

HUMAN CAUSES OF GLOBAL CHANGE / 47

TABLE 3-1 Estimated Human Contributions Per Decade to Global Warming of Major Greenhouse Gases During Three Time Periods, in Watts per square meter (percentage in parentheses)

Gas	1765-1960 ^a	1980s ^a	2025-2050 Projection ^b
CO ₂	0.059 (68)	0.30 (55)	0.51 (67)
CH ₄	0.018 (21)	0.06 (11)	0.07 (9)
CFCs, HCFCs	0.001 (1)	0.13 (25)	0.11 (15)
N ₂ O	0.003 (4)	0.03 (6)	0.04 (5)
Stratospheric H ₂ O ^c	0.006 (7)	0.02 (4)	0.024 (3)
Total	0.087	0.54	0.76

These estimates are of "radiative forcing" by greenhouse gases, that is, the change they produce in the earth's radiative balance that in turn changes global temperature and climate. Radiative forcing is calculated from current gas concentrations in the atmosphere, which include gases remaining in the atmosphere from all emissions since the beginning of the industrial era, set here at 1765. It is not identical to the "global warming potential" of gases emitted by human activity, a property that integrates the effects of gas emissions over future time. Global warming potential is affected by the different atmospheric lifetimes of greenhouse gases before breakdown, so that the relative importance of gases for global warming depends on the future date to which effects are estimated. In addition, chemical reactions in the atmosphere convert some radiationally inactive compounds into greenhouse gases over time. The estimation of the global warming potential of currently emitted gases is quite uncertain due to incomplete knowledge of the relevant atmospheric chemistry. An early estimate of the 100-year global warming potential of gas emissions in 1990 allocates it as follows: CO₂, 61%; CH₄, 15%; CFCs, 12%; N₂O, 4%; other gases (NO_x, nonmethane hydrocarbons, carbon monoxide), 8% (Shine et al., 1990). Although these estimates differ from the radiative forcing estimates in the table, the differences are not great in terms of the relative importance of the gases for the global warming phenomenon. Our analysis uses the estimates of radiative forcing because they are far less uncertain.

^aSource: Shine et al. (1990:Table 2.6).

^bSource: Shine et al. (1990:Table 2.7), assuming a "business-as-usual" scenario with a coal-intensive energy supply, continued deforestation and associated emissions, and partial control of CO and CFC emissions.

Uncertainties for the future projections are very large. Total effects of greenhouse gases projected for 2025-2050 varied by a factor of 5 from the "accelerated policies" scenario, which projected the lowest level of emissions, to the "business-as-usual" scenario, which projected the highest.

^cStratospheric water vapor is believed to increase as an indirect effect of CH₄ emissions.