

Conclusions

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The present review demonstrates the state of the assessment of the CO₂ problem in its broad interdisciplinary character and with its unresolved problems. One problem is an apparent discrepancy in the C budget. Biologists claim that deforestation and oxidation of humus is probably a CO₂ source of similar size to that of the fossil CO₂. On the other hand, the carbon cycle modelers see no way of adapting their models for the CO₂ uptake by the ocean to account for such a large total anthropogenic input. The modelers conclude that based on the observed CO₂ increase and on the interpretation of the responses of the CO₂ system to other types of disturbances, the airborne fraction of the anthropogenic CO₂ is between 45 and 55%, and they propose to use values in this range for predictions of future atmospheric CO₂ concentrations. For different energy scenarios with the main emphasis on fossil fuel use (growth rates between 2.9 and 4.8% per year) it is predicted that the atmospheric CO₂ level will have doubled by the middle of the next century.

Less controversial, although still not confirmed, are the models which predict the extent of the temperature increase for a given CO₂ increase. Recent, more refined, climate modeling experiments reproduce the predictions made some years ago regarding the climatic change due to a CO₂ doubling: the global temperature is expected to increase by 2–3 °C with a 2- to 3-fold polar amplification.

Until recently it was not thought that changes in the atmospheric CO₂ content had played a major role in Quaternary climatic history. However, recent measurements of the CO₂ content of air occluded in ice core samples covering the last 30,000 years suggest that atmospheric CO₂ levels during the last period of glaciation were lower by a factor of 1.5–2 than Holocene values. These findings, if substantiated by further measurements, would indicate that an increase of the atmospheric CO₂ content contributed to the transition from glacial to postglacial.

In discussions of climate history, a change to higher temperatures is often considered as an improvement of climate. A warmer earth may provide better living conditions in some regions but lead to more rigorous ones in other areas. Our society is adapted to the present climatic conditions. Any climatic change

would force a readjustment to new environmental conditions in a relatively short time period, a process which may not be possible without severe problems.

Can the anthropogenic CO₂ excursion be kept within limits corresponding generally to beneficial or at least tolerable climatic change? if so, how?

In one of the papers of this review, a CO₂ strategy was discussed. If in the year 2000 a CO₂ climate effect were detected and then a decision to drastically reduce CO₂ emissions were made, an impossibly rapid growth of solar and nuclear energy would be necessary to keep energy production constant and to help the CO₂ increase keep below a value of 50% corresponding to a global temperature increase of about 1 °C.

However, for several reasons it seems unsuitable to allow decisions regarding CO₂ control to wait till a possible CO₂ effect is observed:

- recent model climate experiments using a more realistic atmosphere–ocean coupling indicate that due to the heat capacity of the upper oceanic layers, the climatic response to the CO₂ increase would be delayed by about 1 decade;
 - according to the existing CO₂ cycle models, the atmospheric CO₂ level would decrease only very slowly after cessation of CO₂ production (time scales of hundreds to thousands of years);
 - the shift to non-fossil energy technology requires decades. Even after a decision were made a considerable further CO₂ increase would have to be accepted.
- Though many questions remain open, it is recommended that the CO₂ problem be considered as a part of all future energy planning. Will this recommendation be followed? Developments during the last year do not support this hope. Some months ago a US National Energy Plan was made which puts the main emphasis on the use of coal.

It must be realized by scientists, decision makers and the public that man is faced with a serious problem which demands full attention. Strong internationally coordinated scientific and technical efforts are necessary to create a long-term world energy system which will not lead to future environmental problems with concomitant undesirable socio-economic consequences.

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