TABLE 1.1
National emissions estimates for 1997 (Values in millions of short tons/yr)

Source category	PM_{10}	SO_2	CO	NO_x	VOC	Pb
Transportation	0.7	1.4	67.0	11.6	7.7	0.00052
Fuel combustion	1.1	17.3	4.8	10.7	0.9	0.00050
Industrial processes	1.3	1.7	6.1	0.9	9.8	0.0029
Miscellaneous	—	0.0	9.6	0.3	0.8	—
Total	3.1	20.4	87.5	23.5	19.2	0.0039
Percentage of 1970 total	—	65%	78%	116%	70%	1.7%

PM_{10} = particulate matter, 10 μ or smaller; see Chapter 8. SO_2 = all sulfur oxides, mostly SO_2; see Chapter 11. CO = carbon monoxide; see Chapter 15. NO_x = all nitrogen oxides, mostly NO and NO_2. The mass shown is based on all NO being converted to NO_2; this is referred to as "NO_x expressed as NO_2"; see Chapter 12. VOC = volatile organic compounds; see Chapter 10. Pb = lead; see Chapter 15.

No value is shown for PM_{10} emissions as a fraction of 1970 emissions because no reliable estimate is available for PM_{10} emissions in 1970. Forest fires are the most important of the "Miscellaneous" sources, for most pollutants. This table contains no entry for O_3, which is a major pollutant, but which is almost entirely a secondary pollutant for which there are no major primary emission sources. VOC are listed not because they are directly harmful to human health, but because they are a major primary precursor of secondary O_3.
Source: Ref. 2.

Engineers recognize that there is not *one* air pollution problem but a group of related problems, and that some of the problems are mostly caused by industry and others are mostly caused by motor vehicles. The public and many politicians hope to find a simple, one-step, inexpensive solution to "the air pollution problem." Engineers recognize that we are unlikely to find such a solution, and must continue to apply limited solutions to parts of the family of air pollution problems.

4. From 1970 to 1997, the United States has made significant progress in reducing emissions of lead (mostly by taking lead out of gasoline) and modest progress in reducing emissions of the other major pollutants. The air pollutant emission situation can be roughly approximated by

$$\left(\begin{array}{c}\text{Air pollutant}\\\text{emissions}\end{array}\right) = \text{population} \cdot \left(\begin{array}{c}\text{economic activity}\\\text{per person}\end{array}\right) \cdot \left(\begin{array}{c}\text{pollutant emissions}\\\text{per unit of economic}\\\text{activity}\end{array}\right)$$

(1.1)

Since the environmental awakening of 1969–1970, the population of the United States has increased by about 30%, our economic activity per person by about 80%, and our motor vehicle usage by about a factor of 4. But the pollutant emissions per unit of economic activity have declined steadily because of stringent programs of emission control. Thus, in most of the United States, the emissions and hence the measured concentrations of most pollutants in the atmosphere declined steadily between 1970 and 1997. The decline has not been as rapid as many have wished, or as rapid as many predicted, and there are exceptions to this decline (e.g., increases in acid rain in the northeastern United States). In general, however, the installation