarks at the Fourth Annual Ewing Symposium, Tenafly, NJ

EP3a: "Few people doubt that the world has entered an energy transition away from dependence upon fossil fuels and toward some mix of renewable resources that will not pose problems of CO_2 accumulation...since fossil fuels, and liquid chemical fuels, are really the heart of the energy and the CO_2 problem, I will focus on those."

EP3a: David notes that "I'm generally upbeat about the chances of coming through this most adventurous of all human experiments with the eco-system."

EP3b: "It is ironic that the biggest uncertainties about the CO_2 buildup are not in predicting what the climate will do, but in predicting what people will do. The scientific community is apparently reaching some consensus about the general mechanisms of the greenhouse effect. It is considerably less agreed on how much fossil fuels mankind will burn; how fast economies will grow; what energy technologies societies will foster and when; and so how fast the buildup will occur."

EP3a: David describes projections run by Exxon: "Beyond our normal twenty-year outlook period, we recently attempted a forecast of the CO_2 build-up. We assumed different growth rates at different times, but with an average growth rate in fossil fuel use of about one percent a year starting today, our estimate is that the doubling of atmospheric CO_2 levels might occur sometime late in the 21th century. That includes the impacts of synfuels industry. Assuming the greenhouse effect occurs, rising CO_2 concentrations might begin to induce climatic changes around the middle of the 21th century...The real point of these extrapolations is to get an understanding of how soon the problem may become serious enough to require action. And the lesson is that, while the issue is clearly important, we can still afford further research on the problem."

EP3a: "...the world continues to grapple with the profound issues posed by the CO_2 buildup..."

IP3: David describes projections run by Exxon: "Beyond our normal twenty-year outlook period, we recently attempted a forecast of the CO_2 build-up. We assumed different growth rates at different times, but with an average growth rate in fossil fuel use of about one percent a year starting today, our estimate is that the doubling of atmospheric CO_2 levels might occur sometime late in the 21th century. That includes the impacts of synfuels industry. Assuming the greenhouse effect occurs, rising CO_2 concentrations might begin to induce climatic changes around the middle of the 21th century...The real point of these extrapolations is to get an understanding of how soon the problem may become serious enough to require action. And the lesson is that, while the issue is clearly important, we can still afford further research on the problem."

IP1: "clearly, there is vast opportunity for conflict: For example, it is more than a little disconcerting the few maps showing the likely effects of global warming seem to reveal the two superpowers losing much of the rainfall, with the rest of the world seemingly benefitting."

IP2 [generic "risk"]: "...the world continues to grapple with the profound issues posed by the CO_2 buildup..."

1989 Kheshgi, H. S. | The sensitivity of CO_2 projections to ocean processes | N/A | Third International Conference on Analysis and Evaluation of Atmospheric CO_2 Data

EP3a [pre-1990]: Author notes that "Direct observation shows that the concentration of CO_2 is increasing in the atmosphere, apparently as a result of the actions of man through combustion of fossil fuel and deforestation." They use a carbon cycle model to model "projected atmospheric CO_2" due to different fossil fuel and decarbonization scenarios and under different ocean uptake responses. The author concludes that "The sensitivity studies do show, nevertheless, that processes in the oceans can affect projections of climate change; and the response of these processes to climate change is not fully understood. With further study of ocean processes, the uncertainty of climate and carbon cycle projection...can be reduced, and a better understanding may indicate ocean-related means for mitigation of any enhanced greenhouse effect."

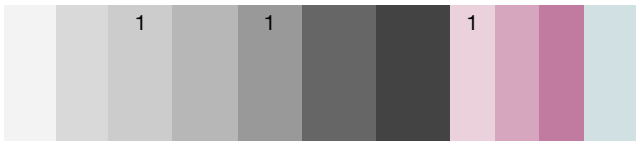
IP2: No position

1992 Hadlow, R. E. | Update of Industry Experience With CO_2 Injection | N/A | 67th Annual Technical Conference and Exhibition of the Society of Petroleum

				Engineers, Washington, DC. October 4-7, 1992	

EP4a: No position

IP2: No position

1995	Kheshgi, H. S.	Research relevant to the integrated assessment of climate change	N/A	Proceedings of the Third Japan-US Workshop on Global Change Modeling and Assessment	

EP3a: They describe their integrated science model that incorporates "radiative forcing of climate by greenhouse gases, an energy balance model for global temperature response to forcing, and a model for sea level response."

EP4a [pre-1995]: "Concern over possible climate change from an enhanced greenhouse effect has created pressure for policies..."

EP3a: Implicit acknowledgment of AGW through description of work on several different mitigation options: CCSU, reforestation, "sequestering atmospheric carbon dioxide by increasing ocean alkalinity."

IP1: Authors refer to AGW's "possible ecological, economic and social impacts."

1995	Kheshgi, H. S., Jain, A. K., Wuebbles, D. J	Accounting for the missing carbon sink in global carbon cycle models	N/A	Tsukuba Global Carbon Cycle Workshop	

EP4a: Models carbon cycle without any mention of AGW. For consistency, such cases are coded EP4a.

IP2: No position

1995	Jain, A. K., Kheshgi, H. S., Wuebbles, D. J.	Use of carbon isotopes for the calibration of global carbon cycle models	N/A	Tsukuba Global Carbon Cycle Workshop	

EP3a: Almost no discussion of AGW, but an implicit acknowledgment through reference to "assessments of fossil fuel greenhouse warming."

IP2: No position

1996	Edmonds, J. A., Wise, M.	Agriculture, Land Use, and	Pacific Northwest	N/A	

	A., Sands, R. D., Brown, R. A., Kheshgi, H. S.	Commercial Biomass Energy	Laboratory, PNNL-11155		

EP3a: Fig. 1, a summary of their model, visually connects "Human Activities" --> "Atmospheric Composition" --> "Climate & Sea Level" --> "Ecosystems".

IP1: Fig. 1, a summary of their model, visually connects "Human Activities" --> "Atmospheric Composition" --> "Climate & Sea Level" --> "Ecosystems".

1996	Raymond, L. (Chairman, Exxon Corp.)	Climate change: don't ignore the facts	“Global Warming: who’s right?” - Exxon Spring Publication, The Lamp	N/A	

EP4b-2: Title of pamphlet: "Global warming: who's right? Facts about a debate that's turned up more questions than answers".

EP4b-2: Title of Raymond's article: "Climate change: don't ignore the facts"

EP4b-2: "Today, however, a multinational effort, under the auspices of the United Nations, is under way to cut the use of fossil fuels, based on the unproven theory that they affect the earth's climate."

EP4b-2: "Proponents of the global warming theory say that higher levels of greenhouse gases - especially carbon dioxide - are causing world temperatures to rise and burning fossil fuels is the reason. Yet scientific evidence remains inconclusive as to whether human activities affect global climate...95 percent of the carbon dioxide entering the atmosphere is produced by nature and is beyond our control. Even a small increase in these natural-source emissions could negate any cuts made in the 4 percent of emissions caused by humans."

EP4b-2: "Unfortunately, huge economic consequences and scientific uncertainty have not prevented activists from politicizing the issue and trying to stir up unreasonable fears...This stance [global reductions in fossil fuel use] overlooks the need for longer-term research to determine whether human activity impacts global climate."

EP4b-2 [post-1995]: "Better understanding needed...[W]hat's the best way to manage the issue of potential global climate change? First, we must understand it better, and that's why Exxon is conducting its own research and supports that of others dealing with related science, economics and policy options."

EP4b-2: "Dealing with facts...[L]et's build on a foundation of facts...Precipitous, poorly considered action on climate change could inflict severe economic damage on industrialized nations and dramatically change your way of life. Those who say otherwise are drawing on bad science, faulty logic or unrealistic assumptions. We must reject policies that will clearly impose a heavy burden on costs but offer benefits that are largely speculative and undefined."

IP3: "Unfortunately, huge economic consequences and scientific uncertainty have not prevented activists from politicizing the issue and trying to stir up unreasonable fears...This stance [global reductions in fossil fuel use] overlooks the need for longer-term research to determine whether human activity impacts global climate."

IP3: "Taking drastic action immediately is unnecessary since many scientists agree there's ample time to better understand climate systems and develop the best long-term strategies."

SP1: Subtitle of Raymond's article: "The issue reaches into every home and pocketbook around the world."

SP1: "In the debate over global climate change, one of the most critical facts has become one of the most ignored - the undeniable link between economic vitality and energy use."

SP1: "This [UNFCCC] policy, if implemented, has ominous economic implications that could touch pocketbooks and impair lifestyles throughout and even beyond the

industrialized world. Developing nations...are excluded from most emission-reduction proposals, but they're not immune to their impact. In our increasingly integrated world economy, policies that limit growth in industralized nations affect trade with developing nations and hinder their economies as well. This would have profound implications since developing nations face real and immediate problems...adequate sanitation...without safe drinking water...disease and suffering. Solving these problems as populations increase requires economic growth, which, in turn, requires rising energy use."

SP1: "Meeting unrealistic targets for reductions in greenhouse gas emissions will require extreme measures involving increased central government control over energy use. Such measures would include higher energy taxes, fuel rationing and other steps designed to limit energy consumption...taxes required to reduce fossil fuel use to 1990 levels would be substantial. They could add about 60 cents to the price of a gallon of gasoline in the United States, more than quadrupling the federal excise tax on motor fuel, and could raise the price of residential and commercial fuels by 50 percent. The effect of such taxes could be slower economic growth, job losses and impaired ability to compete in foreign markets."

SP1: "...poorly considered action on climate change could inflict severe economic damage..."

SP1: "Worldwide fuel rationing"

SP1: "Dealing with facts...[L]et's build on a foundation of facts...Precipitous, poorly considered action on climate change could inflict severe economic damage on industrialized nations and dramatically change your way of life. Those who say otherwise are drawing on bad science, faulty logic or unrealistic assumptions. We must reject policies that will clearly impose a heavy burden on costs but offer benefits that are largely speculative and undefined."

SP1: "Unfortunately, huge economic consequences and scientific uncertainty have not prevented activists from politicizing the issue and trying to stir up unreasonable fears...This stance [global reductions in fossil fuel use] overlooks the need for longer-term research to determine whether human activity impacts global climate."

1996 Adler, J. H. | Global warming. What to think? What to do? | “Global Warming: who’s right?” - Exxon Spring Publication, The Lamp | N/A

EP4b-2: "Is global warming good or bad? Let's say human activity does contribute to warming the planet. What would that warming mean?..."

EP4b-2: "We face more questions than answers on almost every aspect of this issue."

EP4b-2: "The United Nations issued a summary report, observing in part that "a pattern of climatic response to human activities is identifiable in the climatological record." But none of this is as clear-cut as it may seem."

EP4b-1: "The British Meteorological Office's declaration of 1995 as the hottest year on record was based on incomplete data and did not meet universal acceptance."

EP4b-1: "Global weather satellites, which have taken the earth's temperature since 1979, found that 1995 was actually an average year."

EP4b-2: "As far as the U.N. declaration goes, the full underlying report acknowledged great uncertainty about climate change. It stopped short of blaming human activities for any recent trends."

EP4b-1/2: "Increases in global temperature may or may not be a sign of global warming caused by human activity. The rise in temperature since the late 19th century could be part of the natural fluctuations that occur over long periods of time. Such fluctuations took the earth in and out of ice ages for millennia. Satellite measurements...have shown absolutely no warming trend over the past 17 years."

EP4b-1: Figure on page 6-7, shows "absolutely no warming trend over the past 17 years."

EP4b-2: "Predictions of global warming are based on computer models that have proved to be inaccurate...Some scientists point out that computer-based models have been unable to represent current temperatures and climate accurately and are therefore a questionable guide to the next 50 to 100 years. The world has not warmed nearly as much as the models say it should have by now."

EP4b-2: "As models have improved, predicted temperatures have failed."

EP4b-2: "We need to know more about the effect of solar cycles on global temperature. Although they're getting better, current computer models may still overestimate observed warming. One possible reason for this is the sun. As Science magazine reported earlier this year, several recent studies have found a correlation between temperature changes and solar cycles [note, this is not a Science editorial, but a non-peer-reviewed opinion piece in Science by Richard A Kerr]...To date, solar cycles have not been incorporated into global climate computer models."

EP4b-2: "Notwithstanding the tremendous uncertainty surrounding global warming, delegates from around the world have scheduled several U.N.-sponsored meetings..."

EP4b-1/2: "The biggest remaining question is which will we begin to feel first: the possible heat of global warming or the weight of global warming policy?"

IP3: "Is global warming good or bad? Let's say human activity does contribute to warming the planet. What would that warming mean?...warming that occurs mostly during the winter would reduce extreme cold, increase cloud cover and moderate temperature fluctuations. This sort of warming is more likely to raise soil moisture levels than to produce severe droughts. To the extent that questions about the effects of global warming have been answered, the indications are that a warmed would be far more benign than many imagine...moderate warming would reduce mortality rates in the U.S., so a slightly warmer climate would be more healthful."

IP3: "...although changing weather patterns could mean disruption, the human capacity for adaptation has been established throughout recorded time."

IP3: "Clearly, considerable uncertainty exists about future climate change. We are faced with more questions than answered on almost every aspect of this issue, including whether possible changes could be both good and bad."

SP1: "[should governments] adopt policies now aimed at dramatically reducing greenhouse gas emissions - at huge economic costs to society?"

SP1: "The cost of reducing greenhouse gas emissions could be staggering....[numerous examples]"

SP1: "Studies show the projected temperature in the middle of the next century will scarcely be affected whether policies are enacted now or 20 years from now."

SP1: "There is still a tremendous amount of uncertainty about how the climate will change in the 21st century. More certain is the fact that seeking to achieve dramatic reductions in greenhouse gas emissions will require steep cuts in the use of energy from fossil fuels and greatly disrupt the world economy."

SP1: "The biggest remaining question is which will we begin to feel first: the possible heat of global warming or the weight of global warming policy?"

1997	Flannery, B. P., Kheshgi, H., Marland, G., MacCracken, M. C	Geoengineering climate	Engineering response to global climate change: planning a research and development agenda	N/A	

EP3a: "One possible response to concerns of climate change from the buildup of greenhouse gases in the atmosphere is to evaluate the potential to offset climate change, or its impacts, through intentional control of climate or of the concentrations of atmospheric greenhouse gases."

EP2: "It seems likely that climate will change to some degree as a result of human actions that have already occurred or to which we are committed."

EP2/4b-2 [post-1995]: "Potential climate change from an enhanced greenhouse effect is an example of geoengineering driven largely by human intervention in the

geochemical cycle of carbon." Contextually, the doubt expressed here by tentative wording is particularly mild and reflects common academic parlance. However, to ensure consistent identification of tentative wording across all documents, we code as EP4b-2 (as well as EP2).

EP3a: "Although the underlying cause of the greenhouse-induced climatic change is the modification of the infrared radiation balance by the increasing concentrations of greenhouse gases..."

EP2: "Preliminary inquiry suggests that geoengineering options might be technically able to counteract inadvertent human impacts on the Earth's climate system."

IP1: "Although model projections of a warmer Earth are uncertain, it appears that the intensity and tracks of storms may change. In addition, it has been suggested that severe storms such as hurricanes may increase in frequency and/or intensity...Projections suggest a potential sea level rise of up to about 1 m by 2100."

1997	Raymond, L. (Chairman, Exxon Corp.)	Energy - key to growth and a better environment for Asia-Pacific nations	N/A	Speech at World Petroleum Congress (October 13, 1997)					1	1		1	1	1

EP4b-2: "Proponents of the [upcoming UNFCCC Kyoto] agreements say they are necessary because burning fossil fuels causes global warming. Many people - politicians and the public alike - believe that global warming is a rock-solid certainty. But it's not."

EP4b-1: "In answer to the first question ["Is the Earth really warming?"], we know that natural fluctuations in the Earth's temperature have occurred throughout history - with wide temperature swings. The ice ages are a good example. In fact, one period of cooling occurred from 1940 to 1975. In the 1970s, some of today's prophets of doom from global warming were predicting the coming of a new ice age...sensitive satellite measurements have shown no warming trend since the late 1970s. In fact, the earth is cooler today than it was 20 years ago."

EP4b-2: "We also have to keep in mind that most of the greenhouse effect comes from natural sources, especially water vapor. Less than a quarter is from carbon dioxide, and, of this, only four percent of the carbon dioxide entering the atmosphere is due to human activities - 96 percent comes from nature. Leaping to radically cut this tiny sliver of the greenhouse pie on the premise that it will affect climate defies common sense and lacks foundation in our current understanding of the climate system."

EP4b-2: "Forecasts of future warming come from computer models that try to replicate Earth's past climate and predict the future. They are notoriously inaccurate. None can do it without significant overriding adjustments. Even then, 1390's models were predicting temperature increases of two to five degrees Celsius by the year 2100. Last year's models say one to three degrees. Where to next year?"

EP4b-2: "So the case for so called global warming is far from air tight. You would think that all the uncertainty would give political leaders pause. Unfortunately, it hasn't, and officials continue to insist that agreement is needed in Kyoto."

EP4b-2: "...let's agree there's a lot we really don't know about how climate will change in the 21st century and beyond. That means we need to understand the issue better, and fortunately, we have time. It is highly unlikely that the temperature in the middle of the next century will be significantly affected whether policies are enacted now of 20 years from now."

EP4b-2: "Before we make choices about global climate policies, we need an open debate on the science, an analysis of the risks, and a careful consideration of the costs and benefits. So far, this has not taken place, and until it has, I hope that the governments of this region will work with us to resist policies that could strangle economic growth."

IP3: "...let's agree there's a lot we really don't know about how climate will change in the 21st century and beyond. That means we need to understand the issue better, and fortunately, we have time. It is highly unlikely that the temperature in the middle of the next century will be significantly affected whether policies are enacted now of 20 years from now."

IP2 [generic "risk"]: "Before we make choices about global climate policies, we need an open debate on the science, an analysis of the risks, and a careful consideration of the costs and benefits. So far, this has not taken place, and until it has, I hope that the governments of this region will work with us to resist policies that could strangle economic growth."

SP1: "Today, Exxon and the world petroleum industry are still “Keepers of Light.” We earn that title by providing energy to light the way to economic progress, higher standards of living and hope for a brighter future for people around the world."

SP1: "I know there are some people who argue that we should drastically curtail our use of fossil fuels for environmental reasons...let me state at this point my belief that such proposals are neither prudent nor practical. With no readily available economic alternatives on the horizon, fossil fuels will continue to supply most of the world’s and this region’s energy for the foreseeable future. Their use is essential both for economic growth and for the elimination of poverty, which is itself the worst polluter."

SP1: "To achieve the kind of reduction in carbon dioxide emissions most advocates are talking about, governments would have to resort to energy rationing administered by a vast international bureaucracy responsible to no one. This could include the imposition of punishing, high energy taxes. This heavy burden of taxes and regulation would take its toll in many ways - in slower economic growth, lost jobs and a profound and unpleasant impact on the way we live. Companies in industrialized nations that compete in world markets would be seriously handicapped...excluding developing countries from the reductions will not prevent them from being hurt. Their exports will suffer as the economies of industrialized nations slow. So all of us would suffer from these proposals."

SP1: "Before we make choices about global climate policies, we need an open debate on the science, an analysis of the risks, and a careful consideration of the costs and benefits. So far, this has not taken place, and until it has, I hope that the governments of this region will work with us to resist policies that could strangle economic growth."

SP1: "The most pressing environmental problems of the developing nations are related to poverty, not global climate change. Addressing these problems will require economic growth, and that will necessitate increasing, not curtailing, the use of fossil fuels...the real secret to environmental improvement is economic growth. And as this growth continues, the economies of this region will need to import more oil, and, to a lesser extent, gas."

1998	Exxon (preface by Raymond, L. (Chairman, Exxon Corp.))	Global climate change, everyone's debate	N/A	N/A			1	1		1	1

EP4b-2: "Climate change - It isn't new. Earth's climate is affected by many complex variables, such as sunlight, clouds, rain, wind, ice, storms, lightning, volcanoes, comets, magnetic fields and living organisms, including humans. Throughout history, climate has fluctuated between periods of cooling and periods of warming. Some of those changes lasted hundreds of years, others hundreds of thousands. Over the past century, we've seen a slight warming trend of one-half degree Celsius (about one degree Fahrenheit). This recent warming trend falls well within the range of natural changes in Earth's temperature over the past 250,000 years."

EP4b-2: "Nearly all CO_2 emissions come from natural sources. Only a small amount comes from burning fossil fuels...Does the tiny portion of greenhouse gases caused by burning fossil fuels have a measurable effect on worldwide climate? No one knows for sure. That's the crux of the debate." [see also Figure "Sources of greenhouse gases"]

EP4b-2: "...the executive summary of the [IPCC 1995] report, the part most people read, was heavily influenced by participants who are not scientists. The summary, which was not peer-reviewed, states that the balance of evidence suggests a discernible human influence on climate. But many scientists say that a great deal of uncertainty still needs to be resolved." [In reality, the “discernible human influence” conclusion was published in the Summary for Policymakers, the Technical Summary, and Chapter 8, and was peer-reviewed.]

EP4b-1/2: "Scientific uncertainties...sensitive satellite measurements by the National Aeronautics and Space Administration indicated no significant warming or cooling between 1979 and 1998...Forecasts of global warming come from complex computer models that try to predict the future. They do not adequately explain past climate change. Many of the variables are not well understood, and projections range widely."

EP4b-2: "Unfortunately, they [Kyoto signatories] ignored the scientific uncertainties and adopted steps to rein in CO_2..."

EP4b-2 [post-1995]: "If burning fossil fuels proves to be a significant factor in global climate change, then..."

EP4b-2 [post-1995]: "The potential for climate change caused by elevated levels of carbon dioxide in the atmosphere is a legitimate concern, and reducing the scientific uncertainties is important. We should continue to research this issue."

IP3: "Fortunately, all indications are that climate change is a very long-term phenomenon."

IP3: "Do we need an insurance policy? Some people argue that the world needs to take out an insurance policy against the possibility of global warming just in case. In deciding whether to buy insurance, people carefully consider several key questions. What is the risk they're trying to protect against? How much does the policy cost? What would the policy do for them? When should they buy the policy? Answering these questions about global climate change clarifies several points. Because of the scientific uncertainties, we don't have a clear understanding of the risks involved. The Kyoto agreement makes the cost of the policy high. No one can tell us with certainty what benefit we will gain. Thus, it doesn't seem to be a good time to buy the policy."

SP1: "To get to the [Kyoto] target, we would [by 2010] have to stop all driving in the U.S. or close all electric power plants or shut down every industry. Obviously, these are not realistic options...meeting the Kyoto target would clearly have a huge economic impact."

SP1: "Independent economists project that to get the targeted reductions in fossil-fuel use, price increases like these would be required: 40 percent for gasoline, 50 percent for home heating oil, 25 percent for electricity and 50 percent for natural gas. These and other price hikes could cost the average American family of four about $2,700 a year. At least some developed countries would probably have to impose significantly higher fossil fuel taxes, rationing or both."

SP1: "For developing countries, mixed impacts are expected. If the Kyoto restrictions economically impair industrialized countries, imports from developing nations will decline. That could significantly disrupt global trade and economic growth. Because they would be exempt from requirements to cut CO_2 emissions, developing nations may attract more industry and jobs from industrialized countries that restrict fossil fuel consumption. That means fewer jobs in countries the U.S., for example that do impose such limits."

SP1: "...developing countries face enormous challenges, such as alleviating poverty and raising living standards, extending life expectancy and expanding educational opportunities. Meeting these basic human needs requires economic growth. And economic growth requires energy. Developing countries have chosen to address these real and immediate quality-of-life problems instead of a potential problem whose existence, timing and severity have yet to be established."

1999 Kheshgi, H. S., Archer, D. | Modeling the Evasion of CO_2 Injected into the Deep Ocean | Greenhouse Gas Control Technologies | N/A

EP3a: "Deep ocean storage of CO_2 captured from flue gases is being considered as a potential response option to global warming concerns...To slow or reduce human emissions of greenhouse gases, Marchetti (1975) proposed that CO_2 emissions from power plants might be captured and stored in the deep oceans."

EP4b-2 [post-1995]: "The evasion of captured CO_2 released into the deep oceans is an important factor in determining the effectiveness of marine CO_2 disposal as an option to mitigate potential climate change." Contextually, the doubt expressed here by tentative wording is particularly mild and reflects common academic parlance. However, to ensure consistent identification of tentative wording across all documents, we code as EP4b-2.

IP2: No position

1999 Kheshgi, H. S., Jain, A. K. | Reduction of the atmospheric concentration | Greenhouse Gas Control Technologies | N/A

		of methane as a strategic response option to global climate change			

EP3a: "Modeled sources and sinks of CH_4 show that there is scope to affect radiative forcing of climate by reduction of emissions of CH_4 and the alteration of emissions of other gases which deplete tropospheric OH. For example, if anthropogenic CO, NO_x, CH_4 and CO_2 emissions rates were reduced over the next century by the same relative extent, an extent leading to stabilization of CO_2 concentration at levels from 450 to 750 ppmv...then radiative forcing of climate would be reduced from that resulting from an emissions growth baseline scenario (IPCC scenarios IS92a); in these cases the reduction of radiative forcing due to changes in CH_4 concentration would be at least 27% of that due to changes in CO_2 concentration, and more if NO_x emissions were reduced...While there is scope in reducing radiative forcing via reduction in CH_4 concentration, there remain large uncertainties in quantification of methane emissions...Nevertheless, proposals are being made to reduce both CH_4 and CO_2 emissions in response to climate change concerns. A least-cost approach to reducing radiative forcing of climate over the next century would include some reduction of emissions of both gases..."

EP2: "Atmospheric methane concentration has increased from 0.7 ppmv in pre-anthropogenic times...to 1.7 ppmv in 1992. This change in methane concentration has led to an estimated increase in radiative forcing of climate of 0.47 W/m^2 compared to the increase of 1.56 W/m^2 due to the change in CO_2 concentration...The increase in methane concentration is thought to be due primarily to increase in methane sources. In the 1980s, methane sources are estimated to be 30% natural (e.g. wetlands), 19% fossil fuel related (e.g. coal mine emissions), and 51% from human-induced biospheric sources (e.g. livestock, agriculture and decomposition of wastes)....While methane is itself a greenhouse gas and has a direct effect on the radiative forcing of climate, methane has additional indirect effects on climate forcing...Both the mitigation of methane emissions and the enhancement of methane sinks could be components of a strategic response to global climate change."

EP3a: "Both the mitigation of methane emissions and the enhancement of methane sinks could be components of a strategic response to global climate change."

EP3a: "Considerable attention has been paid to the stabilization of CO_2 concentration in the atmosphere in response to concerns about the impacts of global climate change and the objective of the framework convention on Climate Change."

EP3a: Acknowledge "fossil CO_2 emissions" and "anthropogenic sources of each [CO_2, CO, CH_4, NO_x] gas"

EP2: "The reduction in radiative forcing of climate due to a decrease in methane concentration from the IS92a baseline is comparable to that of CO_2 in some of the scenarios shown in Figure 1."

EP3a: "A strategic response to climate change will incorporate hedging strategies which attempt to avoid severe outcomes in light of uncertain impacts and mitigation costs."

IP3: "Higher-cost [climate mitigation] options could be held in reserve as part of a hedging strategy, should climate change prove to be severe."

2001	Flannery, B. P.	An Industry Perspective on Carbon Management	Carbon Management: Implications for R&D in the Chemical Sciences, National Academy Press	N/A	

EP4b-2: "Although we know the human emissions fairly well, we don't know the natural emissions well at all. Added to this uncertainty is the fact that natural emissions can change as a result of long-term climate changes. From data on the year-to-year fluctuations in the accumulation of atmospheric CO_2, it appears that they can also change as a result of volcanic eruptions, fluctuations in sunlight, and other factors this may not be understood. These factors make understanding CO_2 in the atmosphere difficult. Adding to this difficulty is what might happen in the atmosphere over the next 100 years if these processes themselves begin to change."

EP3a: "Figure 3.4, based on simple conventional models shows the possible effects of Kyoto from 1990 through 2100. The results are based on the IS92a scenario, but

introducing the Kyoto limitations. In this case, I assume that the developed world reduces its emissions to 5% below the 1990 levels and holds them at this point for the next 100 years and the developing world continues to emit as projected in the IS92a scenario. These are crude approximations. The top curve shows how temperatures might evolve under IS92a. The lower curve shows the consequences of Kyoto. The net effect is to delay the projected temperature rise in 2100 by approximately a decade. The chart should not be taken too literally because the uncertainty associated with the temperature rise is larger than the scale in this graph."

IP3: "If climate change proves to be serious over the coming decades and requires a transition to new technologies..."

IP3: "If climate change proves to be serious" is repeated multiples times.

IP3: "As its objective, the FCCC calls for stabilization of greenhouse gas concentrations at a level that prevents dangerous human interference with the climate system. However, science today cannot draw conclusions about the level of greenhouse gases that would be appropriate as a stabilization target."

IP2: In a Q&A session after the talk, Flannery is asked by Tom Brownscombe of Shell Chemical, "Does global warming prove itself to be a serious issue in your view, and why should we take precautionary action?" Flannery responds without directly answering the question: "When folks speak of precautionary actions to address climate change, such actions should include a wide range of steps, research being one of them. Looking at and affecting technologies, and discovering what their barriers are is real action. It requires real resources. It requires real prioritization and thought. It's not "no action." I think all companies are taking action to become more efficient. For example, ExxonMobil has more co-generation capacity than any other oil company in the world. We produce over 2,000 megawatts. We didn't need credit for an early action to do that. It makes great economic sense, so we do it. As soon as the regulatory and enabling conditions are in place, we put it in place. With strong management systems and disciplined investment efficiency, steps are easy to implement. We are also undertaking research with General Motors and with Toyota on advanced vehicles, including hybrid and fuel cell powered automobiles. However, fuel cell powered vehicles cannot be rushed into widespread commercial use. They are not economic today. But performing the research to create economic options is real and tangible action." His answer includes doubt about the economic viability of some solutions, but on balance, the overall statement is ambivalent about the seriousness of AGW. We therefore code as IP2.

N.B. No SP1: "The existence of the Kyoto Protocol has been a fundamental stumbling block to action, since it poses such a difficult political challenge and barrier to global involvement." This could be coded as SP1, but can also be read simply as a commentary on policy. We make the latter (conservative) interpretation.

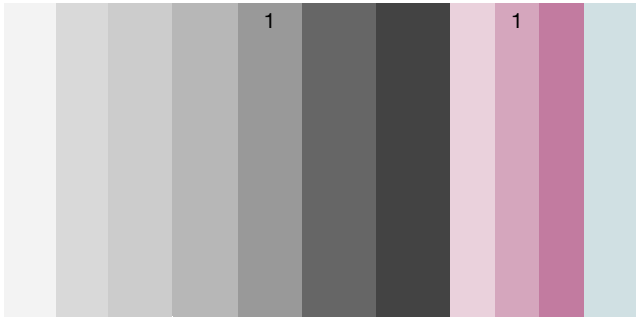
2001	Shinn, J., Kheshgi, H., Grant, J., Bernstein, L.	Technology assessment in climate change mitigation	N/A	Greenhouse Gas Control Technologies: Proceedings of the 5th International Conference on Greenhouse Gas Control Technologies		1	1						1					

EP2: "The workshop also examined results of recent efforts to assess the potential of technology to mitigate climate change." They refer to the IPIECA workshop as: "Technology assessment in climate change mitigation."

EP3a: Implicitly acknowledge AGW by reference to need to "reduce the output of greenhouse gases." This workshop was designed "to examine the results of several major greenhouse gas mitigation technology assessment programmes." "No single technology appears to have the potential to provide the majority of the emissions reduction necessary to stabilize atmospheric concentrations of greenhouse gases, the ultimate objective of the UNFCCC."

IP2: No position

2001	Le Quéré, C., Aumont, O., Bopp, L., Bousquet, P., Ciais, P., Francey, R.,	Two decades of ocean CO_2 sink and variability	N/A	6th International CO_2 Conference, October 1-5, Sendai, Japan, 2001					1				1					

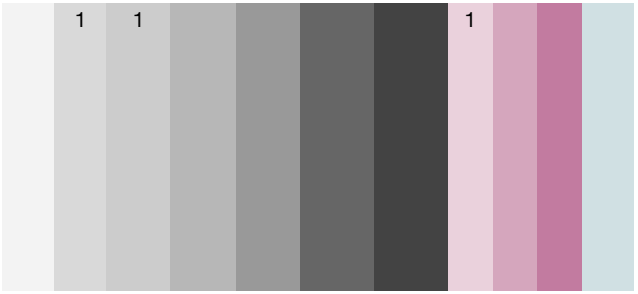
	Heimann, M., Keeling, R., Kheshgi, H., Peylin, P., Piper, S., Prentice, I. C., Rayner, P. EP4a: No position IP2: No position				
2001	Ruselowski, G. (GM), Wallace III, J. P. (Wallace & Assoc.), Choudhury, R. (GM), Wang, M. (Argonne), He, D. (Argonne), Finizza, A. (AJF Consulting), Armstrong, A. (BP), Simnick, J. (BP), Jersey, G. (ExxonMobil), Robbins, J. (ExxonMobil), Cadu, J. (Shell), Brinkman, N. (GM), Santini, D. (Argonne), et al. EP4a: No position IP2: No position	GM, Argonne National Lab, BP, ExxonMobil, Shell, 2001. GM Well-to-Wheel Energy Use and Greenhouse Gas Emissions of Advanced Fuel/Vehicle Systems – North American Analysis	N/A	N/A	
2002	Rickeard, D. J., Kheshgi, H. S. EP4a: No position IP2: No position	European fuel and vehicle options for the future - focus on biofuels	N/A	Proceedings of the 29th FISITA World Automotive Congress	
2002	Kheshgi, H. S. EP4b-1/2 [post-1995]: "The deep reductions in greenhouse gas emissions that may be needed in the long term to mitigate climate change must be viewed in the context of the prospective improvements in energy technology over the next century. Effective R&D for improved energy technology is critical for options to respond to potential climate change, for the United States and for less well-off developing countries." IP2: No position	Ethanol for transportation	Issues in Science and Technology	N/A	

2003 Hoffert, M.I., Caldeira, K., Benford, G., Criswell, D. R., Green, C., Herzog, H., Jain, A. K., Kheshgi, H. S., Lackner, Lewis, J. S., Lightfoot, H. D., Manheimer, W., Mankins, J. C., Mauel, M. W., Perkins, L. J., Schlesinger, M. E., Volk, T., Wigley, T. M. L.

Planning for future energy resources (response letter)

Science

N/A



EP2: "Existing technologies can contribute to global warming mitigation. However, projected levels of emission-free power needed later this century to stabilize climate change appear to be so unprecedented that it would be foolhardy not to assess a broad spectrum of advanced energy sources, converters, and enabling technologies."

EP3a: "...a 2 °C warming target (which can still produce adverse climate impacts) requires non-CO_2-emitting primary power in the 10 to 30 TW range by 2050."

EP2: "...holding global warming to <2 °C requires 10 to 30 TW emission-free power in 50 years for plausible economic growth, regardless of power sources."

EP2: "We are confident that the world's engineers and scientists can rise to the even greater challenge of stabilizing global warming."

IP1: "...a 2 °C warming target (which can still produce adverse climate impacts) requires non-CO_2-emitting primary power in the 10 to 30 TW range by 2050."

2003 Kheshgi, H. S.

Evasion of CO_2 injected into the ocean in the context of CO_2 stabilization

Greenhouse Gas Control Technologies

N/A

EP3a: "The eventual evasion of injected CO_2 to the atmosphere is one consideration when assessing deep-sea disposal of CO_2 as a potential response to climate change concerns."

EP3a: Author introduces the idea of "cumulative fossil fuel use" and "cumulative CO_2 emissions." Fig. 3 shows that a "550 ppm stabilization trajectory" requires a rapid decline in annual CO_2 emissions, with cumulative emissions between 2015 and 2100 (integrating area beneath curve) of roughly 490 GtC. This is comparable to contemporary carbon budget estimates for <2 °C of roughly 442-651 GtC (see caption of table S2). Author also notes that "cumulative fossil fuel use of 2000 Gt C might not exhaust global fossil fuel reserves, but limits to fossil fuel use might be driven by better alternatives that emerge over the next century." He refers to "notional scenarios for a fossil fuel era of limited duration."

IP2: No position

2003 Kheshgi, H. S., Rickeard, D. J.

Greenhouse gas emissions from bio-ethanol and biodiesel fuel supply

Greenhouse Gas Control Technologies

N/A

systems

EP4a: Repeated discussion of "avoided GHG emissions," "reduction of GHG emissions," potential of switching from "fossil systems" of fuels to biofuels, but never any mention of warming/climate change. For consistency, such cases are coded EP4a.

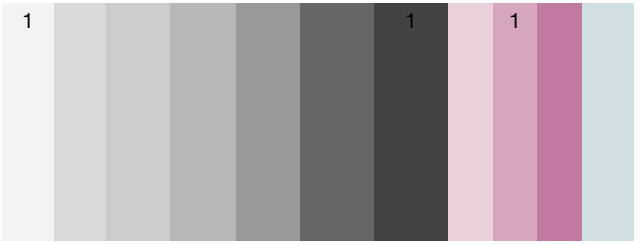
IP2: No position

2003 Kheshgi, H. (Taskforce Chairman), Cappelen, F. (Statoil), Crookshank, S. (API), Heilbrunn, A. (Total), Lee, A. (Chevron Texaco), Mikus, T. (Shell), Robson, W. (Nexen Inc), Senior, B. (BP) and Stileman, T. (IPIECA)

Carbon Dioxide Capture And Geological Storage: Contributing to Climate Change Solutions

N/A

IPIECA Workshop, Brussels, Belgium, 21-22 Oct 2003



EP4b-2 [post-1995]: "Improved technology will be needed if there are to be options for the deep reductions in greenhouse gas emissions that may be justified over the next half-century, a period over which energy demand is expected to more than double."

EP1: "Climate change presents a long-term risk associated with the build-up of CO_2 (primarily from fossil fuel use) and other greenhouse gases in the atmosphere."

IP2: No position

2004 Kheshgi, H., Khanna, M.

Climate Change and Environmental Policy

Mitigation and Adaptation Strategies for Global Change

N/A

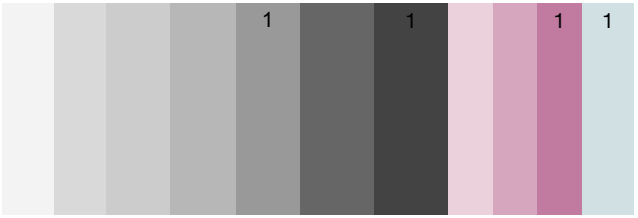
EP3a: While authors emphasize that there is uncertainty about how serious AGW's impacts may be, they are implicitly clear about its basic reality by their focus on climate impacts and mitigation: "The purpose of this conference was to assemble multi-disciplinary researchers working on quantifying the impacts of climate change, the efficacy of alternative mitigation options, and the costs that would be imposed by various greenhouse gas mitigation policies."

EP3a: The focus of the journal, "Mitigation and Adaptation Strategies for Global Change," implicitly assumes that AGW is real.

IP3/IP1: "Global climate change presents one of the most controversial and complex environmental policy challenges facing the world. Continued emissions of greenhouse gases pose long-term climate risks to both society and ecosystems. There is, however, a great deal of uncertainty about the severity of future climate change, its impact on ecosystems and economic activity, and the extent adaptation would reduce human and ecosystem vulnerability. There is also considerable debate about the timing and intensity of mitigation actions that may be justified and the policies that may be adopted to reduce greenhouse gas emissions."

IP3/IP1: "The first four papers examine the global and regional climatic effects of anthropogenic emissions using climate models and impact models to estimate their economic implications...test the sensitivity of estimates of economic impacts of climate change on agriculture, forestry, energy, water and coastal resources for the nations of the world. Overall they find that impacts and benefits largely offset each other when globally aggregated, resulting in the net global economic impact of climate change being relatively small." Other workers "discuss the potential impacts on agriculture, water resources, ecosystems and human well-being that could be associated with these projections...By 2090, they project summer in Illinois to be more like that currently in eastern Texas, while winters could be more like that in Oklahoma today."

IP3: Kheshgi and Khanna conclude that "this set of papers covers diverse issues related to climate change and provide both overviews of current knowledge about the impacts and implications of climate change as well as directions for future research. In particular, they underscore the considerable uncertainties that persist in our understanding of the extent of future climate change, its economic impacts and policy implications."

2005	Flannery, B.P., Kheshgi, H.S	An industry perspective on successful development and global commercialization of innovative technologies for GHG mitigation	Proceedings of the Intergovernmental Panel on Climate Change Workshop on Industry Technology Development, Transfer and Diffusion, Tokyo, September 2004	Intergovernmental Panel on Climate Change Workshop on Industry Technology Development, Transfer and Diffusion, Tokyo, September 2004	

EP4b-2 [post-1995]: "If addressing climate change risks requires a transition to new technologies that supply energy with far lower GHG emissions..."

EP4a: "Both human and natural emissions affect atmospheric concentrations of CO_2..." This could be read to imply that natural variations may explain recent global warming. However, this statement is strictly correct. On balance, we therefore code as EP4a.

EP4b-2: "While we know the human emissions fairly well, especially from fossil fuel use, we don't know the natural emissions well at al. And they can change....These factors confuse some of the issues of what's going on in the atmosphere recently, what might go on in the atmosphere over the next 100 years....and what might be required if some CO_2 limit is to be achieved."

EP4b-2: The "550ppm target is political...the UNFCCC calls for stabilization of GHG concentrations at a level that prevents dangerous human interference....However, science is unable today to draw conclusions about the level of GHGs that might be appropriate as a stabilization target, and the decisions concerning the criterion dangerous likely involve input from political as well as scientific considerations."

IP3 [generic “risk”]: "If climate change proves to be a serious issue...If climate change proves to be very serious, and society needed to do something dramatic, then we should consider all options" (in context of geoengineering). At the end of the document, author does, however, say that "Clearly, as an exercise in risk management, the potential for serious risks from climate change justifies some level of public and private effort and expenditure on research and development to create options for technologies with far lower greenhouse gas emissions and to improve end-use energy efficiency."

IP3: The "550ppm target is political...the UNFCCC calls for stabilization of GHG concentrations at a level that prevents dangerous human interference....However, science is unable today to draw conclusions about the level of GHGs that might be appropriate as a stabilization target, and the decisions concerning the criterion dangerous likely involve input from political as well as scientific considerations."

SP1: "Emissions will continue to grow to meet the demands...Countries like India, China and Indonesia are going to rely on domestic coal to meet growing needs...and their emissions are going to grow rapidly....Fossil fuels will remain the dominant source of energy supply over this period and beyond. Even with rapid year-to-year growth, intermittent renewable energy from wind and solar will remain a small contributor to global energy needs."

SP1: "...stabilising at 550ppm would require a phase out in the use of fossil fuels by the middle of the century in the Annex I countries. That's a huge step."

SP1: Author compares renewables to other historical technological advances (e.g. coal to oil): "new forms of technology...entered into widespread use because they provided qualitatively new service and higher levels of performance. Powerful economic drivers came about naturally through the operation of markets. With respect to many technologies being championed as potential contributors to address climate change, this is not the case. Rather, with today's performance, they would provide people with the

same or reduced service at higher cost."

SP1: Assesses "a number of promising options for mega-technologies that could make a substantial contribution to limiting or eliminating for future emissions of CO_2 ...We haven't stressed renewables on our list of mega-options and perhaps they should be there. However, in today's markets, with the exception of hydropower, they only succeed in niche applications...Outside of such niches, their widespread use is limited because current technology can't compete in cost or reliability with conventional fossil fuels..." "Governments at times subsidize small-scale costs, and governments have at times subsidized early market penetration, (sic) the cost to governments to subsidize widespread global use of new energy technologies would be huge."

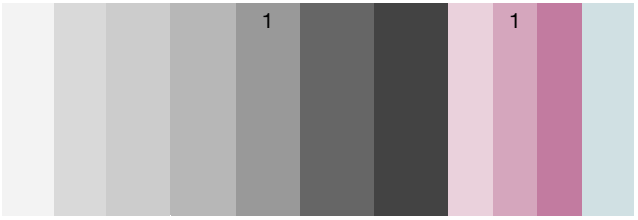
2005	Kheshgi, H., Stileman, T., Cappelen, F., Crookshank, S., Heilbrunn, A., Lee, A., Mikus, T., Robson, W., Senior, B.	Carbon Dioxide Capture And Geological Storage: Contributing to Climate Change Solutions	18-0987 WPC Conference Paper	18th World Petroleum Congress, Johannesburg, Petroleum Economist, 2005	

EP3a: Not much discussion of AGW, but implicit acknowledgment through discussion of CCS solutions:

"Concern about global climate change, and the challenges and risks it poses, will require sustained efforts to develop understanding and effective solutions while at the same time meeting the growing needs of society for energy. The development and utilization of technologies to capture and then store CO_2 in underground formations offer significant potential for reducing CO_2 emissions." This report "considers CO_2 capture and geological storage as a potential option for reducing future emissions of Greenhouse Gases (GHGs)."

"Climate change presents a long-term risk associated with the build-up of CO_2 (primarily from fossil fuel use) and other greenhouse gases in the atmosphere. If the concentration of CO_2 in the atmosphere were to be limited to an as-of-yet-undetermined level, then cumulative global CO_2 emissions would ultimately also have to be limited as well."

IP2 [generic "risk"]: "Climate change presents a long-term risk associated with the build-up of CO_2 (primarily from fossil fuel use) and other greenhouse gases in the atmosphere."

2005	Gabus, A.,...Kheshgi, H. S. (Reviewer), et al.	Climate Models: An Assessment of Strengths and Limitations Comments on the Draft Prospectus for Synthesis and Assessment Product 3.1, Expert Review Collation, February 2–March 7, 2005	N/A	N/A	

EP4a: Detailed commentary on specifics of draft report, no discussion of AGW as real and/or human-caused.

IP2: No position

2006	Imbus, S., Orr, F. M., Kuuskraa, V. A., Kheshgi, H., Bennaceur, K., Gupta,	Critical issues in CO_2 capture and storage: findings of the SPE	102968-MS SPE Conference Paper	Society of Petroleum Engineers, SPE-102968	

	N., Rigg, A., Hovorka, S., Myer, L., Benson, S	advanced technology workshop (ATW) on carbon sequestration			

EP3a: "Carbon dioxide capture and storage (CCS) is emerging as a key technology for greenhouse gas (GHG) mitigation…It is up to the CCS community to demonstrate CCS as a cost effective, save and available option for climate change mitigation…CCS as part of a portfolio of climate change mitigation approaches…CCS as a climate mitigation option…"

EP3b: "Projected impacts of CO_2 emissions on the Earth system were outlined by K. Caldeira (Carnegie Institution). In addition to a review of well-publicized atmospheric warming effects, the impact on sea level, ocean acidification and habitat migration were projected using a scenario approach."

IP1: "Current and projected rates of CO_2 emissions from fossil fuels may lead to changes in global climate with significant impact."

IP1: "Projected impacts of CO_2 emissions on the Earth system were outlined by K. Caldeira (Carnegie Institution). In addition to a review of well-publicized atmospheric warming effects, the impact on sea level, ocean acidification and habitat migration were projected using a scenario approach."

IP2 [borderline case of generic “risk”]: "Risk [of CCS] should be put into perspective [by scientists communicating with policymakers] with respect to familiar hazards and the risk of not addressing GHG emissions at the scale and timeframe needed."

2006	Kheshgi, H., Cappelen, F., Crookshank, S., Heilbrunn, A., Lee, A., Mikus, T., Robson, W., Senior, B., Stileman, T., Warren, L.	Carbon Dioxide Capture And Geological Storage: Contributing to Climate Change Solutions	98583-MS SPE Conference Paper	SPE International Conference on Health, Safety, and Environment in Oil and Gas Exploration and Production	

EP3a: Not much discussion of AGW, but implicit acknowledgment through discussion of CCS solutions:

"Concern about global climate change, and the challenges and risks it poses, will require sustained efforts to develop understanding and effective solutions while at the same time meeting the growing needs of society for energy. The development and utilization of technologies to capture and then store CO_2 in underground formations offer significant potential for reducing CO_2 emissions." This report "considers CO_2 capture and geological storage as a potential option for reducing future emissions of Greenhouse Gases (GHGs)."

"Climate change presents a long-term risk associated with the build-up of CO_2 (primarily from fossil fuel use) and other greenhouse gases in the atmosphere. If the concentration of CO_2 in the atmosphere were to be limited to an as-of-yet-undetermined level, then cumulative global CO_2 emissions would ultimately also have to be limited as well."

IP2 [generic "risk"]: "Climate change presents a long-term risk associated with the build-up of CO_2 (primarily from fossil fuel use) and other greenhouse gases in the atmosphere."

2006	Cohen, K. P. to Lord Rees (The Royal Society)	Response to letter from The Royal Society	N/A	N/A	

EP3a: "We recognize that the accumulation of greenhouse gases in the Earth's atmosphere poses risks that may prove significant for society and ecosystems...Human activities have contributed to these increased concentrations...mainly through the combustion of fossil fuels for energy use...Even with many scientific uncertainties, the risk

that greenhouse gas emissions may have serious impacts justifies taking action."

IP1 [almost generic "risk" but talks about risks for "society and ecosystems" and refers to potential "serious impacts"]: "We recognize that the accumulation of greenhouse gases in the Earth's atmosphere poses risks that may prove significant for society and ecosystems...Human activities have contributed to these increased concentrations...mainly through the combustion of fossil fuels for energy use...Even with many scientific uncertainties, the risk that greenhouse gas emissions may have serious impacts justifies taking action."

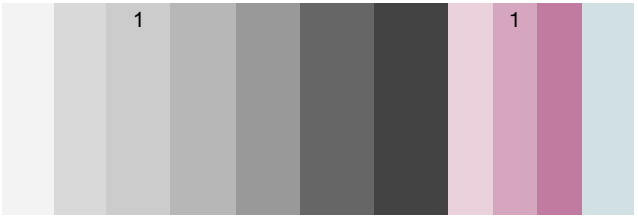
2008 Kheshgi, H. S., Shires, T., Lev-On, M., Siveter, R., Ritter, K., Hochhalter, T. | Harmonizing the quantification of CCS GHG emission reductions through oil and natural gas industry project guidelines | 19th World Petroleum Congress | N/A

EP3a: Implicit acknowledgment of AGW in focus on GHG emissions reductions guideline proposals and reference to requirements of "climate change regimes" on reduction planning.

EP4b-2: "Nor are [the Oil and Natural Gas Industry Guidelines for Greenhouse Gas Reduction Projects] intended to imply a direct connection between GHG emissions from the oil and natural gas industry and the phenomenon commonly referred to as climate change."

IP2: No position

2009 Birdsey, R., Bates, N., Behrenfeld, M., Davis, K., Doney, S. C., Feely, R., Hansell, D., Heath, L., Kasischke, E., Kheshgi, H., Law, B., Lee, C., McGuire, A. D., Raymond, P., Tucker, C. J. | Carbon cycle observations: gaps threaten climate mitigation policies | EOS | N/A



EP3a: Discusses carbon cycle observations in the context of “climate mitigation policies.”

IP2: No position

2009 Parker, M. E., Northrop, S., Vaencia, J. A., Foglesong, R. E., Duncan, W. T. | CO_2 management at ExxonMobil's LaBarge field, Wyoming, USA | N/A | International Petroleum Technology Conference, IPTC 13258

EP4a: Although authors make several references to "mitigating GHG emissions," there is no mention of AGW. For consistency, such cases are coded EP4a.

IP2: No position

2009	Sweatman, R. E., Parker, M. E., Crookshank, S. L.	Industry experience with CO_2-enhanced-oil-recovery technology	Society of Petroleum Engineering, SPE 126446	N/A	

EP3a: "With carbon capture and storage (CCS) being widely considered and with a few countries implementing commercial-scale CCS projects, technology transfer shares the experience of the oil/gas industry and the major contribution it can make as part of the solution for climate change." "Underground geological storage of CO_2 is a promising technology for reducing greenhouse-gas (GHG) emissions..."

IP2 [generic "risk"]: "Decisions on the appropriate actions to address the risks posed by climate change are informed by the evolving state of knowledge on climate science and its inherent uncertainties, and the capabilities of both technologies and institutions."

SP1: "Unlike solar- and wind-energy equipment and facilities, oil/gas wells, rigs, and other structures can be hidden from public view to satisfy concerns regarding unattractive industrial facilities and the effect on community interests such as tourism and residential-property values. Oil/gas surface facilities and wells also can avoid environmentally sensitive locations, such as wildlife habitats in marshes and other wetlands, by drilling many directional wells from a single location that is outside the sensitive area."

2010	Kheshgi, H., Lee, A., Levang, O., Linhares, M., Juez, J. M., Poot, B., Siveter, R.	Increasing the Pace of Technology Innovation and Application to Enable Climate Change Solutions	Society of Petroleum Engineers, SPE-126678	N/A	

EP3a: "The creation of energy technology options to meet the global demand for energy with low greenhouse gas emissions is an essential component of a risk management approach to global climate change...Meeting society's rising energy demand for economic and social development, including priorities such as the eradication of poverty, while mitigating the risks of climate change by reducing greenhouse gas emissions, poses a fundamental challenge..."

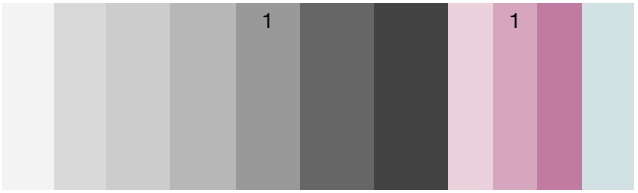
EP2 [uncertainty about size and pace, but not reality of AGW]: They discuss uncertainty in "size and pace of climate change" and, therefore, mitigation options needed: "Mitigation scenarios for atmospheric CO_2 concentration growth to stabilize would require net emissions to peak, then decline ultimately to a very small fraction of current emissions. How soon the peak would occur, and how high the peak would be, depends on the stabilization level. In light of forecasts of large increases in energy demand, supplied primarily by fossil fuels, stabilization would require the development and deployment of affordable and innovative energy and emissions reduction technologies. Global climate sensitivity, which the Intergovernmental Panel on Climate Change (IPCC) has recently assessed as likely to be in the range of +2 to +4.5 °C for a doubling of CO_2 in the atmosphere, is an important and uncertain factor. Uncertainty in climate sensitivity affects our understanding of the size and pace of climate change. Consequently it limits our ability to specify the peak in emissions and ultimate atmospheric concentrations of GHGs that would correspond to a given temperature change. For example, if modelled temperature rise were limited to less than 2 °C under a scenario with high climate sensitivity, then emissions would decline rapidly towards zero now; whereas under a scenario with low climate sensitivity, emissions could continue to rise unabated until beyond 2050".

IP3: They discuss uncertainty in "size and pace of climate change" and, therefore, mitigation options needed: "Mitigation scenarios for atmospheric CO_2 concentration growth to stabilize would require net emissions to peak, then decline ultimately to a very small fraction of current emissions. How soon the peak would occur, and how high the peak would be, depends on the stabilization level. In light of forecasts of large increases in energy demand, supplied primarily by fossil fuels, stabilization would require the development and deployment of affordable and innovative energy and emissions reduction technologies. Global climate sensitivity, which the Intergovernmental Panel on Climate Change (IPCC) has recently assessed as likely to be in the range of +2 to +4.5 °C for a doubling of CO_2 in the atmosphere, is an important and uncertain factor. Uncertainty in climate sensitivity affects our understanding of the size and pace of climate change. Consequently it limits our ability to specify the peak in emissions and ultimate atmospheric concentrations of GHGs that would correspond to a given temperature change. For example, if modelled temperature rise were limited to less than 2 °C under a scenario with high climate sensitivity, then emissions would decline rapidly towards zero now; whereas under a scenario with low climate sensitivity, emissions could continue to rise unabated until beyond 2050".

IP2 [generic "risk"]: "Meeting society's rising energy demand for economic and social development, including priorities such as the eradication of poverty, while mitigating the risks of climate change by reducing greenhouse gas emissions, poses a fundamental challenge..."

SP1: "Meeting society's rising energy demand for economic and social development, including priorities such as the eradication of poverty, while mitigating the risks of climate change by reducing greenhouse gas emissions, poses a fundamental challenge..."

2010 Kheshgi, H., Bhore, N. B., Hirsh, R. B., Parker, M. E., Teletzke, G. F., Thomann, H. | Perspectives on CCS cost and economics | Society of Petroleum Engineers, SPE-139716 | SPE International Conference on CO_2 Capture, Storage, and Utilization, New Orleans, Louisiana, USA, 10-12 November, 2010



EP4a: No position

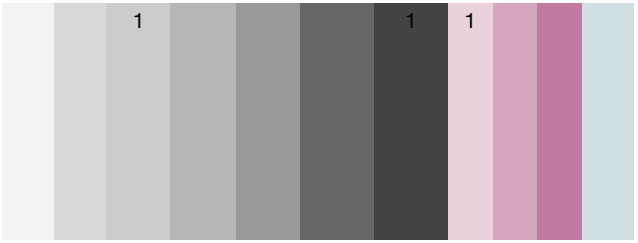
IP2: No position

2010 Feldman, A., Rabl, V., Kheshgi, H., Wright, R., Keairns, D. | Carbon management project and electric power generation scorecard | Energy Tech | N/A

EP3a: "The project was working to identify practical steps the country can take toward managing greenhouse gas emissions, a key issue in the mitigation on climate change."

IP2: No position

2010 Tillerson, R. (Chairman, ExxonMobil Corp.) | The ExxonMobil-XTO Merger: Impact on U.S. Energy Markets - Hearing Before the Subcommittee on Energy and Environment of the Committee on Energy and Commerce House of Representatives (January 20, 2010) | N/A | N/A



EP3a: "Well, we have said for some time that there is no question climate is changing, that one of the contributors to climate change are greenhouse gases that are a result of industrial activities - and there are many greenhouse gasses besides CO_2, which I know you know that. And the real challenge I think for all of us is understanding to what extent and therefore what can you do about it. And it is a scientific challenge. We view it as a risk management problem. There is a risk. The consequences, if those risks play out, are pretty dire."

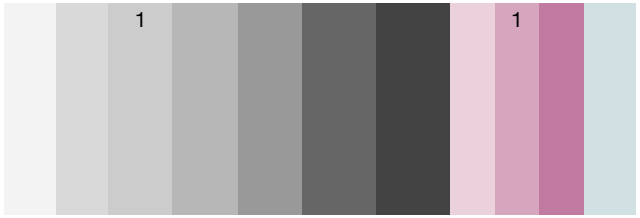
EP4a: "So our view for some time has been, first and foremost, let us continue to support the scientific investigation of what is one of the most complicated areas of science that people are studying today, and that is the climate, the science around climate and what affects the climate. It is extremely complicated. And we have supported that work and I know the Congress has made funds to support that work and we support the scientific advancement of understanding this issue. The better we understand that, the better the technology solutions then will be provided and will be provided in the most cost-effective way to consumers the world over."

EP3a/4b-2: "So, yes, we acknowledge that it is a contributing factor. Where I think we have differences and where we perhaps talk past one another from time to time is that, being a science and engineering company, we understand the science, we understand the difficulties of modeling the science...And as we look at the competency of those models, there is not a model available today that is competent, and I think all of those people who run those models would acknowledge that. So we say keep studying it. In the meantime, the risks are significant, the consequences could be dire so we should take action."

IP1 [almost generic "risk", but articulates potentially "dire" consequences]: "Well, we have said for some time that there is no question climate is changing, that one of the contributors to climate change are greenhouse gasses that are a result of industrial activities—and there are many greenhouse gasses besides CO_2, which I know you know that. And the real challenge I think for all of us is understanding to what extent and therefore what can you do about it. And it is a scientific challenge. We view it as a risk management problem. There is a risk. The consequences, if those risks play out, are pretty dire."

IP1 [almost generic "risk", but articulates potentially "dire" consequences]: "So, yes, we acknowledge that it is a contributing factor. Where I think we have differences and where we perhaps talk past one another from time to time is that, being a science and engineering company, we understand the science, we understand the difficulties of modeling the science...And as we look at the competency of those models, there is not a model available today that is competent, and I think all of those people who run those models would acknowledge that. So we say keep studying it. In the meantime, the risks are significant, the consequences could be dire so we should take action."

2012 Kheshgi, H., de Coninck, H., Kessels, J. | Carbon dioxide capture and storage: seven years after the IPCC special report | Mitigation and Adaptation Strategies for Global Change, Special Issue: Five years after the IPCC Special Report on Carbon dioxide Capture and Storage: state of play | N/A



EP3a: They refer to "CCS as one option in the portfolio of options available for society to address climate change, energy, and other pressing societal issues."

EP3a: "CCS is envisioned to reduce carbon dioxide (CO_2) emissions to the atmosphere when applied to large facilities that use fossil fuels. Applied to biomass, it may also lower CO_2 concentrations in the atmosphere while supplying energy." "...CCS was assessed to be cost competitive with other options for deep reductions in greenhouse gas emissions." Although no direct link made here to AGW, context (published in IPCC climate mitigation report) implies EP3a.

IP2: No position

2012 Kheshgi, H., Hirsh, R. B., Parker, M. E., Teletzke, G. F., Thomann, H. | Carbon Dioxide Capture and Storage: Perspectives on Cost and Economics | Proceedings of the 2012 World Gas Conference | 2012 World Gas Conference

EP4a: No mention of "climate change", "global warming", etc. For consistency, such cases are coded EP4a.

IP2: No position

2013 Washington, W.,..., Kheshgi, H. S., et al. | A Review of the Draft 2013 National Climate | N/A | Panel to Review the National Climate

		Assessment		Assessment	

EP3a: Little explicit discussion of AGW, but clear implicit assumption of AGW as the premise of the National Climate Assessment under review here and the Review Panel's explicit acceptance of the central conclusions and messages of the NCA draft. For example:

EP3a: "The NCA is a report to inform the President, the Congress, and the American people about the current state of scientific knowledge regarding climate change effects on U.S. regions and key sectors, now and in the coming decades."

EP3a: "The influence of human activities has grown over time to become a dominant driver of global environmental change, such that it is no longer possible to understand the earth's ecological and physical systems without a concomitant understanding of how human activities influence these systems."

EP3a: "The [NCA] report offers a wealth of information about the potential impacts of climate change on specific regions and for important social and economic sectors, and in general this is one of the strongest aspects of the report."

EP3a: "...climate change impacts on cities (beyond just storm surge and sea level rise)"

IP1: "...the decline of some tribal and indigenous cultures has been ongoing for many decades and may be accelerated by (but not primarily driven by) climate change."

IP1: "The discussion of human health issues needs to explore potential health threats caused by climate-related changes in infectious agents and to acknowledge the very limited understanding of the links between climate change, ecosystem change and disease vectors."

IP1: "...climate change impacts on cities (beyond just storm surge and sea level rise)"

2014	Landuyt, W., Lee, A., Verduzco, L., Castaneda, J., Siveter, R.	Addressing adaptation to climate risks in the oil and gas industry	N/A	SPE International Conference on Health, Safety and Environment; SPE 168370	

EP3a: "The objective of this paper is to explore the oil and gas industry's awareness of climate change-related risks and appropriate responses, and efforts to incorporate them into an overall risk management framework...Understanding climate change risks and opportunities, and ways to incorporate them into broader risk management systems is an integral part of the oil and gas industry's framework for business decisions."

EP3a: "Whilst uncertainty surrounding projections from climate science will likely remain for the foreseeable future, investment decisions will still be made by industry in the interim. With appropriate information, the oil and gas industry can conduct an assessment to evaluate where climate risks expose vulnerabilities in business operations and assets." Discusses reasonable scientific uncertainties in the context of adaptation planning.

EP3a: "The uncertainty in projecting future climate change, including changes in temperature and weather extremes, remains substantial, particularly for work that seeks to inform adaptation options on a local scale." Discusses reasonable scientific uncertainties in the context of adaptation planning.

IP2 [generic "risk"]: "The objective of this paper is to explore the oil and gas industry's awareness of climate change-related risks and appropriate responses, and efforts to incorporate them into an overall risk management framework...Understanding climate change risks and opportunities, and ways to incorporate them into broader risk management systems is an integral part of the oil and gas industry's framework for business decisions."

IP1 [almost generic "risk", but alludes to possible impacts on business operations and assets]: "Whilst uncertainty surrounding projections from climate science will likely

remain for the foreseeable future, investment decisions will still be made by industry in the interim. With appropriate information, the oil and gas industry can conduct an assessment to evaluate where climate risks expose vulnerabilities in business operations and assets."

IP1: "Climate change poses risks to society, infrastructure and ecosystems that vary across regions and arise from a diverse set of climate factors (Parry et al., 2007). Despite uncertainty in climate variability and diversity of future projections, indications are that additional changes to climate and its variability over the next three to four decades are inevitable regardless of mitigation scenarios (Rogelj et al., 2012; see Figure 2). Over this timeframe, adaptation to changing climates is likely to take place irrespective of, or in addition to, any mitigation efforts (Pielke Jr, 2007). Identifying the risks of climate change to industry operations and assets provides an opportunity to develop business plans aimed at minimizing disruptions."

IP1: "While temperature variations are the primary effect associated with climate change, the potential effects on water scarcity, flooding, extreme weather and temperature events, sea level rise, and food security may be more important for the oil and gas industry and society at large (Parry et al., 2007)."

IP1: "The uncertainty in projecting future climate change, including changes in temperature and weather extremes, remains substantial, particularly for work that seeks to inform adaptation options on a local scale." Discusses uncertainties but implicitly acknowledges the likelihood of climate impacts – therefore IP1 not IP3.

IP1: "The oil and gas industry is identifying a range of risks from current and future climate variability (e.g. floods, sea level rise, extreme events, migratory shifts of species, permafrost thawing, water availability, etc.) to their operations, supporting infrastructure and the value chain (IPIECA, 2012; see Figure 3). Examples could include:
• Reduced window of time for tundra travel due to increased permafrost melting;
• Increased lightning strikes in northern latitudes, potentially causing damage to infrastructure and impacts on communities, particularly where electrical grounding is lacking or through the initiation of wildfires; Increased coastal erosion leading to a degradation of coastal barriers;
• Changes in storm strength leading to increased wind speed and wave loading on offshore facilities;
• Regional changes in precipitation pattern and frequency, altering the availability of water resources for operations and susceptibility to flooding of infrastructure; and
• Reduced certainty regarding assumptions made about the efficiency of equipment, such as gas turbines.
• The ability of operators and other key personnel to return to work after a major event due to blackouts, inundations and even personal property damage".

IP1: "The process of risk assessment will involve understanding how climate change could alter the severity of a given hazard by changing its frequency and/or intensity (see Figure 5)...Physical risks from cyclones, sea level rise, and snow and ice were identified by some companies as potential high significance risks to climate."

Internal Documents

Year	Authors	Title	Date/Details	EP1	EP2	EP3a	EP3b	EP4a	EP4b-1	EP4b-2	IP1	IP2	IP3	SP1
1977	Shaw, H. to Harrison, J. W.	Environmental Effects of Carbon Dioxide	October 31, 1977					1				1		

EP4a: No position

IP2: No position

1978	Black, J. to Turpin, F. G. (cc: Alpert, N. et al.)	The Greenhouse Effect	May 18, 1978				1		1	1	1			

EP3b: "What is considered the best presently available climate model for treating the Greenhouse Effect predicts that a doubling of the CO_2 concentration in the atmosphere would produce a mean temperature increase of about 2 °C to 3 °C over most of the earth. The model also predicts that the temperature increase near the poles may be two to three times this value."

EP4b-1: "The CO_2 increase measured to date is not capable of producing an effect large enough to be distinguished from natural climate variations."

EP4b-2: "At present meteorologists have no direct evidence that the incremental CO_2 in the atmosphere comes from fossil carbon." However, "Atmospheric scientists generally attribute this growth in CO_2 to the combustion of fossil fuel." "Although carbon dioxide increase is predominantly attributed to fossil fuel combustion, most scientists agree that more research is needed to definitely establish this relationship. The possibility that the increasing carbon dioxide in the atmosphere is due to a change in the natural balance has not yet been eliminated." "...current scientific opinion overwhelmingly favors attributing atmospheric carbon dioxide increase to fossil fuel combustion. However, most scientists feel that more research is needed to support an unqualified conclusion."

EP4b-2: "Models which predict the climatic effects of a CO_2 increase are in a primitive stage of development."

EP4b-2: "Predictions on the significances of increases in atmospheric CO_2 must be based upon climate modeling. Modeling climatic effects is currently handicapped by an inability to handle all the complicated interactions which are important to predicting the climate...cloudiness...atmosphere-ocean circulation-sea surface temperature interaction...climate is rarely predictable...It is not certain, however, that such a pessimistic outlook is justified and it has not stopped the development of many models of the Greenhouse Effect and other climate phenomena."

EP3b: "One of the best general circulation models of the Greenhouse Effect, and the one which is most frequently quoted, is that developed by Manabe and Wetherald. Their predictions for the climatic effect of a doubling of CO_2 are presented in Vugraph 9. Thls vugraph predicts that a doubling of the atmospheric CO_2 concentration would produce a temperature rise at lower altitudes and a temperature decrease above twenty kilometers. At the surface the temperature rise would be about 2 to 3 °C from the equator up to about 60 [degrees] latitude, with a much greater increase predicted for the poles."

EP3b: "It is generally accepted by climatologists that a doubling of the carbon dioxide concentration in the atmosphere would produce from 1.5 °C - 3.0 °C warming at the earth's surface in the lower and mid-latitudes with about 2 to 3 times greater effect at the poles."

EP3b: "Summary...In the first place, there is general scientific agreement that the most likely manner in which mankind is influencing the global climate is through carbon dioxide release from the burning of fossil fuels. A doubling of carbon dioxide is estimated to be capable of increasing the average global temperature by from 1 to 3 °C, with a

10 C rise predicted at the poles. More research is needed, however, to establish the validity and significance of predictions with respect to the Greenhouse Effect. It is currently estimated that mankind has a 5-10 yr time window to obtain the necessary information."

IP1: "...an increase as large as 2 °C would probably also affect the distribution of the rainfall. A possible result might be a shift of both the desert and the fertile areas of the globe toward higher altitudes. Some countries would benefit but others could have their agricultural output reduced or destroyed. The picture is too unclear to predict which countries might be affected favorably or unfavorably...Any large temperature increase at high latitudes would be associated with a reduction in snow cover and a melting of the floating ice-pack."

IP1: "Present thinking holds that man has a time window of five to ten years before the need for hard decisions regarding changes in energy strategies might become critical."

IP1: "It appears fairly certain that if the high increases they predict in the polar regions do occur, the permanent snow cover and floating sea ice will be reduced or possibly eliminated...There will probably be no effect on the polar ice sheets...The area on which most uncertainty exists is with respect to the West Antarctic Ice sheet. The water in this glacier is equivalent to about a seven meter rise in the world's oceans. The West Antarctic ice sheet extends out over the ocean floor. Warmer oceans might result in an intrusion of the ocean waters underneath this ice sheet and a decrease in its size might occur. If this happens, an oceanic rise of some fraction of the maximum amount (7 meters) might take place."

IP1: "With a warmer climate around the world, it seems fairly certain that precipitation could increase. On a global basis, this should result in the lengthening of the growing season. Growing seasons are estimated to increase about ten days for each 1 °C rise in temperature."

IP1: "The changing precipitation patterns, however, would benefit some areas and would harm others. It is not possible, on the basis of present information, to predict just where these effects would occur. As a first estimate, one might say that the climatic zones in the world would move northward. The effect of this on the agriculture of the U.S. and Russia is indicated in Vugraph 13."

1978 Shaw, H. to David Jr., E. E. | Untitled (request for a credible scientific team) | December 7, 1978

EP4a: No position

IP2: No position

1978 Weinberg, H. N. to Gornowski, E. J. | CO_2 | March 7, 1978

EP4b-2: Sets goal of "trying to define whether a long-term CO_2 problem really exists and, if so, what counter measures would be appropriate."

EP4b-2: "the key thing would be to determine whether we have a problem with CO_2 or we don't and, if we do, where the problem comes from."

IP2: No position

1979 Shaw, H. to Weinberg, H. N. (cc: Werthamer, N. R.) | Research in Atmospheric Science | November 19, 1979

EP4a: No position

IP2: No position

1979 Mastracchio, R. L. to Hirsch, R. L. (cc: Black, J. F. et al.) Controlling Atmospheric CO_2 October 16, 1979

EP3b: "Present climatic models predict that the present trend of fossil fuel use will lead to dramatic climatic changes within the next 75 years. However, it is not obvious whether these changes would be all bad or all good."

EP4b-2: "It must be realized that there is great uncertainty in the existing climatic models because of a poor understanding of the atmospheric/terrestrial/oceanic CO_2 balance."

EP2/3b: "The most widely held theory is that: -The increase [in "the CO_2 concentration in the atmosphere"] is due to fossil fuel combustion; -Increasing CO_2 concentration will cause a warming of the earth's surface; -The present trend of fossil fuel consumption will cause dramatic environmental effects before the year 2050."

EP4b-2: "However, the quantitative effect is very speculative because the data base supporting it is weak. The CO_2 balance between the atmosphere, the biosphere and the oceans is very ill-defined. Also, the overall effect of increasing atmospheric CO_2 concentration on the world environment is not well understood. Finally, the relative effect of other impacts on the earth's climate, such as solar activity, volcanic action, etc. may be as great as that of CO_2. Nevertheless, recognizing the uncertainty, there is a possibility that an atmospheric CO_2 buildup will cause adverse environmental effects in enough areas of the world to consider limiting the future use of fossil fuels as major energy sources. This report illustrates the possible future limits on fossil fuel use by examining different energy scenarios with varying rates of CO_2 emissions."

EP3b: "The present trends of fossil fuel combustion with a coal emphasis will lead to dramatic world climate changes within the next 75 years, according to many present climatic models."

EP3b: "A vast amount of speculation has been made on how increased CO_2 levels will affect atmospheric temperatures. Many models today predict that doubling the 1850 atmospheric CO_2 concentration will cause a 1 to 5 °C global temperature increase (see Figure 4). Extrapolation of present fossil fuel trends would predict this doubling of the CO_2 concentration to occur about 2050. A temperature difference of 5 °C is equal to the difference between a glacial and an interglacial period. The temperature increases will also tend to vary with location being much higher in the polar region (see Figure 5). These temperature predictions may turn out too high or low by several fold as a result of many feedback mechanisms that may arise due to increased temperatures and have not been properly accounted for in present models."

EP2: "No Limit on CO_2 Emissions [scenario name]...The yearly atmospheric CO_2 increase rises from 1.3 ppm in 1976 to 4.5 ppm in 2040. Noticeable temperature changes would occur around 2010 as the concentration reaches 400 ppm. Significant climatic changes occur around 2035 when the concentration approaches 500 ppm. A doubling of the pre-industrial concentration occurs around 2050. The doubling would bring about dramatic changes in the world's environment (see Appendix A). Continued use of coal as a major energy source past the year 2050 would further increase the atmospheric CO_2 level resulting in increased global temperatures and environmental upsets." [See similar descriptions for other scenarios, e.g. "An atmospheric CO_2 concentration of 440 ppm is assumed to be a relatively safe level for the environment."]

IP3: "Present climatic models predict that the present trend of fossil fuel use will lead to dramatic climatic changes within the next 75 years. However, it is not obvious whether these changes would be all bad or all good."

IP1: "The most widely held theory is that: -The increase [in "the CO_2 concentration in the atmosphere"] is due to fossil fuel combustion; -Increasing CO_2 concentration will cause a warming of the earth's surface; -The present trend of fossil fuel consumption will cause dramatic environmental effects before the year 2050."

IP1: "However, the quantitative effect is very speculative because the data base supporting it is weak. The CO_2 balance between the atmosphere, the biosphere and the

oceans is very ill-defined. Also, the overall effect of increasing atmospheric CO_2 concentration on the world environment is not well understood. Finally, the relative effect of other impacts on the earth's climate, such as solar activity, volcanic action, etc. may be as great as that of CO_2. Nevertheless, recognizing the uncertainty, there is a possibility that an atmospheric CO_2 buildup will cause adverse environmental effects in enough areas of the world to consider limiting the future use of fossil fuels as major energy sources. This report illustrates the possible future limits on fossil fuel use by examining different energy scenarios with varying rates of CO_2 emissions."

IP1: "The present trends of fossil fuel combustion with a coal emphasis will lead to dramatic world climate changes within the next 75 years, according to many present climatic models."

IP2 [generic "risk"]: "The potential problem is great and urgent...Only with a better understanding of the balance will we know if a problem truly exists."

IP1: "A vast amount of speculation has been made on how increased CO_2 levels will affect atmospheric temperatures. Many models today predict that doubling the 1850 atmospheric CO_2 concentration will cause a 1 to 5 °C global temperature increase (see Figure 4). Extrapolation of present fossil fuel trends would predict this doubling of the CO_2 concentration to occur about 2050. A temperature difference of 5 °C is equal to the difference between a glacial and an interglacial period. The temperature increases will also tend to vary with location being much higher in the polar region (see Figure 5). These temperature predictions may turn out too high or low by several fold as a result of many feedback mechanisms that may arise due to increased temperatures and have not been properly accounted for in present models."

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IP1: "Ecological Consequences Of Increased CO_2 Levels. From: Peterson, E.K., "Carbon Dioxide Affects Global Ecology," Environmental Science and Technology 3 (11), 1162-1169 (Nov '69).

"1. Environmental effects of increasing the CO_2 levels to 500 ppm... - The southwest states would be hotter, probably by more than 3 F, and drier; - The flow of the Colorado River would diminish and the southwest water shortage would become much more acute; - Most of the glaciers in the North Cascades and Glacier National Park would be melted. There would be less of a winter snow pack in the Cascades, Sierras, and Rockies, necessitating a major increase in storage reservoirs; - Marine life would be markedly changed. Maintaining runs of salmon and steelhead and other subarctic species in the Columbia River system would become increasingly difficult.

2. “Effects of a doubling of the 1850 CO_2 concentration. (580 ppm)... - Most areas would get more rainfall, and snow would be rare in the contiguous states, except on higher mountains; - Ocean levels would rise four feet; - The melting of the polar ice caps could cause tremendous redistribution of weight and pressure exerted on the Earth's crust. This could trigger major increases in earthquake and volcanic activity resulting in even more atmospheric CO_2 and violent storms; - The Arctic ocean would be ice free for at least six months each year, causing major shifts in weather patterns in the northern hemisphere."

1979 Garvey, E. A., Shaw, H., Broecker, W. S., Takahashi, T. presentation to Machta, L. (NOAA) | Proposed Exxon Research Program to Help Assess the Greenhouse Effect | March 26, 1979

EP4b-2: "Program Goal" is to "use Exxon expertise and facilities to help determine the likelihood of a global greenhouse effect."

IP2: No position

1980 Weinberg, H. N. to Shaw, H. and Werthamer, N. R. | Greenhouse Program | June 9, 1980

EP4a: No position

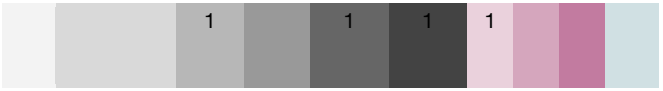
IP2: No position

1980 Eckelmann, W. R. (Exxon Science & Tech Dept) to O'Loughlin, M. E. J. (cc: David, E. E. et al.) | Exxon's View and Position on "Greenhouse Effect" | January 29, 1980

EP4b-2: "Science and Technology feels that the build-up of carbon dioxide in the atmosphere is a potentially serious problem requiring the results of a huge worldwide research effort before quantitative predictions can be reached on the probabilities and timing of world climate changes...The major questions that need to be answered in a more definitive way in order to evaluate the significance of increasing CO_2 concentrations are: first, what is the contribution of fossil fuel combustion emissions to the atmospheric CO_2 build-up; second, what happens to the CO_2 that does not remain in the atmosphere; and third, how will the continued increases of CO_2 in the atmosphere affect the world climate?"

IP2 [generic "risk"]: "Science and Technology feels that the build-up of carbon dioxide in the atmosphere is a potentially serious problem requiring the results of a huge worldwide research effort before quantitative predictions can be reached on the probabilities and timing of world climate changes...The major questions that need to be answered in a more definitive way in order to evaluate the significance of increasing CO_2 concentrations are: first, what is the contribution of fossil fuel combustion emissions to the atmospheric CO_2 build-up; second, what happens to the CO_2 that does not remain in the atmosphere; and third, how will the continued increases of CO_2 in the atmosphere affect the world climate?"

1980 Shaw, H. to Kett, R. K. (cc: McCall, P. P. et al.) | Exxon Research and Engineering Company's Technological Forecast CO_2 Greenhouse Effect | December 18, 1980



EP3b: "The most widely accepted calculations carried on thus far on the potential impact of a doubling of carbon dioxide on climate indicate that an increase in the global average temperature of 3+/-1.5 °C is most likely."

EP3b: "There have been other calculations on a more limited scale by a number of climatologists which project average temperature increases on the order of 0.25 °C for a doubling of CO_2. These calculations are not held in high regard by the scientific community."

EP4b-1/2: "Projections on when general consensus can be reached. It is anticipated by most scientists that a general consensus will not be reached until such time as a significant temperature increase can be detected above the natural random temperature fluctuations in average global climate. The earliest that such discreet signals will be able to be measured is after the year 2000. However, depending on the actual global energy demand and supply, it is possible that some of the concerns about CO_2 growth due to fossil fuel combustion will be minimized if fossil fuel use is decreased due to high price, scarcity, and unavailability." [see Fig. 7]

EP3b: Fig. 4 summary of the literature, and Fig. 7, indicate EP3b.

IP1: "Along with temperature increase, other climatological factors that are expected to occur will include uneven global distribution of increased rainfall, and increased evaporation. These disturbances in the existing global water distribution balance will have dramatic impact on soil moisture, and in turn, on agriculture."

IP1: "...quite dramatic. For example, areas that 4,000 to 8,000 years ago in the Altithermal period (when the global average temperature was some 2 °C higher than present) were deserts, may in due time return to deserts." [see Fig. 5]

IP1: " there are some particularly dramatic questions that might cause serious global problems. For example, if the Antarctic ice sheet[,] which is anchored on land, should melt, then this could cause a rise in the sea level on the order of 5 meters. Such a rise would cause flooding in much of the U.S. East Coast including the state of Florida and Washington D.C,..."

1980 Werthamer, N. R. to Weinberg, H. N. | CO_2 Greenhouse Communications Plan | July 8, 1980

EP4a: No position

IP2: No position

1981 Gervasi, G. R. (Esso) to Northington, G. A. (Exxon) (cc: Preston, R. L. et al.) | CO_2 Emissions Natuna Gas Project | February 3, 1981

EP4a: No position

IP2: No position

1981 Shaw, H. to David Jr., E. E. (cc: Barnum, R. E. et al.) | CO_2 Position Statement | May 15, 1981

EP4b-1/2: "An indication of the average global temperature increase due to CO_2 will not be measurable above normal climatic fluctuations (noise) until about 2000." [N.B. At the time, this was Exxon's public "position".]

EP3b: "3 °C global average temperature rise and 10 °C at poles if CO_2 doubles. - Major shifts in rainfall/agriculture; - Polar ice may melt"

IP3: "There is sufficient time to study the problem before corrective action is required." [N.B. At the time, this was Exxon's public "position".]

IP1: "3 °C global average temperature rise and 10 °C at poles if CO_2 doubles. - Major shifts in rainfall/agriculture; - Polar ice may melt"

1981 Cohen, R. W. to Glass, W. (cc: Weinberg, H. N. et al.) | Untitled (catastrophic effects letter) | August 18, 1981

EP3b: "The models that appear most credible (to us) do predict measurable changes in temperature, rainfall pattern, and sea-level by the year 2030 for the postulated fossil fuel combustion rates...." But the impacts will be "well short of catastrophic."

EP3a: Cohen's feedback says that the draft is okay except for the "short of catastrophic" part: ""but changes of a magnitude well short of catastrophic..." I think that this

statement may be too reassuring. Whereas I can agree with the statement that our best guess is that observable effects in the year 2030 are likely to be "well short of catastrophic, it is distinctly possible that the CPD scenario will later produce effects which will indeed be catastrophic (at least for a substantial fraction of the earth's population). This is because the global ecosystem in 2030 might still be in a transient, headed for much more significant effects after time lags perhaps of the order of decades. If this indeed turns out to be the case, it is very likely that we will unambiguously recognize the threat by the year 2000 because of advances in climate modeling and the beginning of real experimental confirmation of the CO_2 effect. The effects of such a recognition on subsequent fossil fuel combustion are unpredictable, but one can say that predictions based only on our knowledge of availability and economics become hazardous."

IP1/IP3: "The models that appear most credible (to us) do predict measurable changes in temperature, rainfall pattern, and sea-level by the year 2030 for the postulated fossil fuel combustion rates...." But the impacts will be "well short of catastrophic."

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1981 Long, G. H. to Lucceshi, P. J. et al. (cc: Barnum, R. E. et al.) — Atmospheric CO_2 Scoping Study — February 5, 1981

EP4a [pre-1995]: "The increasing level of atmospheric CO_2 is causing considerable concern due to potential climate effects." This is borderline EP3a, however authors do not articulate their own position regarding the described concern.

EP4a [pre-1995]: "The potential impact on climate [of "an upward trend in CO_2 content"] concerns many people."

IP3: "Legislation Related to CO_2 Controls. There is no near term threat of legislation to control CO_2. One reason for this is that it has not yet been proven that the increases in atmospheric CO_2 constitute a serious problem that requires immediate action. In addition, even if some action were to be taken, the options for reducing CO_2 build-up in the atmosphere are relatively limited. It has been shown, for example, that the cost of scrubbing large quantities of CO_2 from flue gases is exorbitant. Indirect control measures, such as energy conservation or shifting to renewable energy sources, represent the only options that might make sense."

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1982 Weinberg, H. N., Cohen, R. W., Callegari, A. J., Flannery, B., et al. — CO_2-Greenhouse Effect; Corporate Research Climate Modeling — July 21, 1982

EP3b: Graph showing "Climate model consensus. Estimates of the change in global average surface temperature due to various changes in CO_2 concentration" in comparison to "range of natural fluctuations."

EP3a: Graph of temperature change versus title entitled "First effects predicted by year 2000."

EP4b-2: Slide entitled "Validity of climate models is not established: - Complexity of climate system requires many approximations and parameterizations; Geological and historical climate data are inadequate for validation of models; Predictions of models are unverified."

EP3a: Exxon's own modeling on equatorial evaporative cooling refutes findings of Newell (MIT) which are a "recent controversy...of much smaller CO_2 induced warming", instead finding that "decreased warming proposed by Newell not found."

EP4a: Executives ask, "Is it Exxon's position that warming will take place?" Answer: "Current work is a model study...The model is illustrative rather than fully predictive. Predictions are subject to approximations and simplifications used to derive the model."

EP3a: Results of model, shown in figures on pages 10-12, show average temperature rise on order of 2.5 °C for doubling of CO_2; pole temp rise of ~10 °C for doubling of CO_2; and retreat of ice line (to disappearance) at doubling of CO_2.

IP1: "Warming could include major changes in climate: - Temperature; - Rainfall Patterns; - Coastal Sea Levels."

1982 Glaser, M. B. (Exxon Manager, Env Affairs Program) to Cohen, R. W. et al. | CO_2 "Greenhouse" Effect | November 12, 1982

EP3a: "Fossil fuel combustion and the clearing of virgin forests (deforestation) are believed to be the primary anthropogenic contributors although the relative contribution of each is uncertain. The carbon dioxide content of the atmosphere is of concern since it can affect global climate."

EP3a: "The question of which predictions and which models best simulate a carbon dioxide induced climate change is still being debated by the scientific community. Our best estimate is that doubling of the current concentration could increase average global temperature by about 1.3 to 3.1 °C. This increase would not be uniform over the earth's surface with the polar caps likely to see temperature increases on the order of 10 °C and the equator little, if any, increase."

EP4b-1: "There is currently no unambiguous scientific evidence that the earth is warming. If the earth is on a warming trend, we're not likely to detect it before 1995."

EP4b-2: "Overall, the current outlook suggests potentially serious climate problems are not likely to occur until the late 21st century or perhaps beyond at projected energy demand rates. This should provide time to resolve uncertainties regarding the overall carbon cycle and the contribution of fossil fuel combustion as well as the role of the oceans as a reservoir for both heat and carbon dioxide."

EP3b: "The most widely accepted calculations carried on thus far on the potential impact on climate of doubling the carbon dioxide content of the atmosphere use general circulation models (GCM). These models indicate that an increase in global average temperature of 3 +/- 1.5 °C is most likely."

EP4b-2: "This [Charney] National Research Council study concluded that there are major uncertainties in these models in terms of the timing for a doubling of CO_2 and the resulting temperature increase."

EP4b-1/2: "It is anticipated by most scientists that a general consensus regarding the likelihood and implications of a CO_2 induced greenhouse effect will not be reached until such time as a significant temperature increase can be detected above the natural random temperature fluctuations in average global climate. These fluctuations are assumed to be +/- 0.5 °C."

EP3b/4b-1: "A number of climatologists claim that they are currently measuring a temperature signal (above climate noise) due to a CO_2 induced greenhouse effect, while the majority do not expect such a signal to be detectable before the year 2000."

EP3a/b: "A doubling of atmospheric CO_2 would [lead to] the temperature increase ranging between 1.3 and 3.1 °C. The projected range presented above is considerably lower than the generally accepted range of 1.5 to 4.5 °C."

IP1/IP3: "Considerable uncertainty also surrounds the possible impact on society of such a warming trend, should it occur. As the low end of the predicted temperature range there could be some impact on agricultural growth and rainfall patterns which could be beneficial in some regions and detrimental in others. At the high end, some scientists suggest there could be considerable adverse impact including the flooding of some coastal land masses as a result of a rise in sea level due to melting of the Antarctic ice sheet. Such an effect would not take place until centuries after a 3 °C global average temperature increase actually occurred."

IP1/IP3: "The "greenhouse effect" is not likely to cause substantial climatic changes until the average global temperature rises at least 1 °C above today's levels. This could occur in the second to third quarter of the next century. However, there is concern among some scientific groups that once the effects are measurable, they might not be reversible and little could be done to correct the situation in the short term."

IP3: "Overall, the current outlook suggests potentially serious climate problems are not likely to occur until the late 21st century or perhaps beyond at projected energy demand rates. This should provide time to resolve uncertainties regarding the overall carbon cycle and the contribution of fossil fuel combustion as well as the role of the oceans as a reservoir for both heat and carbon dioxide."

IP1: "...warm the earth's surface causing changes in climate affecting atmospheric and ocean temperatures, rainfall patterns, soil moisture, and over centuries potentially melting the polar ice caps." [See for more details on agricultural effects, rainfall, etc.]

IP1: "In addition to the effects of climate on global agriculture, there are some potentially catastrophic events that must be considered. For example, if the Antarctic ice sheet[,] which is anchored on land should melt, then this could cause a rise in sea level on the order of 5 meters. Such a rise would cause flooding on much of the U.S. East Coast, including the State of Florida and Washington, D.C."

IP1: "There could also be positive feedback mechanisms as deposits of peat, containing large reservoirs of organic carbon, are exposed to oxidation. Similarly, thawing might also release large quantities of carbon currently sequestered as methane hydrates."

IP1: "Health effects associated with changes in the climate sensitive parameters, or stress associated with climate related famine or migration could be significant...."

IP1/IP3: "...the AAAS-DOE workshop participants felt that society can adapt to the increase in CO_2 and that this problem is not as significant to mankind as a nuclear holocaust or world famine."

IP1: [on MIT study] "The second limit [500-1000ppm CO_2] can be illustrated as an assumed threshold for inducing great irreversible harm to our planet, such as causing a large ocean level rise due to melting polar ice."

IP3: "Given the long term nature of the potential problem and the uncertainties involved, it would appear that there is time for further study and monitoring before specific actions need be taken. At the present time, that action would likely be curtailment of fossil fuel consumption which would undoubtedly seriously impact the world's economies and societies."

SP1: "Making significant changes in energy consumption patterns now to deal with this potential problem amid all the scientific uncertainties would be premature in view of the severe impact such moves could have on the world's economies and societies."

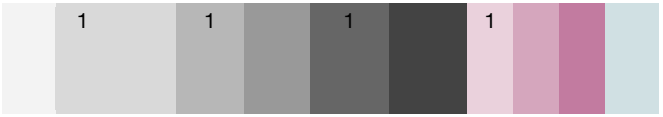
SP1: "Given the long term nature of the potential problem and the uncertainties involved, it would appear that there is time for further study and monitoring before specific actions need be taken. At the present time, that action would likely be curtailment of fossil fuel consumption which would undoubtedly seriously impact the world's economies and societies."

1982 Natkin, A. M. to Weinberg, H. N. (cc: CRL/CO_2 Greenhouse Program Forshee, M. E. et al.) June 18, 1982

EP4a: No position

IP2: No position

1982 Cohen, R. W., Levine, D. G. to Natkin, A. M. (Office of Science & Tech, Exxon) (cc: Callegari, A. J. et al.) | Untitled (consensus on CO_2 letter) | September 2, 1982



EP4b-1: "Although the increase of atmospheric CO_2 is well documented, it has not yet resulted in a measurable change in the earth's climate." "It is generally believed that the first unambiguous CO_2-induced temperature increase will not be observable until around the year 2000."

EP2/3b: " ...the quantitative predictions derived from the various models show considerable variation. However, over the past several years a clear scientific consensus has emerged regarding the expected climatic effects of increased atmospheric CO_2. The consensus is that a doubling of atmospheric CO_2 from its pre-industrial revolution value would result in an average global temperature rise of (3.0 +/- 1.5) °C. The uncertainty in this figure is a result of the inability of even the most elaborate models to simulate climate in a totally realistic manner."

EP3a/3b: "It should be emphasized that the consensus prediction of global warming is not unanimous. Several scientists have taken positions that openly question the validity of the predictions of the models, and a few have proposed mechanisms which could mitigate a CO_2 warming. One of the most serious of these proposals has been made by Professor Reginald Newell of MIT...In our climate research we have explored the global effects of Newell's evaporative buffering mechanism using a simple mathematical climate model...we find...a global averaged temperature increase that falls well within the range of the scientific consensus. Our results are consistent with the published predictions of more complex climate models...In summary, the results of our research are in accord with the scientific consensus on the effect of increased atmospheric CO_2 on climate. Our research appears to reconcile Newell's observations and proposed mechanism with the consensus opinion."

IP1: "There is unanimous agreement in the scientific community that a temperature increase of this magnitude would bring about significant changes in the earth's climate including rainfall distribution and alterations in the biosphere."

1982 Cohen, R. W. to Kimon, P. (cc: Berner, R. et al.) | Untitled (Esso project terminated letter) | July 14, 1982

EP4a: No position

IP2: No position

1983 Gervasi, G. R. (Esso) to Downing, R. G. et al. (cc: Gates, D. F. et al.) | Background Paper Environmental Issues Natuna Gas Project | October 27, 1983

EP4a: No position

IP2: No position

1983 Natkin, A. M. to Preston, R. L. (Esso Eastern) (cc: Gervasi, G. R. et al.) | Untitled (ocean storage environmental concerns letter) | October 17, 1983

EP4a: No position

IP2: No position

1984 Flannery, B., Callegari, A. J., Nair, B., Roberge, W. G. | The Fate of CO_2 from the Natuna Gas Project if Disposed of by Subsea Sparging | N/A

EP3a: "This would make Natuna the world's largest point source emitter of CO_2 and raises concern for the possible incremental impact of Natuna on the CO_2 greenhouse problem".

EP3a: "Release of this amount of CO_2 to the atmosphere raises concern with respect to its effect on the CO_2 greenhouse problem."

EP3a: "...the buildup of atmospheric CO_2 influencing climate through a greenhouse effect."

IP2: "We focus on two principal features (1) the role CO_2 addition on seawater chemistry, especially pH, and (2) the retention time for CO_2 to remain dissolved in seawater before degassing to the atmosphere." "The principal conclusions from our models are that (1) the retention time is only about ten years or less, and (2) addition of CO_2 raises the acidity of seawater sufficiently to cause dissolution of calcite over an area of order 1000 square km in size. These effects indicate that sparging offers no advantage over direct atmospheric venting of CO_2." [See for many more quotes on acidification and degassing.] Classified as IP2 because although document implies knowledge that fossil fuel burning will lead to ocean acidification and views this as detrimental, this is not strictly an impact of AGW.

1984 Callegari, A. J. | Corporate Research Program in Climate/CO_2-Greenhouse | February 2, 1984

EP4b-2: "Validity of models not established. - Complexity of carbon cycle and climate system require many approximations and parameterizations; - Geological and historical data are inadequate for validation of models."

EP3b: "Climate model consensus" -- figure shows temp projection consensus from many models and temp versus time, with "first effects predicted by year 2000" (figure from Hansen et al.1981).

EP3b: "Climatic effect of CO_2 doubling (NRC): - Mean surface temperature rise of between 1.5 °C and 4.5 °C with "values in lower half of range most probable";... - Coverage and thickness of sea ice decreases -- sea level rise..."

IP1: "Climatic effect of CO_2 doubling (NRC): - Mean surface temperature rise of between 1.5 °C and 4.5 °C with "values in lower half of range most probable";... - Coverage and thickness of sea ice decreases -- sea level rise..."

1984 Shaw, H. | CO_2 Greenhouse and Climate Issues | EUSA/ER&E Environmental Conference, Florham Park, New

Jersey, March 28, 1984

EP2: Table 1 ("Results/Effects") shows "Exxon" prediction of "time for CO_2 doubling" as 2090; "average temperature rise" as "1.3 - 3.1 °C "; impact of alternate energy sources" as "insensitive." This is compared with EPA, NRC/NAS and MIT studies of AGW impacts.

EP2: Backup figure 1 ("Growth of atmospheric CO_2 and instantaneous global temperature increase as a function of time") shows "most probable temperature increase" of 2.6 °C by 2080 arising from increased CO_2 levels around 620ppm.

EP2/3b: "Our next task is to covert the amount of CO_2 emitted from fossil fuel oxidation into a projection of how it may impact on climate...A graph showing all these assumptions is reproduced on the last vugraph [backup fig. 1 above]. Most climatologists assume that the CO_2 effect will be detectable by the year 2000...the threshold would occur at 340 ppm CO_2 and would cause a temperature rise of 3 °C in 2090 when the current amount of atmospheric CO_2 would double, if the pre-industrial concentration had been between 290 and 300ppm. If the preindustrial CO_2 had been between 260 and 270 ppm, then a doubling would cause a 2 °C rise in global average temperature. These values fall toward the lower end of the generally accepted temperature range for a doubling of 3 +/- 1.5 °C, and are consistent with the recently published 50th percentile line in the NAS report."

IP1: Table 1 summarises EPA as projecting: "sea level rise" of "150 cm, 2040; 215 cm, 2100"; "precipitation" as "possible major changes"; "agricultural" as "pluses and minuses"; "impact of alternate energy sources" as "small".

IP1: Table 1 summarises NRC/NAS as projecting: "sea level rise" of "70 cm 2080 (3-4°C rise)"; "precipitation" as "drier midwest"; "agricultural" as "benefits will balance debits"; "impact of alternate energy sources" as "insensitive".

IP1: Table 1 summarises MIT as projecting: "precipitation" as "significant, but unpredictable"; "agricultural" as "significant, but unpredictable"; "impact of alternate energy sources" as "large".

IP1: "A 2 to 3°C increase in global average temperature can be amplified to about 10 °C at the poles. This could cause polar ice melting and a possible sea-level rise of 0.7 meter by 2080. The time scale for such a catastrophe is measured in centuries. Other potential effects associated with a high atmospheric CO_2 concentration and a warmer climate are:

- redistribution of rainfall
- positive and negative changes in agricultural productivity
- accelerated growth of pests and weeds
- detrimental health effects
- population migration

Society must carefully study the problem in order to establish a desirable course of action. We can either adapt our civilization to a warmer planet or avoid the problem by sharply curtailing the use of fossil fuels. The general consensus is that society has sufficient time to technologically adapt to a CO_2 greenhouse effect."

IP3: "Society must carefully study the problem in order to establish a desirable course of action. We can either adapt our civilization to a warmer planet or avoid the problem by sharply curtailing the use of fossil fuels. The general consensus is that society has sufficient time to technologically adapt to a CO_2 greenhouse effect."

IP3: "Conclusions/Recommendations: Exxon. There is adequate time to study the problem. Legislation is premature."

1985 Flannery, B. P. CO_2 Greenhouse Update 1985 October 4, 1985

EP4b-2: "General circulation models disagree on steady state response 2xCO_2."

EP3b/4b-2: However, figure and other sentences still endorse basic consensus: "Basic results: - Global mean temperature rise 1.5-4.5 °C; -warming greater at poles. Major disagreement between models."

EP3b: "Recent models show 4-5 °C Global warming"

EP3b/4b-1: "Models claim to detect CO_2 effect, but required other types of forcing: - volcanoes, solar variation, (oceanic upwelling)...Consensus view CO_2 warming not yet confirmed by observation"

EP3b: "Ocean delays CO_2 warming: - As yet unrealized warming could be substantial"

EP3b: "Consensus prediction 1 °C warming (1860-2000), 2-5 °C (2100)"

EP3a/b/4b-1: "Emerging dilemma for climate models: Why hasn't warming been observed? - Recent GCM models predict greater sensitivity...Proposed solution, delay from oceanic thermal buffering much greater than found in previous studies." The Exxon team have run a "1D ocean model" ("upwelling diffusion model for heat transfer into the mixed layer and deep ocean", based on Hoffert, Callegari, Hseih 1980)...they find "lag time decades not hundreds of years" / "response delayed by decades, 30 years, not centuries".

IP1: "Ocean delays CO_2 warming: - As yet unrealized warming could be substantial"

1985 Shaw, H., Henrikson, F. W. to Lab Directors/Program Managers (cc: Cohen, R. W. et al.) | CR Interactions (handout for June 12th meeting with Lee Raymond) | May 7, 1985

EP4a: No position

IP2: No position

1988 Carlson, J. M. to Levine, D. G. | The Greenhouse Effect | March 8, 1988

EP2: "The greenhouse effect may be one of the most significant environmental issues for the 1990s...The principal Greenhouse gases are by-products of fossil fuel combustion."

EP4b-2: "There is no consensus on the net effect of these processes." [Referring to CO_2 warming with positive feedback effect on water vaporization.]

EP4b-2: "The climate models are not very reliable because approximations are used to represent poorly understood interactions."

EP3b: "Climate models predict a 1.5 °C to 4.5 °C global temperature increase in 100 years - depending on the projected growth in fossil fuel use."

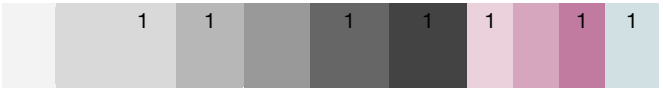
EP4b-1: "Actual measurements of Northern Hemisphere average temperatures show no clear pattern over a 20-year period from 1960 to 1980. When projected at a rate corresponding to about 2 °C increase over 100 years, the trend does not escape from the uncertainty band for another 10 years."

IP2: "The greenhouse effect may be one of the most significant environmental issues for the 1990s...The principal Greenhouse gases are by-products of fossil fuel combustion."

IP1: "Such warming could result in partial polar ice cap melting with associated sea level rise and since CO_2 and H_2O vapor aid plant growth, there could be an acceleration or alteration in vegetation growth patterns favoring selected species."

IP3: "It is too early to specify the severity of the potential impacts of the enhanced greenhouse effect."

1989 Levine, D. G. | Potential Enhanced Greenhouse Effects, Status and Outlook | Presentation to the Board of Directors of Exxon Corp, February 2, 1989



EP4b-2: "In spite of the rush by some participants in the Greenhouse debate to declare that the science has demonstrated the existence of PEG today...I do not believe such is the case. Enhanced Greenhouse is still deeply imbedded in scientific uncertainty, and we will require substantial additional investigation to determine the degree to which its effects might be experienced in the future."

EP4b-2: "...complex climate models...which...incidentally...have yet to be verified."

EP4b-2: "...policy initiatives are being advanced now and they could well out-pace scientific progress."

EP3a/EP4b-2: Figure entitled "Historical record of global temperature change": "Recent warming reverses cooling from 1940s-1970s: - 1980s warmest decade on record; - persistent trend could signal greenhouse warming." But "Noteworthy differences with greenhouse predictions."

EP4b-2: "However, the warming does not agree with models based on CO_2 variations. In particular, enhanced greenhouse models predict a smoothly accelerating increase of temperature with time...The data are quite different. Most noticeable is a cooling trend between the 1930s and late 1970s when the model predicts warming."

EP3a/EP4b-1: "Data on temperature variation in the 1980s are now becoming available. They show a reversal of the recent cooling trend. In fact, the 3 warmest years on record occurred in the 1980s. If this trend persists it could signal that enhanced greenhouse warming is finally becoming detectable."

EP3b: "Potential climate impact from CO_2: Next 100 years. "Changing Climate", National Research Council 1983: -Temperature, Global Mean Temperature Increase...1.5-4.5 °C, Greater warming in polar regions (2-3x)"

EP3/EP4b-2: "Consensus predictions call for warming between 1.5-4.5 °C for doubled CO_2 with greater warming at the poles. Note that these numbers reflect the range produced by available models. No one knows how to evaluate the absolute uncertainty in the numbers."

EP4b-1: "Historical temperatures show only slight warming...not enough to confirm enhanced greenhouse."

EP3b: "Projections suggest: - significant climate change with a variety of regional impacts; and - sea level rise with generally negative consequences."

IP1: "Potential climate impact from CO_2: Next 100 years. "Changing Climate", National Research Council 1983: -Sea Level/Sea Ice, Coverage and thickness of sea ice/glaciation will decrease, Sea level rise (meltwater+ thermal expansion)...70 cm ; -Natural ecosystems and agriculture, Regional climate change; temperature hydrology, Enhanced productivity from increased CO_2, global net effect uncertain."

IP1: "The extent and thickness of glaciers are predicted to decrease, leading to sea level rise. The NRC report chose a most likely value of 70 cm sea level rise. Other predictions suggest a broader range from 30-200 cm. The rise occurs both from a larger amount of water in the oceans, and from thermal expansion."

IP1/IP3: "Models cannot yet predict regional climate change with much accuracy. I am sure you have all heard that the US mid-west may become a dust bowl from enhanced greenhouse, while Russia may become more fruitful. That is a projection of some models, but others show the opposite."

IP1: "Projections suggest: - significant climate change with a variety of regional impacts; and - sea level rise with generally negative consequences."

IP3: "...the size and timing of impacts are uncertain."

IP1: "The [World-Wide General Assembly] commission's report..."Our Common Future"...contains a heavy dose of greenhouse concerns...on climate, agriculture, energy...and lists it as the #1 environmental problem we face."

IP1: "The United Nations Environmental Program (UNEP)...has made PEG [potential enhanced greenhouse] its #1 priority."

IP1: Climate change has "Enormous potential global impacts"

SP1: "Some key perceptions/misconceptions: Nuclear and/or renewable energy resources can solve the problem"

SP1: "There have been dramatic shifts in attitudes towards nuclear energy by environmental groups because of their concerns over PEG. Furthermore, renewable energy advocates have traditionally overstated capabilities. These both tend to encourage a precipitous shift to alternate energy and understate the considerable difficulties which must be overcome."

1989 Flannery, B. P. | Greenhouse Science | CONNECTIONS (ExxonMobil publication - "Proprietary information for company use only"), Fall 1989

EP3a: "We now know that concentrations of trace atmospheric gases are growing at a rate that could impact human and natural systems through global warming and associated climate change."

EP4b-2: "We also know that the modeled projections are far from certain: potential impacts could be small and manageable or they could be profound and irreversible. Uncertainty arises from incomplete scientific understanding - and missing data - to describe the role of fundamental processes such as cloud formation and oceanic circulation, that are known to be important in predicting climate change. Available data display such large natural fluctuations that, today, observations neither confirm nor refute the possibility of climate change from an enhanced Greenhouse effect...science is unlikely to provide definitive forecasts for decades."

EP2 [pre-1995]: "Today, CO_2 emissions contribute about half the forcing leading to a potential enhancement of the Greenhouse effect."

EP3b: "While uncertainty exists, science supports the basic idea that man's actions pose a serious potential threat to climate. Efforts to minimize that risk will influence the future direction of the energy industry."

IP1/IP3: "We also know that the modeled projections are far from certain: potential impacts could be small and manageable or they could be profound and irreversible. Uncertainty arises from incomplete scientific understanding -- and missing data -- to describe the role of fundamental processes such as cloud formation and oceanic circulation, that are known to be important in predicting climate change. Available data display such large natural fluctuations that, today, observations neither confirm nor refute the possibility of climate change from an enhanced Greenhouse effect...science is unlikely to provide definitive forecasts for decades."

1995 Bernstein, L. S. (Mobil Oil Corp.) to Members of Global Climate Coalition | Primer on Climate Change Science | December 21, 1994

EP4b-2: "The Global Climate Coalition's Science and Technical Advisory Committee believes that the IPCC statement [that "the balance of evidence suggests that there is a discernable human influence on global climate"] goes beyond what can be justified by current scientific knowledge."

EP3b: "Can human activities affect climate? The scientific basis for the Greenhouse Effect and the potential impact of human emissions of greenhouse gases such as CO_2 on climate is well established and cannot be denied."

EP4b-2: "The climate models which are being used to predict the increases in temperature which might occur with increased atmospheric concentrations of greenhouse gases are limited at present both by incomplete scientific understanding of the factors which affect climate and by inadequate computational power."

EP4b-2: "Have human activities over the last 120 years affected climate, i.e. has the change been greater than natural variability? Given the limitations of climate models and other information on this question, current claims that a human impact on climate has already been detected, are unjustified."

EP3a: "Are there alternate explanations for the climate change which has occurred over the last 120 years? Explanations based on solar variability, anomalies in the temperature record, etc. are valid to the extent they are used to argue against a conclusion that we understand current climate or can detect a human component in the change in climate that has occurred over the past 120 years. However, these alternative hypotheses do not address what would happen if atmospheric concentrations of greenhouse gases continue to rise at projected rates."

EP3b: "The science of the Greenhouse Effect is well established and can be demonstrated in the laboratory."

EP3b/EP4b-2: "The potential for a human impact on climate is based on well-established scientific fact, and should not be denied. ...However, as will be discussed below, it is still not possible to accurately predict the magnitude (if any), timing or impact of climate change as a result of the increase in greenhouse gas concentrations."

EP3a: "Several arguments have been put forward attempting to challenge the conventional view of greenhouse gas-induced climate change. These are generally referred to as "contrarian" theories. This section summarizes these theories and the counter-arguments presented against them...The contrarian theories raise interesting questions about our total understanding of climate processes, but they do not offer convincing arguments against the conventional model of greenhouse gas emission-induced climate change."

IP3: "The potential for a human impact on climate is based on well-established scientific fact, and should not be denied. ...However, as will be discussed below, it is still not possible to accurately predict the magnitude (if any), timing or impact of climate change as a result of the increase in greenhouse gas concentrations."

2002 Flannery, B. P. to Cooney, P. and Marburger, J. (White House) (cc: Randol, A. G.) | Activities | March 18, 2002

EP4b-2: "A programmatic approach to asses and reduce uncertainty in climate prediction. Gaps and uncertainty in observations and scientific understanding of critical climate processes limit current ability to predict the rate and consequences of future climate change. For climate change policy consideration the most critical scientific issues concern: - The extent of natural variability as a contributor to current and past climate changes; - Detection of climate change from human influences: with what confidence can science confirm that climate change have occurred that can be attributed to human influence...; - Ability to predict future consequences of climate change: with what confidence can science predict:...2) associated changes in climate, and 3) the impacts of climate change on humans and natural ecosystems."

EP4b-2: "A major frustration to many is the all-too-apparent bias of IPCC to downplay the significance of scientific uncertainty and gaps..."

IP3: "A programmatic approach to asses and reduce uncertainty in climate prediction. Gaps and uncertainty in observations and scientific understanding of critical climate processes limit current ability to predict the rate and consequences of future climate change. For climate change policy consideration the most critical scientific issues concern: - The extent of natural variability as a contributor to current and past climate changes; - Detection of climate change from human influences: with what confidence can science confirm that climate change have occurred that can be attributed to human influence…; - Ability to predict future consequences of climate change: with what confidence can science predict:...2) associated changes in climate, and 3) the impacts of climate change on humans and natural ecosystems."

Advertorials

Year	Authors	Title	Date	EP1	EP2	EP3a	EP3b	EP4a	EP4b-1	EP4b-2	IP1	IP2	IP3	SP1
1989	Mobil	People Who Live in Greenhouses...	July 6, 1989			1		1	1	1		1		

EP4b-1/2: "Scientists do not agree on the cause and significance of these changes [“possibility the temp in our greenhouse is rising”] - but many believe there's reason for concern about levels of "green-house gases" in earth's atmosphere."

EP4a: "The global climate is so huge and various that no easy formulas - or easy answers - apply. Nor do we fully understand the role of the oceans in absorbing and releasing carbon dioxide from and into the atmosphere. While much research remains to be done, we're already seeing world-wide pressure to reduce the atmospheric build-up of carbon dioxide."

EP3a [pre-1990/1995]: "There's some possibility the temp in our greenhouse is rising - and that certain gases associated with industrial activity and population growth may now be trapping more of the sun's energy than has been the case in the past...Global temperatures seem to be increasing...Over the last hundred years, the annual average temperature is up by one degree Fahrenheit, with the warmest years coming recently, in the '80s...the possibility of global warming."

IP2: No position

1994	Mobil	33/50: An experiment that works	June 9, 1994					1				1		

EP4a: No position

IP2: No position

1995	Mobil	The sky is <u>not</u> falling	September 28, 1995					1					1	

EP4a: No position

IP3: Title is: "The sky is <u>not</u> falling." Byline is: "The environment...better than you think."

IP3: "Good news: The end of the Earth as we know it is not imminent. The cycle of decline in the quality of our environment can be broken and, despite what some environmentalists are claiming, great strides have already been taken towards improving our situation...more than 30 years have passed since the environmental movement began. They made their point. There is no longer a need for alarmists; but there is a need for some perspective and some optimism. There's a lot of good news out there."

IP3: "Gregg Easterbrook has given us that perspective in his recent book, "Moment on the Earth: The Coming Age of Environmental Optimism" (Viking Penguin. 1995). Easterbrook talks about the dire predictions of the 1960s and 1970s that did not come to pass, sheds light on the tenacity of the Earth and discusses how much good has already occurred, while not diminishing the work that remains to be done. The robin, which some believed would be extinct by now, is still one of the most prolific birds in the United States..."

IP3: "And to those who think industry and nature cannot coexist, we say show a little respect for Mother Nature. She is one strong lady, resilient and capable of rejuvenation.

The environment recovers well from both natural and man-made disasters."

IP3: "In his book, Easterbrook points out nature itself has produced far more devastating changes than any caused by man - ice ages, meteor strikes, large-scale volcanic eruptions that spewed millions of tons of "pollutants" into the air - and the environment has survived. Does this justify or lessen the impact of industrial pollution? Of course not. Our point is that nature, over the millennia, has learned to cope. Mother Nature is pretty successful in taking on human nature."

1996 Mobil | A policy agenda for tomorrow | December 12, 1996

EP4a: No position

IP2: No position

SP1: "Concern over global climate change is triggering actions that could cause severe dislocations throughout the world economy."

1996 Mobil | Less heat, more light on climate change | July 18, 1996

EP4b-2: Title is "Less heat, more light on climate change"
EP4b-2 [post-1995]: "many governments are grappling with the possibility that human activities are enhancing nature's greenhouse effect, which might trigger significant changes in the global climate."
EP4b-2: "...policy and politics may well outrun science and common sense."
EP4b-2: "The greenhouse effect is a natural phenomenon." [Not strictly incorrect, but in context, implication is that natural factors can explain recent global warming, which they cannot.]
EP4b-2: "Naturally occurring greenhouse gases - predominantly water vapor - account for 95 to 97 percent of the current effect. The other 3 to 5 percent is attributable to man's activities." [Not strictly incorrect, but in context, implication is that natural factors can explain recent global warming, which they cannot.]
EP4b-2: "The rest is believed to be absorbed by increased plant growth and the oceans. We know little about this nonatmospheric absorption, which complicates decision-making. For example, how might plant growth and absorption by the ocean change with higher global temperatures? Moreover, greenhouse-gas emissions, which have a warming effect, are offset by another combustion product - particulates - which leads to cooling."

IP3: "One thing we do know is that greenhouse gases reside in the atmosphere for long periods of time and are dispersed over the entire globe...The concentration of greenhouse gases is building up slowly - less than 0.5 percent annually for CO_2 - and that gives us time to implement effective mitigation measures."

SP1: "The developing nations argue that the industrialized world has no right to impose its environmental rules on them, possibly short-circuiting their industrial revolution, without compensation or dispensations. This raises thorny social and economic issues."

1996 Mobil | With climate change, what we don't know can hurt us | July 26, 1996

EP4b-2: Title is "With climate change, what we don't know can hurt us."

EP3a/4b-2: "climate in the 10,000 years since the last Ice Age...has actually been quite volatile, changing Earth in ways that may dwarf the impact of human activity and complicate predicting climate trends. Nevertheless, the human factor in global climate change and the chance that we might be headed for damaging social and economic dislocations cannot be ignored."

EP4b-2: They refer to "The evolving science of climate change." [Strictly correct, but context heightens doubt.]

IP1: "climate in the 10,000 years since the last Ice Age...has actually been quite volatile, changing Earth in ways that may dwarf the impact of human activity and complicate predicting climate trends. Nevertheless, the human factor in global climate change and the chance that we might be headed for damaging social and economic dislocations cannot be ignored." Note, however, that context somewhat suggests that "damaging social and economic dislocations" may actually refer to the result of climate mitigation efforts (which would instead imply a coding of SP1), rather than to climate change itself. We assign the conservative coding of IP1.

IP3: "The compressed timetable of these [UNFCCC] negotiations tends to create an unwarranted sense of crisis. A gradual approach - one that would not result in an appreciable buildup of gases over the next 100 years - would allow us to improve our understanding of the potential threat and to develop more efficient technology to deal with it."

SP1: "Unfortunately, the policy decisions now being considered in United Nations climate change negotiations could lead to premature, inequitable and ultimately counter-productive measures. At stake are trillions of dollars in technological and industrial changes, potentially disruptive trade wars and an unprecedented transfer of wealth."

SP1: "There is great pressure to assign responsibility for the stabilization and reduction of emissions, along with the cost, almost entirely to the industrialized world. While the developing world would be spared the initial burden, such selective controls would penalize all nations in the long run."

SP1: "Imposing controls only on the industralized world would likely cause what economists call "carbon leakage" - the transfer of energy-intensive industries to less-regulated countries, where they would offset the benefits of emission reductions. Beyond this, the cost of mitigation, even for the wealthiest nations, would weaken their purchasing power and lead to a reduction in imports from the developing countries - depriving them of a powerful impetus for growth and prosperity."

1997 Mobil Stop, look and listen before we leap March 6, 1997 

EP4b-2: "The CRA [Charles River Associates economic] study injects a healthy dose of realism into the climate-change debate." "International efforts to deal with climate change are lurching from speculation toward action that could wreak havoc on nations even as the underlying science and economics continue to signal caution. While governments have agreed that there may be reasons for concern over the buildup of GHG emissions...there is no consensus on what constitutes "dangerous levels" of emissions nor is there agreement on when, where and how best to reduce their impact."

IP3: "The CRA [Charles River Associates economic] study injects a healthy dose of realism into the climate-change debate." "International efforts to deal with climate change are lurching from speculation toward action that could wreak havoc on nations even as the underlying science and economics continue to signal caution. While governments have agreed that there may be reasons for concern over the buildup of GHG emissions...there is no consensus on what constitutes "dangerous levels" of emissions nor is there agreement on when, where and how best to reduce their impact."

SP1: "The CRA [Charles River Associates economic] study injects a healthy dose of realism into the climate-change debate." "International efforts to deal with climate change are lurching from speculation toward action that could wreak havoc on nations even as the underlying science and economics continue to signal caution. While governments have agreed that there may be reasons for concern over the buildup of GHG emissions...there is no consensus on what constitutes "dangerous levels" of emissions nor is there agreement on when, where and how best to reduce their impact."

SP1: "We are concerned that policy makers are not considering the implications of controlling CO_2 emissions. Studies have examined some of the emission-control plans tabled to date and concluded that they will impose painful burdens on developed economies, particularly if timetables are short and targets are unrealistic. For Americans, such solutions mean jobs will disappear and lifestyles will be pinched as our industrial infrastructure sinks. A study just issued by Charles River Associates (CRA) provides additional weight to the impact of emission controls in an age of global markets. The report shows how ill-timed or ill-considered abatement measures could stunt world economic growth, unsettle global trading patterns and set the stage for a new era of trade protectionism...[carbon] rationing will increase energy prices for both industry and the consumer. The cost of limiting emissions could range from $200 to $580 per ton of carbon, depending on the timing and severity of the plan selected...this equates to an additional cost to consumers of 50 cents to $1.50 per gallon of gasoline in today's dollars. The expected blow to U.S. prosperity would be considerable, according to CRA: an annual drop in gross domestic product ranging from $105 billion in the year 2010 to $460 billion in 2030, both in today's dollars. At the lower range, this works out to a loss in annual household income of roughly $1000."

SP1: "The developed world feels the pain as it is forced to switch fuels and revamp its industrial infrastructure. The developing world, which now exports 60 to 75 percent of its

products to industrialized countries, will see those markets shrivel as economic growth stalls and demand for protectionist measures grows."

SP1: "The entire world's prosperity depends on a course of wise, sustainable action."

1997 Mobil | Climate change: Let's get it right | June 23, 1997

EP4b-2 [post-1995]: "The concern [of nations] is that the buildup of these gases (carbon dioxide, methane, and nitrous oxide) in the atmosphere could cause climate change."

EP4b-2: "We encourage governments to take the time to do it right - to examine the science, decide if emission levels are dangerous and then evaluate steps to effectively mitigate or reduce future emissions."

IP3: "We encourage governments to take the time to do it right - to examine the science, decide if emission levels are dangerous and then evaluate steps to effectively mitigate or reduce future emissions."

IP1: "Much is at stake in these upcoming [Kyoto] global climate discussions - not just a habitable planet for future generations, but also a world where all nations can provide for the economic well-being of their citizens."

SP1: "Much is at stake in these upcoming [Kyoto] global climate discussions - not just a habitable planet for future generations, but also a world where all nations can provide for the economic well-being of their citizens."

SP1: "Many studies point out that in a world where economies are increasingly integrated, energy exporters and developing nations will suffer as well. As industrial economies are driven to switch fuels and revamp their industrial bases, their growth will falter, altering trade patterns throughout the world...high energy prices, which would follow from stiff commitments to reduce CO_2 emissions, would have a crushing effect on these [six energy-intensive] sectors."

1997 Mobil | The Senate Speaks | July 31, 1997

EP4a: No position

IP3 [generic "risk"]: "Assessing the potential dangers from the buildup of greenhouse gases (mainly carbon dioxide and methane) and developing an action plan to combat emissions in an equitable manner has produced serious disagreement among scientists, economists and climate change negotiators for the past five years."

SP1: "Senate Resolution 98...signals genuine concern about ratifying a [Kyoto] treaty that doesn't involve participation by all nations or could jeopardize the U.S. economy."

1997 Mobil | When facts don't square with the theory, throw out the facts | August 14, 1997

EP4b-2: "The White House has promised to lay the economic facts before the public. Yet, the administration's top advisor said such an analysis won't be based on models and it will "preclude...detailed numbers." If you don't provide numbers and don't rely on models, what kind of rigorous economic examination can Congress and the public expect? We're also puzzled by ambivalence over models. The administration downplays the utility of economic models to forecast cost impacts 10-15 years from now, yet its negotiators accept as gospel the 50-100-year predictions of global warming that have been generated by climate models - many of which have been criticized as seriously flawed."

IP2: No position

SP1: "...international efforts to curb global warming could spark a big run-up in energy prices."

SP1: "...the proposals submitted by other countries thus far would be disruptive and costly to the U.S. economy."

SP1: "The second study, conducted by Argonne National Laboratory under a contract with the Energy Department, examined what would happen if the US. had to commit to

higher energy prices under the emission reduction plans that several nations had advanced last year. Such increases, the report concluded, would result in "significant reductions in output and employment" in six industries - aluminum, cement. chemical, paper and pulp, petroleum, refining and steel. Hit hardest, the study noted, would be the chemical industry, with estimates that up to 30 percent of US. chemical manufacturing capacity would move offshore to developing countries. Job losses could amount to some 200,000 in that industry, with another 100,000 in the steel sector. And despite the substantial loss of U.S. jobs and manufacturing capacity, the net emission reduction could be insignificant since developing countries will not be bound by the emission targets of a global warming treaty."

SP1: "As for emissions trading, many economists have theorized about the role they could play in reducing emissions, but few have grappled with the practicality of implementing and policing such a scheme."

1997 Mobil CNN and the value of instant replay October 16, 1997

EP4a: No Position

IP2: No position

1997 Mobil Global climate change October 23, 1997

EP4b-2 [post-1995]: "government representatives will meet in Kyoto, Japan, in early December to see if they can agree on a plan to control carbon dioxide (CO_2) and other greenhouse gases that may be linked to global warming and climate change."

EP4b-2: "In the coming weeks, we'll wade into the debate, beginning with what we do and don't know about greenhouse gases and climate change."

EP4b-2: "Initiatives like these, which are good for the environment, can be taken while the debate continues."

IP2 [generic "risk"]: "Because we believe there is potential reason for concern, there are measures we can take that will give us time to get better data so governments don't have to commit to policies that will damage economies.

IP3: "As the deadline in Kyoto approaches, there's considerable pressure to reach an agreement. Frankly, the pressure seems misplaced. Let's not rush to a solution before we fully understand the dimensions of the problem."

SP1: "Because we believe there is potential reason for concern, there are measures we can take that will give us time to get better data so governments don't have to commit to policies that will damage economies.

1997 Mobil Reset the alarm October 30, 1997

EP4b-2: Mobil says a potential Kyoto agreement would be "imposing a solution before the problem has been defined."

EP4b-2: "Let's face it: The science of climate change is too uncertain to mandate a plan of action that could plunge economies into turmoil. Yet, that's what nations seem prepared to do. Scientists cannot predict with certainty if temperatures will increase, by how much and where changes will occur. We still don't know what role man-made greenhouse gases might play in warming the planet. We're not impugning the existing science or suggesting that "our science is better than your science." Current science isn't bad; it just doesn't go far enough. Better science is emerging on what factors affect global warming. No need to wait 20 or 50 years: big breakthroughs that will dramatically inform our decision-making are expected in the next five to 10 years. Scientists are getting more precise in calculating temperature variations: they're probing the role of clouds and oceans on climate. Such information can take much of the guesswork out of what and where actions will be needed."

EP4b-2: Let 's not rush to a decision at Kyoto. Climate change is complex; the science is not conclusive; the economics could be devastating."

IP3: Title is "Reset the alarm"

SP1: "What is not moderate is the call [by the U.S. government, and perhaps other countries?] to lower emissions to 1990 levels. A cutback of that size would inflict considerable economic pain...Committing to binding targets and timetables now will alter today's lifestyles and tomorrow's living standards. Flexibility will be constrained. Carpooling in; sport utility vehicles out. High fuel and electric bills. Factory closures. Job displacement. And could businesses and consumers cut their energy consumption by 30 percent without some form of tax or carbon rationing? Probably not."

SP1: Let 's not rush to a decision at Kyoto. Climate change is complex; the science is not conclusive; the economics could be devastating."

1997	Mobil	Science: what we know and don't know	November 6, 1997				1			1	1

EP4b-2: Title is "Science: what we know and don't know"

EP4b-2: "As the debate over climate change heats up, science is being up-staged by the call for solutions. At stake is a complex issue with many questions. Some things we know for certain. Others are far from certain."

EP4b-2: "First, we know greenhouse gases account for less than one percent of Earth's atmosphere...The focus of concern is CO_2. While most of the CO_2 emitted by far is the result of natural phenomena - namely respiration and decomposition - most attention has centered on the three to four percent related to human activities -- burning of fossil fuels, deforestation." [Not strictly incorrect, but in context, suggests that natural factors explain recent global warming.]

EP4b-2: Figure minimizes the significance of human GHG emissions (versus "Natural Phenomena").

EP4b-2: "Although the linkage between the greenhouse gases and global warming is one factor, other variables could be much more important in the climate system than emissions produced by man."

EP4b-2: "The UN-sponsored Intergovernmental Panel on Climate Change thought it had found the magic bullet when it concluded that the one-degree Fahrenheit rise in global temperatures over the past century may bear a "fingerprint" of human activity. The fingerprint soon blurred when an IPCC lead author conceded to the "uncertainty inherent in computer climate modeling.""

EP4b-2: "Nations are being urged to cut emissions without knowing either the severity of the problem - that is, will Earth's temperature increase over the next 50-100 years? - or the efficacy of the solution - will cutting CO_2 emissions reduce the problem?"

EP4b-2: "Within a decade, science is likely to provide more answers on what factors affect global warming, thereby improving our decision-making. We just don't have this information today. Answers to questions on climate change will require more reliable measurements of temperature at many places on Earth, better understanding of clouds and ocean currents along with greater computer power...Whatever effect increased concentrations of man-made gases may have, it will develop slowly over decades. Thus, there is time for scientists to refine their understanding of the climate system, while governments, industry and the public work to find practical means to control greenhouse gases, if such measures are called for."

IP3: "Nations are being urged to cut emissions without knowing either the severity of the problem -- that is, will Earth's temperature increase over the next 50-100 years?"

IP3: "Whatever effect increased concentrations of man-made gases may have, it will develop slowly over decades. Thus, there is time for scientists to refine their understanding of the climate system, while governments, industry and the public work to find practical means to control greenhouse gases, if such measures are called for."

SP1: "...nations at Kyoto are being asked to embrace proposals that could have potentially huge impacts on economies and lifestyles."

SP1: "Adopting quick-fix measures at this point could pose grave economic risks for the world."

SP1: "Nations are being urged to cut emissions without knowing either the severity of the problem - that is, will Earth's temperature increase over the next 50-100 years? - or the efficacy of the solution - will cutting CO_2 emissions reduce the problem?"

1997 Mobil Climate change: a prudent approach November 13, 1997 

EP4b-2: "questions [by governments in Kyoto] on how to reduce greenhouse gas emissions now and who should bear the burden of these cuts...we believe, are premature. We don't know enough about the factors that affect global warming and the degree to which - if any - that man-made emissions (namely, carbon dioxide) contribute to increases in Earth's temperature. Instead, we should be asking: What precautionary voluntary steps can be taken now to reduce greenhouse gases while science is developing answers that will improve our decision-making?"

EP4a: Cites research at MIT, Pacific Northwest Labs, and especially at Columbia "on the role that oceans play in the climate system...Improving understanding of this system could lead to better predictions of future climate change." [In context, this can be read as emphasizing scientific uncertainties. But in isolation, not strictly objectionable. On balance, we code as EP4a.]

EP4b-2: "More [research] is on the tap for the future. More to understand the greenhouse gas implications of our investment decisions as we develop new hydrocarbon resources."

EP4b-2 [post-1995]: "scientists work to provide more definitive answers on the impact that these gases and other factors may have on our climate system. Let's wait for more answers before taking on obligations that could jeopardize better living standards for all."

IP2: No position

SP1: "Let's wait for more answers before taking on obligations that could jeopardize better living standards for all."

1997 Mobil Climate change: where we come out November 20, 1997 

EP4b-2 [post-1995]: "We share the widespread concern over the possibility that human activity may contribute to global warming, and we have used this platform to participate in the climate change debate."

EP4b-2: "Two questions, we believe, must be asked [about proposals leading up to Kyoto to reduce emissions to 1990 levels by 2010]: is it necessary? And is there a better way to do it? As to its necessity, the best answer to date is a resounding "maybe." Even after two decades of progress, climatologists are still uncertain how - or even if - buildup of man-made greenhouse gases is linked to global warming. It could be at least a decade before climate models will be able to link greenhouse warming unambiguously to human actions. Important answers on the science lie ahead."

EP4b-2: "There is a better way [versus Kyoto proposals] - one that doesn't commit nations to targets that may be scientifically overblown and financially crippling."

IP2 [generic "risk"]: Advertorial refers to climate change as "the potential problem".

SP1: "There is simply no easy way to get back to that level ["1990 levels by the year 2010" as called for in advance of Kyoto] given the current and projected rates of growth in energy demand. Agreeing to mandatory targets will stunt economic growth."

SP1: "Credible economic studies, including those by Charles River Associates and Wharton Economic Forecasting Associates, point out the enormous, cumulative costs that these proposals could have. Just stabilizing greenhouse gas, emissions at 1990 levels and assuming the benefits of ongoing technology will compel industrialized nations to cut their consumption of fossil fuels by nearly 30 percent. Energy producers and energy-intensive industries will suffer most, but everyone will feel the pinch."

SP1: "Even if developing nations are exempted from emissions cuts (as many nations have proposed), they would also feel the impact, for they would face reduced markets for their goods."

SP1: "There is a better way [versus Kyoto proposals] - one that doesn't commit nations to targets that may be scientifically overblown and financially crippling."

1997 Mobil | Climate change: a degree of uncertainty | December 4, 1997 | 

EP4b-2: Not entirely clear what the article means by "uncertainty" in all its usages, but this theme dominates the advertorial. Title's double entendre suggests uncertainty about reality of recent global warming: "Climate change: a degree of uncertainty"

EP4b-2: "The debate on climate change has been long, complex and intense."

EP4b-2 [post-1995]: "Two factors argue for nations to move prudently. First, there is a high degree of uncertainty over the timing and magnitude of the potential impacts that man-made emissions of greenhouse gases have on climate...Objectives and actions to deal with climate change can only be determined as additional knowledge is gained and uncertainties minimized."

EP4b-2: "To address the scientific uncertainty, governments, universities and industry should form global research partnerships to fill in the knowledge gap, with the goal of achieving a consensus view on critical issues within a defined time frame...During the fact-finding period..."

EP4b-2: "...we ask the Kyoto delegates to avoid mandates based on uncertain science...Take steps to curtail emissions, develop more energy-efficient technologies and improve scientific understanding..."

IP3: "The mission of the delegates at the Kyoto conference should not be driven by the politics of an artificial deadline..."

IP3: "Two factors argue for nations to move prudently. First, there is a high degree of uncertainty over the timing and magnitude of the potential impacts that man-made emissions of greenhouse gases have on climate..."

IP1: "Mobil shares the widespread concern about the potential impact of these emissions on the global climate. At the same time, we are concerned that mandated emission cutbacks now will produce grave economic consequences for all nations." This is a borderline case (almost generic “risk”), however, it does acknowledge the potential for negative impacts. Therefore, on balance, we code as IP1 (as well as SP1).

SP1: "Mobil shares the widespread concern about the potential impact of these emissions on the global climate. At the same time, we are concerned that mandated emission cutbacks now will produce grave economic consequences for all nations."

SP1: "...the emission-reduction policies being considered carry with them very large economic risks."

1997 Mobil | The Kyoto conference | December 18, 1997 | 

EP4a: No position

IP2: No position

SP1: "Can these [Kyoto Protocol] cuts be gotten without resorting to a carbon tax or some form of energy rationing?"

1998 Mobil | Post Kyoto, what's next? | January 29, 1998 | 1 | 1 | 1

EP4a: No position

IP1: “Nonetheless, we share the growing concerns that governments, the public and many of our customers have about the buildup of greenhouse gases.” This is a borderline case of generic “risk”, but can be read to implicitly acknowledge the negative impacts of AGW.

SP1: "Here in the U.S., the debate is likely to center on trade-offs. How much prosperity are Americans willing to forgo? How many lifestyle changes will they have to make? How much more tax will they pay?"

SP1: "Credible economic studies have pointed out that mandating emission targets and timetables now will have an enormous negative impact on many national economies."

SP1: “We encourage the public to participate in the debate over the issue. Important decisions affecting lifestyles and our nation’s economic future will be made.”

1998 Mobil | The Kyoto Protocol: a painful response | November 5, 1998 | 1 | 1 | 1

EP4b-2 [post-1995]: "Mobil is concerned about the potential for human activities to affect climate."

IP1: "Mobil is concerned about the potential for human activities to affect climate." This is a borderline case of generic “risk”, but can be read to implicitly acknowledge the negative impacts of AGW.

SP1: "The Kyoto Protocol...will only minimally reduce the amount of greenhouse gases in the atmosphere and will produce major economic distortions in the U.S. and elsewhere."

SP1: Title is "The Kyoto Protocol: a painful response"

SP1: "WEFA estimates the cost of achieving the Kyoto target by 2010 would result in a loss of 2.4 million jobs, a doubling of electricity prices and an annual loss in economic output of $300 billion - an amount greater than our nation's expenditures for primary and secondary education. Ditto DRI's conclusions: job losses of more than one million, an increase in electricity prices of nearly 40 percent and a decline in GDP of roughly $100 billion...the annual loss in GDP could range from $150 billion to $400 billion. That translates to an annual cost of $1,500 to $4,000 per family."

1999 Mobil | Helping Earth breathe easier | April 15, 1999 | 1 | 1

EP4b-2 [post-1995]: "Mobil recognizes the growing concerns about the buildup of greenhouse gases, like CO_2, and its potential contribution to climate change."

IP2 [generic "risk"]: Advertorial refers to climate change as "a potential problem that could require a global long-term solution".

IP2: "Mobil recognizes the growing concerns about the buildup of greenhouse gases, like CO_2, and its potential contribution to climate change." This is borderline IP1, however authors do not articulate their own position regarding the described concerns.

1999 Mobil | Where we are and where we may be heading | July 29, 1999 | 1 | 1 | 1

EP3a: "Reasonable concerns about the buildup of greenhouse gases in the atmosphere and their effect on earth's climate have prompted policymakers to search for a response."

IP2: No position

SP1: "Some countries seem eager to embrace the "quick fix" of the Kyoto Protocol. Others, for compelling economic reasons, are less prepared to act."

SP1: "...fossil fuels - particularly in the transportation sector - will continue to provide the lion's share of energy for the foreseeable future."

1999 Mobil — Some ways to make a difference — August 5, 1999

EP4a: No discussion of AGW specifically.

IP2: No position

SP1: "Can technology make a difference? The answer is, "it depends"…Advanced technology widely implemented by developed nations can cut global emissions…The sheer growth – more than doubling – in emissions that will occur in the rest of the world simply overwhelms these reductions."

1999 Mobil — Scenarios for stablization — August 12, 1999

EP4b-2 [post-1995]: "...the buildup [of CO_2] is a concern to some because of the role that it may play in global climate change."

EP4b-2: "We don't know whether stabilization is necessary and, if so, at what level."

IP3: "We don't know whether stabilization is necessary and, if so, at what level." Borderline case, but it appears to imply the "it's only a few degrees" form of doubt about seriousness [33].

SP1: "Policy-makers are talking about the goal of stabilizing atmospheric CO_2 concentrations - getting to a point where the concentrations stop increasing. Our study shows this simply cannot be done short-term, but as part of our assessment we considered what might be accomplished over a longer term - to 2100 - if strong measures are called for."

SP1: "The tougher goal - stabilization at twice preindustrial levels - would mean reducing global CO_2 emissions by almost 75 percent beyond what they would be with ongoing improvements in energy efficiency...The costs would rise steeply with time and affect the standard of living that future generations could achieve."

1999 Mobil — Lessons Learned — August 19, 1999

EP4b-2: "The world has time to determine whether stabilization ["of CO_2 concentration in the atmosphere"] is necessary."

IP3: "The world has time to determine whether stabilization ["of CO_2 concentration in the atmosphere"] is necessary." Borderline case, but it appears to imply the "it's not urgent" form of doubt about seriousness [33].

SP1: "Renewable forms of energy could play a role, but they have limitations that make them impractical or expensive for most applications."

SP1: "Clearly, stabilization could be achieved only at considerable cost. It's also clear that doing too much too soon, before new technology is proven and available, would add to the cost."

SP1: "Global economic models suggest that there is a penalty for haste."

2000 ExxonMobil — Conservation: the first path — December 7, 2000

EP4a: No position

IP2: No position

2000 ExxonMobil Do No Harm March 16, 2000 

EP4b-2: "Some in the debate believe they can predict changes in climate decades from now. Advocating "precaution," and despite scientific uncertainty, they believe actions should be taken immediately to reduce carbon dioxide emissions by mandating severe restrictions on energy use. Though we wholly support the efficient use of fuel, a prudent approach to the climate issue must recognize that there is not enough information to justify harming economies and forcing the world's population to endure unwarranted lifestyle changes by dramatically reducing the use of energy now. Enough is known about climate change to recognize it may pose a legitimate long-term risk, and that more needs to be learned about it."

EP4b-2: "...we propose an approach that continues a strong focus on scientific understanding...and promotes research and development of technical options that have the potential to make significant longer-term reductions in emissions, if they are needed."

IP3: "Just as changeable as your local weather forecast, views on the climate change debate range from seeing the issue as serious or trivial, and from seeing the possible future impacts as harmful or beneficial."

IP2 [generic "risk"]: "Some in the debate believe they can predict changes in climate decades from now. Advocating "precaution," and despite scientific uncertainty, they believe actions should be taken immediately to reduce carbon dioxide emissions by mandating severe restrictions on energy use. Though we wholly support the efficient use of fuel, a prudent approach to the climate issue must recognize that there is not enough information to justify harming economies and forcing the world's population to endure unwarranted lifestyle changes by dramatically reducing the use of energy now. Enough is known about climate change to recognize it may pose a legitimate long-term risk, and that more needs to be learned about it."

SP1: "Some in the debate believe they can predict changes in climate decades from now. Advocating "precaution," and despite scientific uncertainty, they believe actions should be taken immediately to reduce carbon dioxide emissions by mandating severe restrictions on energy use. Though we wholly support the efficient use of fuel, a prudent approach to the climate issue must recognize that there is not enough information to justify harming economies and forcing the world's population to endure unwarranted lifestyle changes by dramatically reducing the use of energy now. Enough is known about climate change to recognize it may pose a legitimate long-term risk, and that more needs to be learned about it."

SP1: "Most economists tell us that such a step [Kyoto protocol for U.S.] would damage our economy and almost certainly require large increases in taxes on gas and oil. It could also entail enormous transfers of wealth to other countries."

SP1: "...for most nations the Kyoto Protocol would require extensive diversion of human and financial resources away from more immediate and pressing needs in health care, education, infrastructure, and yes, the environment - all critical to the well-being of future generations."

SP1 [by way of weather-climate analogy in opening paragraph]: "Although it is hard to predict what the weather is going to be this weekend, we know with certainty that climate change policies, unless properly formulated, will restrict life itself."

2000 ExxonMobil Unsettled Science March 23, 2000 

EP4b-2: Title is "Unsettled Science".

EP4b-2: "Knowing that weather forecasts are reliable for a few days at best, we should recognize the enormous challenge facing scientists seeking to predict climate change and its impact over the next century...it is not surprising that fundamental gasps in knowledge leave scientists unable to make reliable projections about future changes."

EP4b-2: "A recent report from the National Research Council (NRC) raises important issues, including these still-unanswered questions: (1) Has human activity already begun

to change temperature and the climate, and (2) How significant will future change be?"

EP4b-2: "Some use [the 1 degree Fahrenheit rise in Earth's surface temp over the past 150 years] to claim that humans are causing global warming, and they point to storms or floods to say that dangerous impacts are already under way. Yet scientists remain unable to confirm either contention. Geological evidence indicates that climate and greenhouse gas levels experience significant natural variability for reasons having nothing to do with human activity...medieval warm period...little ice age...Against this backdrop of large poorly understood natural variability, it is impossible for scientists to attribute the recent small surface temp increase to human causes."

EP4b-1: "...computer models relied upon by climate scientists predict that lower atmospheric temperatures will rise as fast as or faster than temperatures at the surface. However, only within the last 20 years have reliable global measurements of temperatures in the lower atmosphere been available through the use of satellite technology. These measurements show little if any warming."

EP4b-2 [post-1995]: "So, while some argue that the science debate is settled and governments should focus only on near-term policies - that is empty rhetoric. Inevitably, future scientific research will help us understand how human actions and natural climate change may affect the world and will help determine what actions may be desirable to address the long-term. Science has given us enough information to know that climate changes may pose long-term risks. Natural variability and human activity may lead to climate change that could be significant and perhaps both positive and negative..."

EP4b-2: Figure presents misleading use of data published in *Science* to imply that natural variability might explain recent global warming: see discussion in main text.

IP3: "A recent report from the National Research Council (NRC) raises important issues, including these still-unanswered questions: (1) Has human activity already begun to change temp and the climate, and (2) How significant will future change be?"

IP3: "Even less is known about the potential positive or negative impacts of climate change. In fact, many academic studies and field experiments have demonstrated that increased levels of CO_2 can promote crop and forest growth."

2000 ExxonMobil The Promise of Technology March 30, 2000

EP3a: Implied that "technologies that offer the possibility of supplying and utilizing energy with far fewer emissions" are an "effective near-term means to address the long-term response to climate change."

IP2 [generic “risk”]: “Climate change may pose legitimate long-term risks…the potential risks posed by climate change.”

2001 ExxonMobil Moving past Kyoto... April 10, 2001

EP4b-2: "...the growing recognition that most governments cannot meet the politically chosen [Kyoto] targets without resorting to economy-wrecking measures."

IP3: "Scientifically unfounded scare scenarios were and continue to be promoted in an effort to justify the protocol."

IP2 [generic "risk"]: Advertorial refers to "manag[ing] the long-term risk of climate change."

SP1: "...the growing recognition that most governments cannot meet the politically chosen [Kyoto] targets without resorting to economy-wrecking measures."

SP1: "Kyoto was too much too soon."

2001	ExxonMobil	...to a sounder climate policy	April 17, 2001	

EP4a: "In our view, the most effective way to respond to all concerns and risks [about climate change] is through programs that encourage economically justified near-term actions, and that promote climate understanding and technological innovation for long-term solutions."

EP4b-2: Proposes that the world "conduct scientific research to improve society's ability to predict possible consequences (positive as well as negative) of future climate change. Programs should concentrate on factors that seriously limit current understanding. These include the effects of clouds, aerosols, sea ice, deep-ocean circulation, hydrology and natural climate variability. We also need to improve the monitoring of climate." [Not strictly incorrect, but asymmetrical emphasis on scientific uncertainties leads us, on balance, to code as EP4b-2.]

IP2 [generic "risk"]: "Most people acknowledge that human-induced climate change is a long-term risk".

IP2 [generic "risk"]: "In our view, the most effective way to respond to all concerns and risks [about climate change] is through programs that encourage economically justified near-term actions, and that promote climate understanding and technological innovation for long-term solutions."

IP3: Advertorial proposes that the world "conduct scientific research to improve society's ability to predict possible consequences (positive as well as negative) of future climate change. Programs should concentrate on factors that seriously limit current understanding. These include the effects of clouds, aerosols, sea ice, deep-ocean circulation, hydrology and natural climate variability. We also need to improve the monitoring of climate."

2002	ExxonMobil	Managing greenhouse gas emissions	October 3, 2002	

EP4b-2: "It is our view that better scientific understanding of climate change, human influence on it, and the associated risks and possible consequences are needed. We are heavily involved in such scientific research...But we are taking other actions to minimise the risks of climate change."

EP4b-2: Action against climate change presented as a risk-management approach "while we improve our understanding of the science of this complex issue...The goal of the many activities we are undertaking is to produce practical future reductions in greenhouse gases while we improve our understanding of the science of this complex issue." [Not strictly incorrect, but asymmetrical emphasis on scientific uncertainties leads us, on balance, to code as EP4b-2.]

IP1: "The risk of climate change and its potential impacts on society and the ecosystem are widely recognized. Doing nothing is neither prudent nor responsible. But the same may be said of rash action. Energy and the economic growth it supports are too important to be treated cavalierly. The goal of the many activities we are undertaking is to produce practical future reductions in greenhouse gases while we improve our understanding of the science of this complex issue."

SP1: "The risk of climate change and its potential impacts on society and the ecosystem are widely recognized. Doing nothing is neither prudent nor responsible. But the same may be said of rash action. Energy and the economic growth it supports are too important to be treated cavalierly. The goal of the many activities we are undertaking is to produce practical future reductions in greenhouse gases while we improve our understanding of the science of this complex issue."

2002	ExxonMobil	A responsible path forward on climate	November 22, 2002	

EP4a: Almost no mention of AGW. Announces Global Climate and Energy Project (GCEP) alliance with Stanford.

IP2: No position

SP1: "On an overall basis, many of today's suggested alternative energy approaches are not as energy efficient, environmentally beneficial or economic as competing fossil fuels. They are sustained only through special advantages and government subsidies. This is not a desirable basis for public policy or the provision of energy."

2003	ExxonMobil (Dr. Lynn Orr,	The global climate and energy	February 6, 2003	

Stanford, GCEP Project Director)** challenge

EP3a/4b-2: Begins by acknowledging AGW, but ends by emphasizing doubt: "We humans are interacting with the geo-chemical systems of our planet on a global scale. The concentration of carbon dioxide in the atmosphere has increased by a third from its preindustrial level, and the resulting change in the acidity of the upper ocean can be detected. Although climate has varied throughout Earth's history from natural causes, today there is a lively debate about the timing and magnitude of the climate's response to the presence of more greenhouse gases in the atmosphere. While that debate continues, we should consider now how to develop technology options that have much-lower emissions of greenhouse materials carbon dioxide."

IP1/IP3: Begins by acknowledging AGW's impact, but ends by emphasizing doubt about the "timing and magnitude" of that impact: "We humans are interacting with the geo-chemical systems of our planet on a global scale. The concentration of carbon dioxide in the atmosphere has increased by a third from its preindustrial level, and the resulting change in the acidity of the upper ocean can be detected. Although climate has varied throughout Earth's history from natural causes, today there is a lively debate about the timing and magnitude of the climate's response to the presence of more greenhouse gases in the atmosphere. While that debate continues, we should consider now how to develop technology options that have much-lower emissions of greenhouse materials carbon dioxide."

2004 ExxonMobil Directions for climate research January 21, 2004

EP4b-2: "Progress has occurred in generating new knowledge and in better delineating gaps and uncertainties that limit our current ability to know the extent to which humans are affecting climate and to predict future changes caused by both human and natural forces. Expansion of scientific knowledge will take time and money. It requires extensive long-term data acquisition, breakthroughs in theoretical understanding of key climate processes, efforts to reconstruct better information about past climate, and the development of more-sophisticated computer models to assess understanding and simulate future climate changes."

EP4b-2: "Government agencies should design programs that address the most important major areas of scientific uncertainty...assess the consequences of climate change (accounting for both facts and uncertainties)...Areas of uncertainty that require attention have been identified in numerous reports, including several the NRC. Important areas include the role of clouds and aerosols (small particles in the atmosphere), natural climate variability, oceanic currents and heat transfer, the hydrological cycle, and the ability of climate models to predict changes on a regional and local scale. Agency-led programs should aim to: (1) better quantify levels of uncertainty and explain their relevance for policy decisions, (2) define and conduct studies to resolve uncertainty and (3) report periodically on results and progress...Research does not always eliminate uncertainty, but such programs will lead to better understanding of what we know and do not know and how our knowledge may affect policy decisions." [Not strictly incorrect, but asymmetrical emphasis on scientific uncertainties leads us, on balance, to code as EP4b-2.]

IP2: No position

2004 ExxonMobil Weather and climate January 22, 2004

EP4b-2: "In the debate over climate change, there is an understandable tendency to use recent weather events to draw conclusions about global warming. However, weather and climate are not the same - climate is far more complex."

** Advertorial is signed by Stanford University Professor Lynn Orr, then-director of Stanford's Exxon-funded GCEP alliance, and bears the seal of Stanford University. Although ExxonMobil's precise ties to this advertorial are unknown, it is included in our analysis because evidence suggests some level of involvement by the company (as several observers have noted [91]): the advertorial was published on a Thursday, consistent with ExxonMobil's "Every Thursday" advertorials in the *NYT*, characterized by Brown and Waltzer [6]; the advertorial's formatting matches that of most other ExxonMobil climate change advertorials in the *NYT*; the advertorial is explicit in noting the sponsorship of GCEP by ExxonMobil and other companies; and this advertorial follows another, published by ExxonMobil two-and-a-half months earlier, which centers on ExxonMobil's sponsorship of GCEP and bears the GCEP logo [92].

EP4b-1: "last year's record summer heat in Europe does not confirm a warming world."

EP4b-2: "Geological evidence indicates that Earth's climate has varied continuously, warming and cooling due to changes on and beyond Earth. Factors as diverse as variations in sunlight and Earth's magnetic field, asteroid impacts, Sun-Moon-Earth orbital interactions, cosmic ray fluxes, continental drift, fluctuations in sea level, volcanic eruptions, changes in the biosphere, and massive ebbs and flows of continental glaciers, have significantly influenced climate. Changes in one feature can affect others. During recent ice ages, another factor, greenhouse gas concentrations, changed for reasons that remain unclear." [Not strictly incorrect, but asymmetrical emphasis on scientific uncertainties leads us, on balance, to code as EP4b-2.]

EP4b-2: "Observations and theory both indicate that weather and important aspects of climate, for instance El Nino events, behave in a chaotic fashion that may never allow for definitive, longterm predictions. These and other fluctuations produce significant natural climate variability. For example, over the past thousand years historical accounts and scientific data show evidence of a Medieval Warm Period followed by a Little Ice Age. In the face of natural variability and complexity, the consequences of change in any single factor, for example greenhouse gases, cannot readily be isolated and prediction becomes difficult. Geological and historical records make clear the need to account for natural climate variability and the integrated response of the entire climate system. Over the last few decades climate research has made great progress. In particular, research has highlighted the risks to society and ecosystems resulting from the buildup of greenhouse gases. At the same time, scientific uncertainties continue to limit our ability to make objective, quantitative determinations regarding the human role in recent climate change or the degree and consequences of future change."

IP1/IP3: "Observations and theory both indicate that weather and important aspects of climate, for instance El Nino events, behave in a chaotic fashion that may never allow for definitive, longterm predictions. These and other fluctuations produce significant natural climate variability. For example, over the past thousand years historical accounts and scientific data show evidence of a Medieval Warm Period followed by a Little Ice Age. In the face of natural variability and complexity, the consequences of change in any single factor, for example greenhouse gases, cannot readily be isolated and prediction becomes difficult. Geological and historical records make clear the need to account for natural climate variability and the integrated response of the entire climate system. Over the last few decades climate research has made great progress. In particular, research has highlighted the risks to society and ecosystems resulting from the buildup of greenhouse gases. At the same time, scientific uncertainties continue to limit our ability to make objective, quantitative determinations regarding the human role in recent climate change or the degree and consequences of future change."

S8. Type and topic codings of all documents

Table S5. Type and topic codings of all 187 documents analyzed, sorted by publication year and into document categories: peer-reviewed publications, non-peer-reviewed publications, internal documents, and advertorials. Coded types and topics are indicated by "1" (see section S1.5, Supplementary Information, for definitions, and Table S4 for full document citations).

Peer-Reviewed Documents

		Topics					Types							
Year	Title	Methods & Climate Science	Impacts	Mitigation	Paleoclimate	Policy, Econ. & Misc. Opinions	Academic Journal	Conference/ Workshop Proceeding	Gov. Report	Book	Industry	Misc. Opinion	Int. Doc.	Ad
1982	Exxon global CO_2 measurement system	1					1							
1983	Evaporation-limited tropical temperatures as a constraint on climate sensitivity	1					1							
1984	Energy balance models incorporating transport of thermal and latent energy	1					1							
1984	Energy balance models incorporating evaporative buffering of equatorial thermal response	1								1				
1985	Model Projections of the Time-Dependent Response to Increasing Carbon Dioxide	1							1					
1985	CO_2 driven equator-to-pole paleotemperatures: predictions of an energy balance model with and without a tropical evaporation buffer	1								1				
1988	Conceptual studies for CO_2/natural gas separation using the controlled freeze zone (CFZ) process	1					1							
1991	Marine biota effects on the compositional structure of the world oceans	1					1							
1993	Effect of climate variability on estimation of greenhouse parameters: usefulness of a pre-instrumental temperature record	1					1							

1993	Assessing the effectiveness of marine CO_2 disposal			1			1					
1993	Does recent global warming suggest an enhanced greenhouse effect?	1					1					
1994	The effectiveness of marine CO_2 disposal			1			1					
1994	Integrated Science Model for Assessment of Climate Change		1					1				
1995	Distribution of radiocarbon as a test of global carbon cycle models	1					1					
1995	Sequestering atmospheric carbon dioxide by increasing ocean alkalinity			1			1					
1996	Detection of Climate Change and Attribution of its Causes	1							1			
1996	Modelling ocean carbon cycle with a nonlinear convolution model	1					1					
1996	Estimating the accuracy of Russian paleotemperature reconstructions				1		1					
1996	Accounting for the missing carbon sink with the CO_2 Fertilization Effect	1					1					
1996	A globally aggregated reconstruction of cycles of carbon and its isotopes	1					1					
1996	Longevity in the deep				1		1					
1997	Is there an imbalance in the global budget of bomb-produced radiocarbon?	1					1					
1997	Multiple Timescales for the Neutralization of Fossil Fuel CO_2			1			1					
1997	Comparison of Paleotemperature Reconstructions as Evidence for the Paleo-Analog Hypothesis				1		1					
1997	Analysis of proposed CO_2 emission reductions in the context of stabilization of CO_2 concentration			1				1				
1998	The dynamics of fossil fuel CO_2 neutralization by marine $CaCO_3$			1			1					
1998	Trade-Offs in Fossil Fuel Use: The Effects of CO_2, CH_4 and SO_2 Aerosol			1			1					

	Emissions on Climate								
1999	Future Atmospheric Methane Concentrations in the Context of the Stabilization of Greenhouse Gas Concentrations		1			1			
1999	Model-based estimation of the global carbon budget and its uncertainty from carbon dioxide and carbon isotope records	1				1			
2000	The Potential of Biomass Fuels in the Context of Global Change: Focus on Transportation Fuels		1			1			
2000	Land Use, Land-Use Change, and Forestry		1				1		
2000	Contribution of CH_4 to Multi-Gas Reduction Targets: The Impact of Atmospheric Chemistry on GWPs	1				1			
2001	On strategies for reducing greenhouse gas emissions		1			1			
2001	Testing Distributed Parameter Hypotheses for the Detection of Climate Change	1				1			
2001	The carbon cycle and atmospheric CO_2	1					1		
2001	Detection of Climate Change and Attribution of its Causes	1					1		
2001	Technical Summary	1					1		
2001	Technical and Economic Potential of Options to Enhance, Maintain and Manage Biological Carbon Reservoirs and Geo-Engineering		1				1		
2001	Decision Making Frameworks		1				1		
2002	Substitution of natural gas for coal: climatic effects of utility sector emissions		1			1			
2002	Advanced technology paths to global climate stability: energy for a greenhouse planet		1			1			

2003	Projecting future climate change: implications of carbon cycle model intercomparisons	1				1					
2003	Two decades of ocean CO_2 sink and variability	1				1					
2004	A non-linear convolution model for the evasion of CO_2 injected into the deep ocean		1			1					
2004	Evasion of CO_2 injected into the ocean in the context of CO_2 stabilization		1			1					
2004	Ocean carbon sink duration under stabilization of atmospheric CO_2: a 1,000-year time-scale	1				1					
2005	Sequestration of fermentation CO_2 from ethanol production		1			1					
2005	Emissions and Atmospheric CO_2 Stabilization: Long-term Limits and Paths		1			1					
2005	The photobiological production of hydrogen: potential efficiency and effectiveness as a renewable fuel		1			1					
2005	Ocean storage (Chapter 6)		1				1				
2007	Mitigation from a cross-sectoral perspective		1				1				
2007	Probabilistic estimates of climate change: methods, assumptions and examples (p. 49-61)	1						1			
2007	Transport and its infrastructure		1				1				
2007	Part 1, Climate System Science (p. 2-3)	1						1			
2009	Hollow fiber adsorbents for CO_2 removal from flue gas		1			1					
2009	Nitrogen attenuation of terrestrial carbon cycle response to global environmental factors	1				1					
2009	Improving wellbore seal integrity in CO_2 injection wells		1			1					

2009	Pressure swing reforming: a novel process to improve cost and efficiency of CO_2 capture in power generation		1			1				
2009	Carbon capture and storage business models		1			1				
2009	The CFZTM process: a cryogenic method for handling high-CO_2 and H_2S gas reserves and facilitating geosequestration of CO_2 and acid gases		1			1				
2009	Carbon dioxide enhanced oil recovery injection operations technologies		1			1				
2009	Harmonizing the quantification of greenhouse gas emission reductions through oil and gas industry project guidelines		1			1				
2009	Subsurface design considerations for carbon dioxide storage		1			1				
2009	The effects of gas-fluid-rock interactions on CO_2 injection and storage: insights from reactive transport modeling		1			1				
2011	Comment (on the scale-up of carbon dioxide capture and storage technology systems)		1			1				
2011	Worldwide development potential for sour gas		1			1				
2011	CO_2 management at ExxonMobil's LaBarge field, Wyoming, USA		1			1				
2012	Perspectives on CCS cost and economics		1			1				
2014	The vertical distribution of black carbon in CMIP5 models: Comparison to observations and the importance of convective transport	1				1				
2014	Estimates of Biomass Yield for Perennial Bioenergy Grasses in the United States		1			1				
2014	Industry		1				1			

2014	Key economic sectors and services		1						1				

Non-Peer-Reviewed Documents

		Topics					Types							
Year	**Title**	**Methods & Climate Science**	**Impacts**	**Mitigation**	**Paleoclimate**	**Policy, Econ. & Misc. Opinions**	**Academic Journal**	**Conference/ Workshop Proceeding**	**Gov. Report**	**Book**	**Industry**	**Misc. Opinion**	**Int. Doc.**	**Ad**
1980	Draft statement of findings and recommendations		1						1					
1981	A box-diffusion carbon cycle model with upwelling, polar bottom water formation and a marine biosphere	1								1				
1981	The Atmosphere, Chapter 2, Proceedings of the Workshop on First Detection of Carbon Dioxide	1						1						
1982	Energy and the environment: the next decade					1			1					
1984	Inventing the Future: Energy and the CO_2 "Greenhouse" Effect			1								1		
1989	The sensitivity of CO_2 projections to ocean processes	1						1						
1992	Update of Industry Experience With CO_2 Injection			1				1						
1995	Research relevant to the integrated assessment of climate change			1				1						
1995	Accounting for the missing carbon sink in global carbon cycle models	1						1						
1995	Use of carbon isotopes for the calibration of global carbon cycle models	1						1						
1996	Agriculture, Land Use, and Commercial Biomass Energy			1					1					
1996	Climate change: don't ignore the facts					1						1		
1996	Global warming. What to think? What to do?	1										1		
1997	Geoengineering climate			1						1				
1997	Energy - key to growth and a better environment for Asia-Pacific nations					1						1		

1998	Global climate change, everyone's debate				1						1	
1999	Modeling the Evasion of CO_2 Injected into the Deep Ocean		1				1					
1999	Reduction of the atmospheric concentration of methane as a strategic response option to global climate change		1				1					
2001	An Industry Perspective on Carbon Management		1					1				
2001	Technology assessment in climate change mitigation		1				1					
2001	Two decades of ocean CO_2 sink and variability	1					1					
2001	GM, Argonne National Lab, BP, ExxonMobil, Shell, 2001. GM Well-to-Wheel Energy Use and Greenhouse Gas Emissions of Advanced Fuel/Vehicle Systems – North American Analysis		1						1			
2002	European fuel and vehicle options for the future - focus on biofuels		1				1					
2002	Ethanol for transportation		1								1	
2003	Planning for future energy resources (response letter)		1								1	
2003	Evasion of CO_2 injected into the ocean in the context of CO_2 stabilization		1				1					
2003	Greenhouse gas emissions from bio-ethanol and biodiesel fuel supply systems		1				1					
2003	Carbon Dioxide Capture And Geological Storage: Contributing to Climate Change Solutions		1				1					
2004	Climate Change and Environmental Policy		1				1					
2005	An industry perspective on successful development and global commercialization of innovative		1				1					

	technologies for GHG mitigation										
2005	Carbon Dioxide Capture And Geological Storage: Contributing to Climate Change Solutions		1						1		
2005	Climate Models: An Assessment of Strengths and Limitations Comments on the Draft Prospectus for Synthesis and Assessment Product 3.1, Expert Review Collation, February 2–March 7, 2005	1					1				
2006	Critical issues in CO_2 capture and storage: findings of the SPE advanced technology workshop (ATW) on carbon sequestration		1			1					
2006	Carbon Dioxide Capture And Geological Storage: contributing to Climate Change Solutions		1			1					
2006	Response to letter from The Royal Society			1						1	
2008	Harmonizing the quantification of CCS GHG emission reductions through oil and natural gas industry project guidelines		1			1					
2009	Carbon cycle observations: gaps threaten climate mitigation policies		1							1	
2009	CO_2 management at ExxonMobil's LaBarge field, Wyoming, USA		1			1					
2009	Industry experience with CO_2-enhanced-oil-recovery technology		1			1					
2010	Increasing the Pace of Technology Innovation and Application to Enable Climate Change Solutions		1			1					
2010	Perspectives on CCS cost and economics		1			1					
2010	Carbon management project and electric power generation scorecard		1							1	
2010	The ExxonMobil-XTO Merger: Impact on U.S. Energy Markets - Hearing Before the Subcommittee on Energy and Environment of the Committee on			1						1	

	Energy and Commerce House of Representatives (January 20, 2010)												
2012	Carbon dioxide capture and storage: seven years after the IPCC special report			1								1	
2012	Carbon Dioxide Capture and Storage: Perspectives on Cost and Economics			1				1					
2013	A Review of the Draft 2013 National Climate Assessment					1						1	
2014	Addressing adaptation to climate risks in the oil and gas industry		1					1					

Internal Documents

		Topics					Types							
Year	**Title**	**Methods & Climate Science**	**Impacts**	**Mitigation**	**Paleoclimate**	**Policy, Econ. & Misc. Opinions**	**Academic Journal**	**Conference/ Workshop Proceeding**	**Gov. Report**	**Book**	**Industry**	**Misc. Opinion**	**Int. Doc.**	**Ad**
1977	Environmental Effects of Carbon Dioxide					1							1	
1978	The Greenhouse Effect		1										1	
1978	Untitled (request for a credible scientific team)					1							1	
1978	CO_2					1							1	
1979	Research in Atmospheric Science					1							1	
1979	Controlling Atmospheric CO_2			1									1	
1979	Proposed Exxon Research Program to Help Assess the Greenhouse Effect	1											1	
1980	Greenhouse Program	1											1	
1980	Exxon's View and Position on "Greenhouse Effect"	1											1	
1980	Exxon Research and Engineering Company's Technological Forecast CO_2 Greenhouse Effect		1										1	
1980	CO_2 Greenhouse Communications Plan					1							1	
1981	CO_2 Emissions Natuna Gas Project	1											1	
1981	CO_2 Position Statement					1							1	
1981	Untitled (catastrophic effects letter)		1										1	
1981	Atmospheric CO_2 Scoping Study					1							1	
1982	CO_2-Greenhouse Effect; Corporate Research Climate Modeling	1											1	
1982	CO_2 "Greenhouse" Effect		1										1	

1982	CRL/CO_2 Greenhouse Program				1						1
1982	Untitled (consensus on CO_2 letter)	1									1
1982	Untitled (Esso project terminated letter)				1						1
1983	Background Paper Environmental Issues Natuna Gas Project				1						1
1983	Untitled (ocean storage environmental concerns letter)		1								1
1984	The Fate of CO_2 from the Natuna Gas Project if Disposed of by Subsea Sparging		1								1
1984	Corporate Research Program in Climate/CO_2-Greenhouse	1									1
1984	CO_2 Greenhouse and Climate Issues	1									1
1985	CO_2 Greenhouse Update 1985	1									1
1985	CR Interactions (handout for June 12th meeting with Lee Raymond)		1								1
1988	The Greenhouse Effect	1									1
1989	Potential Enhanced Greenhouse Effects, Status and Outlook	1									1
1989	Greenhouse Science				1						1
1995	Primer on Climate Change Science	1									1
2002	Activities				1						1

Advertorials

		Topics					Types							
Year	Title	Methods & Climate Science	Impacts	Mitigation	Paleoclimate	Policy, Econ. & Misc. Opinions	Academic Journal	Conference/ Workshop Proceeding	Gov. Report	Book	Industry	Misc. Opinion	Int. Doc.	Ad
1989	People Who Live in Greenhouses...	1												1
1994	33/50: An experiment that works					1								1
1995	The sky is not falling					1								1
1996	A policy agenda for tomorrow					1								1
1996	Less heat, more light on climate change	1												1
1996	With climate change, what we don't know can hurt us					1								1
1997	Stop, look and listen before we leap					1								1
1997	Climate change: Let's get it right					1								1
1997	The Senate Speaks					1								1
1997	When facts don't square with the theory, throw out the facts					1								1
1997	CNN and the value of instant replay					1								1
1997	Global climate change					1								1
1997	Reset the alarm					1								1
1997	Science: what we know and don't know	1												1
1997	Climate change: a prudent approach			1										1
1997	Climate change: where we come out					1								1
1997	Climate change: a degree of uncertainty					1								1
1997	The Kyoto conference					1								1

1998	Post Kyoto, what's next?				1							1
1998	The Kyoto Protocol: a painful response				1							1
1999	Helping Earth breathe easier		1									1
1999	Where we are and where we may be heading				1							1
1999	Some ways to make a difference		1									1
1999	Scenarios for stablization		1									1
1999	Lessons Learned		1									1
2000	Conservation: the first path		1									1
2000	Do No Harm				1							1
2000	Unsettled Science	1										1
2000	The Promise of Technology		1									1
2001	Moving past Kyoto...				1							1
2001	...to a sounder climate policy		1									1
2002	Managing greenhouse gas emissions		1									1
2002	A responsible path forward on climate		1									1
2003	The global climate and energy challenge		1									1
2004	Directions for climate research				1							1
2004	Weather and climate	1										1

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