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EXXON RESEARCH AND ENGINEERING COMPANY

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September 2, 1982

H. N. WEINBERG
SEP 2 1982

Mr. A. M. Natkin
Office of Science and Technology
Exxon Corporation
1251 Avenue of the Americas
New York, New York 10020

Dear Al:

I would like to summarize the findings of our research in climate modeling and place our results in the context of the existing body of knowledge of the CO_2 greenhouse effect.

Although the increase of atmospheric CO_2 is well documented, it has not yet resulted in a measurable change in the earth's climate. The concerns surrounding the possible effects of increased CO_2 have been based on the predictions of models which simulate the earth's climate. These models vary widely in the level of detail in which climate processes are treated and in the approximations used to describe the complexities of these processes. Consequently 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 $(3.0 \pm 1.5)^{\circ}C$. 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. The temperature rise is predicted to be distributed nonuniformly over the earth, with above-average temperature elevations in the polar regions and relatively small increases near the equator. 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. The time

[+]National Research Council Panel Report, Carbon Dioxide and Climate: A Second Assessment, National Academy Press, Washington, D.C., 1982.

required for doubling of atmospheric CO_2 depends on future world consumption of fossil fuels. Current projections indicate that doubling will occur sometime in the latter half of the 21st century. The models predict that CO_2-induced climate changes should be observable well before doubling. It is generally believed that the first unambiguous CO_2-induced temperature increase will not be observable until around the year 2000.

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. Newell noted that geological evidence points to a relative constancy of the temperature of the equatorial waters over hundreds of millions of years. This constancy is remarkable in view of major climatic changes in other regions of the earth during this period. Newell ascribed this anchoring of the temperature of the equatorial waters to an evaporative buffering mechanism. In this mechanism, when heating increases at the equator, most of the extra energy induces greater rates of evaporation rather than raising temperatures. Newell proposed that this effect might greatly reduce the global warming effect of increased atmospheric CO_2.

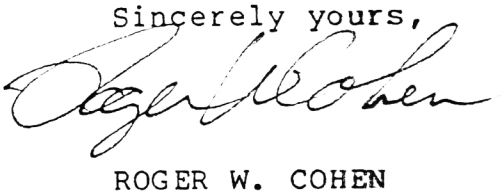
In our climate research we have explored the global effects of Newell's evaporative buffering mechanism using a simple mathematical climate model. Our findings indicate that Newell's effect is indeed an important factor in the earth's climate system. As Newell predicted, evaporative buffering does limit CO_2-induced temperature changes in the equatorial regions. However, we find a compensatingly larger temperature increase in the polar regions, giving 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. They are also in agreement with estimates of the global temperature distribution during a certain prehistoric period when the earth was much warmer than today.

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.

We are now ready to present our research to the scientific community through the usual mechanisms of conference presentations and publications in appropriate journals. I have enclosed a detailed plan for presenting our results.

As we discussed in the August 24 meeting, there is the potential for our research to attract the attention of the popular news media because of the connection between Exxon's major business and the role of fossil fuel combustion in contributing to the increase of atmospheric CO_2. Despite the fact that our results are in accord with those of most researchers in the field and are subject to the same uncertainties, it was recognized that it is possible for these results to be distorted or blown out of proportion. Nevertheless the consensus position was that Exxon should continue to conduct scientific research in this area because of its potential importance in affecting future energy scenarios and to provide Exxon with the credentials required to speak with authority in this area. Furthermore our ethical responsibility is to permit the publication of our research in the scientific literature; indeed to do otherwise would be a breach of Exxon's public position and ethical credo on honesty and integrity.

Sincerely yours,



ROGER W. COHEN

RWC:tmc

Enclosure

cc: A. J. Callegari
E. E. David, Jr.
B. P. Flannery
M. B. Glaser
D. G. Levine
P. J. Lucchesi
H. N. Weinberg

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CO_2 Climate Modeling Research: Timetable for Presentations and Publications

I. Presentations

(1) DOE Sponsored CO_2-CLimate Meeting
September 19-23, 1982 (West Virginia)

(a) Results pertaining to general aspects of the model to be presented in an informal session by our collaborator Professor M. I. Hoffert of NYU. The CO_2 calculations will not be included.

(b) Preprints of the paper [#(1) below] to be distributed at this meeting to general peer comments and discussion.*

(2) Ewing Symposium (Lamont-Doherty/Exxon Foundation Supported)
October 25-27, 1982

(a) Results concerning general aspects of the model and the CO_2 calculations to be presented by B. P. Flannery (CR).

II. Publications

(1) Manuscript developing general aspects of the model to be submitted for publication to the Journal of Geophysical Research, September, 1982.*

(2) Manuscript on CO_2 related model predictions to be submitted in late 1982.

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* Provided formal publication clearance has been granted by this time.