conflict and national security concerns over oil, are now seen in hindsight as having been too ambitious. Some expensive technology pushes are no longer supported--for example, synthetic fuels, the Clinch River Breeder Reactor, magnetohydrodynamics, and the Stirling automobile engine--because they were not economically successful, even though they produced a wealth of scientific knowledge and engineering experience. But these are only a part of the picture.

Improved R&D Productivity
More fundamentally, the Department's record of R&D productivity has steadily improved over nearly two decades of R&D investment. Management techniques for R&D have become more sophisticated and less congressionally directed. They are now squarely rooted in competition, driven by technical merit and scientific peer review, and aligned with the needs of cost-sharing industrial partners.

Economic Successes
This report compiles a brief list of some of the more significant Department sponsored technology developments that have already had, or will have in the next year or so, significant impacts on the U.S. economy. It omits hundreds of scientifically and technically important developments and focuses only on examples of successes with major economic significance.

As a word of caution, please note that the pathway of scientific discovery, from basic research to product development, is often complex and multifaceted. Bringing a new product to market involves many players, and credit for their existence should be shared broadly. The final stages of development are almost always, as they should be, private sector interests. The products that consumers see rarely have any overt indication of an underlying Federal or Department of Energy R&D role.

This does not mean, however, that the R&D was not important, or that it would have been developed anyway if just given enough time. The examples in this report show that the Department of Energy's R&D programs played a key and enabling role in the resulting technology development. The Department does not claim credit for the final design and production of the commercial products. Nor does it wish to understate the critical importance of the private sector's role. It does want to emphasize, however, the collaborative nature of scientific discovery and technology development, with private and public actors each playing distinct and complementary roles.

R&D Management Principles
The Department's programs support high-risk, precompetitive research. The Department's applied energy R&D investments are guided by a set of R&D management principles, which limits and carefully guides the use, and guards against the misuse, of public funds for R&D. The Department supports R&D if and when serious shortfalls occur in areas of R&D otherwise important to society.

R&D Considerations
The Department of Energy's decisionmaking on investment in R&D takes into consideration the following factors:

- The overall significance of the potential benefits of the R&D to the Nation.
- The level of technical difficulty of the task and whether the overall risk of the R&D is such that private industry will not undertake the development on a timely basis.
- The nature of the R&D and whether or not an individual firm might recover its research costs by appropriating to itself the benefits of the knowledge (a "public good") it creates.
- The nature of the industry and whether the fragmented structure of an industry might work against sufficient levels of R&D spending because its firms are too small to undertake certain kinds of R&D projects.