The construction of general computerized models of the three basic elements of a waste management system: input to the system, processing through it, and assimilation by the environment.

4. The only technically and economically efficient way to manage these wastes is through the development of a waste management system organized on a regional basis, transcending artificial political boundaries, and controlling all forms of waste.

Our study also showed that if California continues to use existing systems, merely expanding them to meet greater demands, the total costs for the year 1990 deriving from wastes of all kinds will be about $8 billion per year, and the environment will be more polluted than it is today. (The current total budget of the entire State of California is about $4 billion a year.) Employing systems engineering, and using improvements possible with today's technology or potentially available from advanced technology, we believe that the cost in 1990 could be reduced to about $3 or $4 billion per year, and in addition to lower total costs, we would have a cleaner, more pleasant environment.

In this connection, I would like to amplify my earlier statement that the problem of pollution must be viewed in the larger context of waste management in general. The distinction is not merely semantic, but has substantial practical consequences.

I quote from the report "Waste Management and Control" issued this year by the Committee on Pollution of the National Academy of Sciences National Research Council.

"The difficult job of determining an optimum balance of competing requirements must be approached from a systems point of view. The systems approach must consider the interrelationship of land, air, and water. Too often, municipalities get rid of solid wastes by incomplete burning, which may solve land disposal problems but fouls the air. We must consider the assimilative capacity of water, air, and land taken together as a single entity and in relation to the plants and animals that live there. The assimilative capacities vary with such factors as the tidal flushing of bays, the flow of rivers, and the windiness of the locality."

Pollution, in short, is not a simple, straightforward problem. Population is not only increasing in most sections of the country, but is also constantly shifting about, usually making established waste control systems inadequate. Our present controls of waste are so fragmented that all too often little is done. Our industrial techniques are constantly changing, resulting in new waste problems as well as requiring new control equipment if minimum disposal costs are to be realized. The pollutants are dynamic, flowing in air and water across county, State, and National borders. The waste is itself constantly changing from gaseous to liquid and solid, from liquid to solid and gaseous, and so on, making it difficult and expensive to control once it has left its source. Indeed, we generally do not know what the effects of a given pollutant are, and hence whether to insist on controlling it. Finally, our esthetic demands are becoming of greater importance. Not only are we concerned about preventing undesirable health effects, and lowering waste treatment costs, we are also concerned about such intangibles as clear air and clean, sparkling water.

Another major problem, frequently unrecognized, is that in most cases we do not even know what a pollutant is. To define one we must not only know its chemical composition, but also:

1. Relate this data to other possible pollutants being added at the same time.
2. Define its quantity and rate of addition.
3. Specify its precise location.
4. Specify the volume, composition, and physical and chemical characteristics of the receiving stream or body of air.
5. Determine the capacity of the receiving medium to assimilate or change the pollutant both along its line of flow and at its terminus.
6. Specify the uses that the receiving medium will be put to.

Obviously, such determinations for the hundreds of potential pollutants which may be added during the course of a given day to a given stream or airshed would be very difficult and expensive, even if we knew all the interrelationships, could predict what the stream (or air) flow might be, and could measure the quantities in the first place.

Up to this point, I have attempted a candid assessment of the difficulties we face in merely knowing what we want to accomplish, let alone doing it. But in spite of imperfect knowledge, we must act and act now. The longer we wait, the more serious the situation becomes.