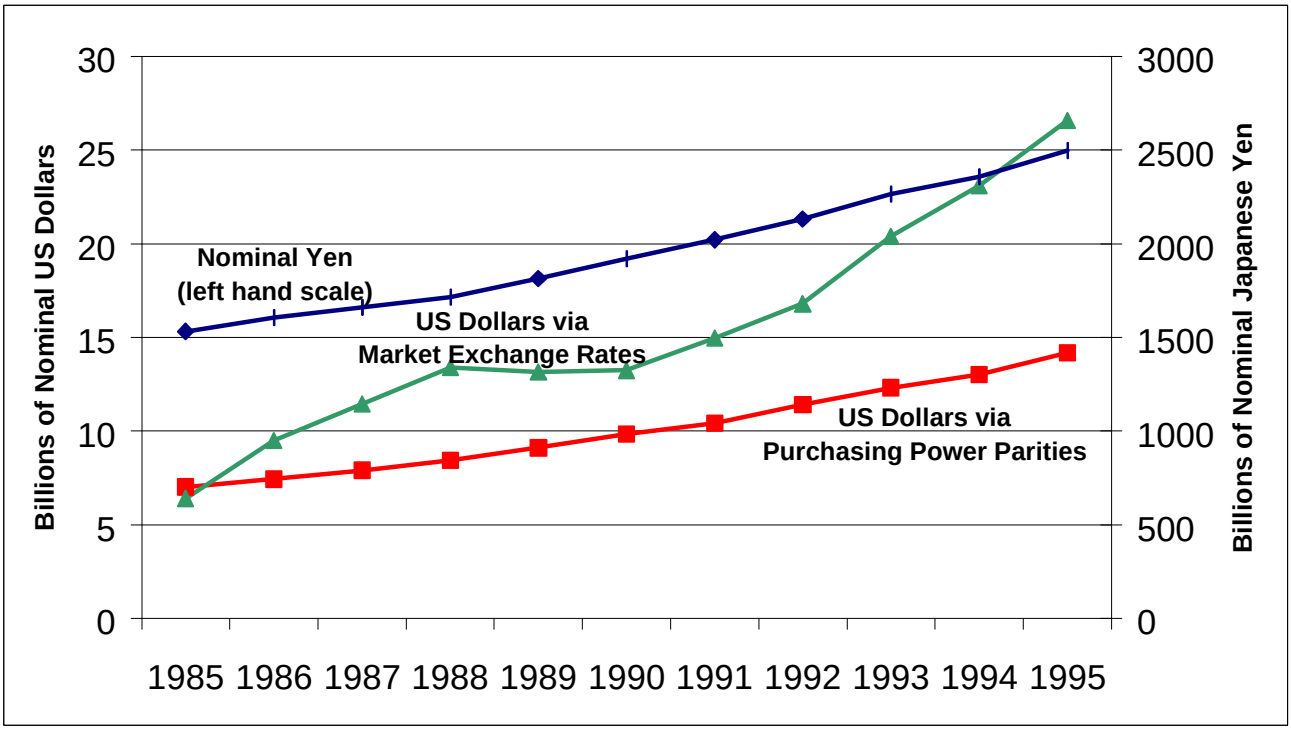

Figure 1: Japanese Public Sector Support for R&D: 1985-1995[1]

Setting Energy R&D in Context

Since the late 1980s, there has been robust and uniform growth in national (public and private sector) investments in R&D in each of the five cases included here: the United States, Japan, Germany, the European Union, and the Netherlands. In fact, in 1997, overall US investments in R&D exceeded the $200 billion mark for the first time in history. The United States' investments in R&D grew by 26% in real terms between 1985 and 1997. Even Japan, which has suffered a prolonged economic recession for most of the 1990s, has expanded its national R&D effort by 44% in real terms over the decade 1985-1995. From 1985 to 1995, R&D in the Netherlands also grew, by 31 % in real terms.

Below this first-order trend of R&D growth in industrialized countries lies a more diverse array of international trends with regard to funding sources and direction. An important development is the increasingly smaller role played by the public sector as an R&D sponsor in several countries. In the United States, Germany, and the Netherlands, public sector investments in R&D, as a percentage of the national total, peaked in the late 1980s or early 1990s and have declined in real terms since then or have been roughly stable. In all countries, budget pressure is an important driver for reducing R&D financing. In the

[1] Source for budget data: *Outline of JFY 1999 Government Budget Requested for Science and Technology*. Report Memorandum #98-14. September 14, 1998. National Science Foundation Tokyo Regional Office. Source for currency conversion rates: NSB *Science and Engineering Indicators: 1998*, Appendix Table 4-2.

United States and in Germany these reductions in public support for R&D can be attributed in large measure to the end of the Cold War and the subsequent reordering of social priorities. In the US, major reductions in defense R&D have been responsible for the overall decline in United States government's R&D investments.[2] In Germany, costs associated with the reunification of the country have forced the government to shift funds away from R&D and toward other national priorities such as addressing unemployment and rebuilding basic infrastructure in the eastern states.

Japan stands out among the cases discussed here, because, in contrast to other industrialized countries, its public sector R&D investments have *increased* while private sector investments *decreased* for most of the past decade.[3] This is largely the inverse of the other four countries, where robust economic growth has spurred growth in private sector R&D that has more than offset declining public sector R&D budgets. In Japan, however, where economic recession has persisted throughout the 1990s, the government has reacted to industry's decreased ability to support R&D and to the general economic malaise by passing a number of stimulus spending bills, many of which have contained significant sums for R&D.

In recent years, an important shift has occurred in the focus of public policy relating to R&D. The role of government-funded research in these nations is being rethought. For example, in Germany and the EU, the commercialization of publicly supported R&D results has become an increasingly important and explicit policy objective, one that might have the effect of displacing investments in more basic research projects. Moreover, there is growing support for the assertion that an increasing short-term focus and market orientation characterize *both* public and private sector R&D investments in many industrialized nations.

That said, the United States and Japanese governments have issued policy statements advocating basic science rather than applied research as a primary focus for their public R&D investments. A widely held belief in the U.S. Congress supports the view that the federal government should limit its R&D activities to the basic science arena, leaving technology development and commercialization to the private sector.[4] In Japan, the government has explicitly rejected its former successful policy of adopting and improving on research carried out elsewhere. The Japanese government now believes that it must increase its support for basic research, reducing its dependence on the basic science of other nations. The Dutch government, which is also placing greater emphasis on support for the highest quality basic research, is adopting a selective approach, concentrating its efforts in a smaller array of research areas.

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[2] Reductions in defense R&D have also had a strong negative impact on the national R&D efforts of the United Kingdom and France, two countries that will be surveyed in the second phase of this project. (Source NSB *Science and Engineering Indicators: 1998*).

[3] Recent data suggest that private sector energy R&D investments in Japan have begun to grow strongly again, beginning in 1997.

[4] Vernon Ehlers, "Unlocking Our Future: Toward a New National Science Policy," A Report to Congress by the House Committee on Science, September 24, 1998.

Also, in the three largest R&D performing countries, the United States, Japan, and Germany, concerted efforts are underway to double (in nominal terms) government investments in civilian R&D. For its part, Japan is likely to reach its goal of doubling government R&D investments from 1992 levels within a few years of its stated target date of fiscal year 2000. In early November 1998, Germany's new government announced its intention of doubling the public research budget over the next five years. These efforts reflect deep concern on the part of some government officials in each of these countries that the overall health of the national R&D enterprise not be bound to fluctuations in the business cycle.

Energy R&D: Decline and Shifting Priorities

Overall public sector investment levels in energy R&D have declined over the past decade as the following data show:

- The US federal energy R&D program has fallen by 26% over the period 1990-1997, a decline of more than $1.2 billion in real terms from the level in 1990.
- The Japanese government's energy R&D program declined 8.6% over the past three years (1996-1998), a real decrease of $226 million. As a percentage of total public sector R&D effort, energy R&D has fallen from 19.9% in 1990 to 13.7% in 1998.
- The German energy R&D program has declined by 71% since 1990, a funding reduction of $1.04 billion.
- EU-sponsored energy R&D has declined by 13% since 1984; as a fraction of the EU Framework Programme budget, energy R&D's share has declined from 47% to 18% over the same period.
- The Netherlands' public energy R&D support declined by 28% in real terms from 1985 to 1995. Support for energy R&D has recovered somewhat between 1996-1997.

The trends in overall public budgets for energy R&D tell an incomplete story, however. Figure 2 graphically shows the energy R&D portfolios of these nations broken out by program area.[5]
Also noteworthy is the fact that national governments have sharply different priorities with regard to energy R&D technology investment areas. For example Japan devotes 66% of all public sector energy R&D expenditures to nuclear fission programs, while the United States and the Netherlands devote a continually declining share—currently less than 8%--of their energy R&D resources to fission.[6] Furthermore, although all of these nations have energy policies that place a very high priority on developing and deploying

[5] The residual "Other" category on this chart deserves explanation. For the US, this category amounts to nearly half of the US total energy R&D effort and constitutes the "basic energy sciences" research programs supported by the US Department of Energy. These programs explore fundamental aspects of the science that underpin energy technologies. In the other countries this "Other Energy R&D" category accounts for programs focusing on systems and policy analysis, as well as some basic research, electric power transmission, distribution, and storage R&D programs.
[6] At this point in this research effort, these comparisons are rough estimates. This research project is still collecting and standardizing the data from country sources. For example, the US "fission energy R&D" program might not include US funds for research covered in the other nation's fission R&D programs such as those used for the geologic disposition of radioactive waste.

renewable energy and energy efficient technologies as a way of increasing their energy security and protecting the environment, only the Dutch government invests the majority of its energy R&D resources in these technology areas.