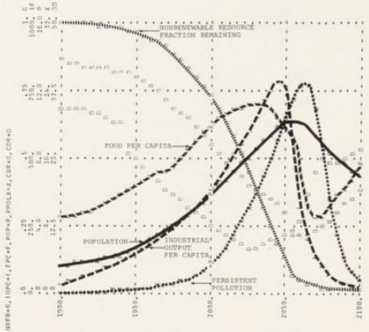

Figure 7-26 Run 7-20: adaptive technological policies—the effects of limitations to technological capabilities

The adaptive technological policies assumed in this run are identical to those in Run 7-19 except that the maximum rate of technological change is assumed to be 2 percent instead of 5 percent per year. Technology is unable to avoid the effects of the constraints to growth because industrial output per capita IOPC and population POP grow faster than the maximum rate of technological change. In this run, resource depletion again halts growth in population and industrial output.

Run 7-20 shows that the adaptive technological policies allow growth to continue for 75 years after 1975. Industrial output per capita IOPC, food per capita FPC, and population POP all continue to grow until the year 2050. But because industrial output per capita IOPC and population POP grow faster than the maximum rate of technological development, technology is unable to avoid the negative pressures that occur when the model's limits are approached. In this case, nonrenewable resource depletion is the first limit reached, for resource usage tends to increase by 4 percent per year due to population growth and industrial development, while recycling technologies tend to reduce per capita resource usage by only 2 percent per year. Growth in industrial output per capita IOPC is halted after the year 2050 as resources near depletion, forcing the fraction of capital that must be allocated to obtaining resources FCAOR to rise. The decrease in industrial output per capita IOPC causes growth in other sectors to stop in a behavior mode similar to that of the reference run (Figure 7-7).

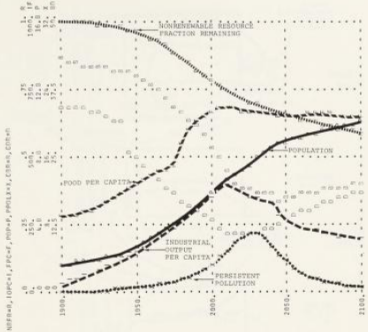

Figure 7-27 Run 7-21: adaptive technological policies—the effects of technological development and implementation costs

Here it is assumed that more effective recycling, pollution control, and land yield advances can be obtained only at increasing costs. These higher costs are represented in the model by a rise in the industrial capital-output ratio ICOR. A trade-off now occurs between the benefits of continued growth and the costs of the technologies that make further growth possible. The rising costs of the new technologies cause industrial output per capita IOPC to decline after the year 2010.

Adaptive Technological Policies—The Effects of Costs of Technological Development and Implementation In Run 7-19 it was shown that continued growth in population and industrial capital is a possible mode of behavior if new technological solutions can be developed at an exponential rate with no side effects and no delays in their development and implementation. Run 7-21 (Figure 7-27) tests the effects of the assumption that the advances in technology modeled in Run 7-19 can be obtained only at some real cost. Figure 7-28 shows the structural additions assumed for this run. As in Run 7-19, technological improvements in resource recycling, pollution control, and land yield capabilities are developed as needed. However, the development and implementation of these new technologies add to the cost of the production process. In this formulation, increases in technological development and implementation costs are modeled as a rise in the industrial capital-output ratio. This simplified representation of costs assumes that the development and