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PRIVATIZING FEDERAL R&D LABORATORIES

by
Joseph P. Martino

EXECUTIVE SUMMARY

Members of Congress and presidential candidates have proposed abolishing various federal agencies and cabinet departments. A number of federal agencies, including some of those proposed for abolition, possess important research and development (R&D) capabilities. It is possible to preserve much of this capability—even if the parent agency is abolished—by privatizing the R&D labs.

This study reviews the civilian R&D capabilities of five agencies: the National Aeronautics & Space Administration (NASA) aeronautics labs, the Department of Agriculture (USDA), the Department of Energy (DOE), the U.S. Geological Survey (USGS), and the National Institute of Standards & Technology (NIST). Drawing on successful privatization of comparable R&D labs in Britain, the study proposes potentially feasible privatization modes on a case-by-case basis.

The NASA aeronautical labs could be privatized separately, using any of three possible methods: sale to a consortium of aerospace user firms, management-employee buyout, or sale to a nonindustry third party (e.g., a university). USDA's Agricultural Research Centers could be privatized individually, either to their host universities or to user cooperatives. USDA specimen collections could be sold either to a user consortium or via a management-employee buyout. Similar options are presented for the DOE, USGS, and NIST laboratories.

Based on their estimated replacement costs, the R&D labs of these five agencies might be worth as much as $17 billion. Ultimately, of course, actual purchase prices would be based on potential buyers' best estimate of the net present value (NPV) of future revenues minus costs of these labs, which could be considerably less, if the government agencies have made poor investments in the labs' capabilities.

Taxpayers would benefit from these privatizations in several ways. First, the sales proceeds could be applied to reducing the national debt (or to helping balance upcoming budgets). Second, annual appropriations for these labs would be eliminated (except to the extent that government customers, such as the Defense Department, continued to purchase certain services from some of these labs). Third, those labs converted to for-profit enterprises (e.g., USGS data provision) would begin paying corporate income taxes. More broadly, privatization would end subsidies to major industries (such as aerospace and petroleum) which would have to pay for research now funded by taxpayers for their benefit. It would also free these labs from the constraints of shrinking federal budgets, cumbersome procurement rules, civil service rules, and the inability to sell their valuable outputs at market prices.

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I. INTRODUCTIONI. INTRODUCTION

Currently there is considerable interest in abolishing various federal agencies and cabinet departments. Some of the agencies discussed as candidates for termination include the Commerce Department, the Department of Energy, the Bureau of Mines, and the Department of Education. Some of the agencies under consideration for termination include scientific and engineering laboratories. The issue of what should be done with those laboratories is inevitably one of the considerations in determining the fate of the parent agency. These laboratories have unique facilities and equipment which some argue must be retained. Hence an analysis of the potential for privatizing these laboratories is appropriate.

The drive to reduce the size of government has already produced one example of a privatized federal government research activity. The Office of Technology Assessment was established in 1972 to provide technical information to Congress. It was disestablished at the end of 1995, as part of the effort to reduce the size of government. During its history OTA had produced over 800 reports, each of which was requested by some member of Congress. In order to preserve the expertise and institutional memory of OTA, some of its employees decided to privatize it. The non-profit Institute for Technology Assessment (ITA) was established at the end of 1995.[1] The founders of ITA intend to seek clients in state and local government, industry, and foreign organizations, as well as continuing to do contract work for the Congress. While the success of ITA is not yet guaranteed, its rapid establishment is certainly an indicator that other government research activities can be privatized, and can seek wider sources of funding than their parent agencies alone. The question then becomes, can other research activities be privatized, and if so, what are the best approaches?

II. PRIVATIZATION OF GOVERNMENT LABORATORIES

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This study will focus only on selected laboratories. Exclusion of others does not mean they should not be considered for privatization. Those selected for study were chosen on the basis of size and capability, as well as apparent market for their capabilities. Privatization of other organizations, not considered here, might also be justified.

A. Purpose Of Privatization
A. PURPOSE OF PRIVATIZATION

Privatization of government activities is not an end in itself. The goal of privatization of research laboratories is to get the right science done by the right people. In many cases, the fact that a laboratory is located within the government prevents the right science from being done, or inhibits the hiring of the right people.

Privatization of government laboratories is intended to return to the private sector those activities which the federal government should not be doing at all, or which the private sector can carry out more effectively or more efficiently than the federal government. With regard to any federal laboratory, the following questions should be asked about its activities:

1. Should this activity be carried out at all? If we weren't doing it now, would we start?
2. If it should be done, must the government be responsible for it, or can it be transferred to the private sector?
3. If the government must retain responsibility, does the government need to perform the activity with government employees, or can it be operated by a contractor?
4. If it cannot be entirely turned over to a contractor, can peripheral functions such as guards, printing, and cafeteria workers be outsourced to the private sector?
5. If it must remain within the government, can it be benchmarked against similar organizations?

[1] Vary Coates, "Can the Office of Technology Assessment be Privatized?" *The Scientist*, January 22, 1996, p. 11.

Efforts at privatizing must take into consideration the desire of politicians to retain authority and influence. We have seen this in the deliberations of Congress since the 1994 elections. Even though many Republicans were ostensibly elected to Congress on a platform of shrinking government, some senior members, now elevated to committee chairmen, have tended to protect the agencies under the purview of their committees. Hence there are two critical points which must be emphasized in evaluating privatization. First, privatized laboratories can sell their services more widely than can government laboratories. The Institute for Technology Assessment, mentioned above, illustrates this point. Second, privatized laboratories can be run more effectively than can government laboratories, since they are not limited by the personnel regulations which all too often make it difficult or impossible to remove ineffective employees, or to compensate effective employees adequately. Emphasis on these points can help overcome lobbying by the affected agencies, and any turf-protecting tendencies on the part of elected or appointed officials.

B. U.S. Experience With Privatization
B. U.S. EXPERIENCE WITH PRIVATIZATION

A current example of privatization in the U.S. illustrates the feasibility of the procedure. The Naval Air Warfare Center in Indianapolis was slated for closure by the Base Realignment and Closure Commission. This would have meant the loss of 2,500 jobs and a payroll of $150 million to Indianapolis. In addition, contracts with local suppliers, amounting to nearly $1 billion annually, would have been lost.

Rather than fight to keep the base open, the City of Indianapolis sought an alternative: privatization. Bids from several defense firms were received by the City of Indianapolis. Hughes Technical Services, a subsidiary of Hughes Electronics Corporation, was the winning bidder, and selected to manage the facility, and has signed a 10-year contract. Workers will become employees of Hughes. In addition, Hughes will bring in 730 new jobs by relocating other activities to Indianapolis. Hughes will lease the facility from Indianapolis for $1 per year, the same lease price which Indianapolis pays the Navy, which retains title to the land.

Key to the privatization effort was the recognition that the Center's employees were really its most valuable resource, more so than the physical facilities. The problem was that the employees, although skilled engineers and scientists, had no experience with commercial markets. Hughes will provide the marketing expertise, allowing the former navy employees to make the transition from government agency to commercial entity.

This successful privatization illustrates the principles listed above. Although the Navy technically retains ownership of the facility, all operations will be carried out by a private firm, utilizing its own employees. The Navy may remain a customer for some of the Center's activities, but the Center will be free to seek other customers, including those already served by Hughes. The Center will become a vigorous part of a competitive economy, paying taxes instead of consuming them.

C. Relevant British Experience

Extensive privatization of government laboratories is not an outlandish idea. There is considerable precedent for this. This experience can be helpful in determining how to privatize the laboratories currently operated by the federal government.

Great Britain is currently the world leader in privatizing government laboratories. Several have already been privatized, and others are in the process of privatization. The initiative for privatization came from the Department of Trade and Industry in 1993. Since then other ministries, including the Department of Transport and the Department of Environment, have initiated privatization programs for their laboratories. The process is now being extended to the entire British government, including those research activities belonging to the Research Council.[2]

Some laboratories have been slated for complete privatization. Others will become contractor-operated while remaining government owned. Those which cannot be contractor-operated will outsource whatever activities can be privatized or

[2] "Prior Options Reviews of Public Sector Research Establishments," OST/HMT/OPS, November 1995. (Office of Science and Technology/Her Majesty's Treasury/Office of Public Service)

contracted out, and the remaining government activities will be benchmarked against similar activities in the private sector.

The process of privatization in Britain is carefully worked out. A steering group is set up for each group of laboratories to be considered for privatization. These groups monitor the reviews made of each laboratory, to verify that the reviews are "thorough, objective and searching,"[3] and to assure that the scope for privatization is being adequately examined. The reviews are advertised in *Government Opportunities*, to give any interested parties an opportunity to make their views known.

Each laboratory slated for privatization is given a set of annual goals, to move it toward self-support. Typical goals include percent of cost recovery from sale of services (including sale to government agencies), percent reduction in cost per direct labor hour (usually through reducing overhead), and percent of tasks completed on time and within budget. Each year higher goals are set for cost recovery and timeliness, and lower goals for cost per direct hour. Thus the laboratories are gradually weaned from their government status, and readied for privatization.

Even after privatization, the laboratories may still have government clients and may obtain some of their funding through government contracts. However, they are then receiving this funding on the basis of providing a service, often in competition with other providers. They are no longer government agencies, and do not appear as part of the budget. They are on the same footing as any other supplier to the government.

As of 1995, the following agencies were planned for privatization.[4]

1. ADAS 1. ADAS

This is the research laboratory of the Ministry of Agriculture, Fisheries and Food. It has a staff of 2000 and is scheduled for privatization in 1997. As a private organization, its mission will be: "To be the leading consultancy to land-based industries in the U.K., working with our customers through the provision of quality services for the benefit of their businesses."[5] As part of its preparation for privatization, ADAS has been developing a private sector clientele, and reducing its costs of operation. By the end of 1994, it was recovering 53 percent of its costs through consulting charges, with a target of raising this to 63 percent in 1995. It also achieved a 5 percent reduction in cost per direct hour during 1994, with a 1995 goal of an additional 4 percent. In addition, ADAS is outsourcing noncore activities, including printing, publicity, and information technology servicing. ADAS has already won several competitive bids for consultancy to customer organizations.

2. Laboratory Of The Government Chemist (LGC) [6]
2. LABORATORY OF THE GOVERNMENT CHEMIST (LGC)

This laboratory provides analytical services and advice in the fields of chemistry and biosciences. Its 1994 staff was 317, and its budget was £16 million. By the end of 1994, it had achieved the goal of full cost recovery through fees paid by users, including government agencies. In addition, performance improved, as measured by projects completed on time, and customer milestones met. It retained and expanded its level of accreditation by the National Measurement Accreditation Service. It was sold in April 1996 to a consortium backed by the Royal Society of Chemistry. A key criterion in selecting a buyer was retention of the Laboratory's reputation and its independence of commercial interests. The winning consortium, LGC Holding, consists of management, employees, the Royal Society of Chemistry, and the venture-capital firm 3i. LGC raised £5 million to purchase the laboratory from the government (for £360,000) and to develop the business.[7]

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3 OST/HMT/OPS November 1995, p. 2.

4 "Next Steps Review: 1994," report to Parliament, Chancellor of the Duchy of Lancaster, December 1994. (hereafter "Next Steps")

5 "Next Steps," p. 2.

6 "Next Steps," p. 55.

7 "Management Teams Purchase U.K. Laboratories," *Privatisation International*, May 1996, p.17.

3. National Physical Laboratory

The National Physical Laboratory is responsible for developing and maintaining measurement standards for physical quantities. In particular, it ensures that accurate measurement standards, compatible with those maintained by major trading partners overseas, are available within the U.K.. During 1994, NPL achieved full recovery of operating costs. The NPL also showed improvements in timeliness of calibrations and completion of project milestones. It became a government-owned, contractor-operated facility in 1995. Five bidders competed for the contract, allowing the government to obtain a good price. The winning bidder was a consortium including Serco, AEA Technology, and Loughbrough University. Other bidders included EDS-Scicon, Brown & Root (an American firm), Rolls Royce, and W.S. Atkins. The Serco contract is for a period of five years, with an option to purchase the Laboratory upon expiration of the contract.

4. National Engineering Laboratory[8]
4. NATIONAL ENGINEERING LABORATORY

The NEL provides a range of engineering services to industry and government. Its unique facilities include a model tank for testing ship models and an extensive structural testing capability. In 1994 the staff was 349 and operating cost was £14.72 million. During 1995 it achieved full recovery of costs. In 1995 it was sold to a private firm, Assessment Services, Ltd., a subsidiary of Siemens Group, which was the "highest" of three bidders. ASL actually submitted a *negative* bid equivalent to $3 million. The other bidders demanded even more from the British government in order to take over NEL. However, since NEL's costs are no longer borne by the British taxpayer, the government was well advised to pay an outside firm a one-time cost to take over NEL.

An earlier attempt to sell NEL failed because NEL was at that time overstaffed. The 1988 staff level of 625 was reduced to 223 by the time of the successful sale to ASL.

5. Transport Research Laboratory
5. TRANSPORT RESEARCH LABORATORY

> *"TRL is the largest and most comprehensive centre for the study of road transport in the United Kingdom. It provides research-based technical help which enables the British Government to set standards for highway and vehicle design, formulate policies on road safety, transport and environment, and encourage good traffic engineering practice."*[9]

In 1994 TRL had a staff of 520 and an income of £30 million. In 1994 it met the goal of recovering full cost of operation. In March 1996 TRL was sold to the Transportation Research Foundation, a nonprofit company set up by the management of TRL.[10] The Foundation was the successful bidder, in competition with a consortium of consulting firms. The price was £6 million, financed by loans from the capital markets

6. Other Planned Privatizations6. OTHER PLANNED PRIVATIZATIONS

Two other British government laboratories are expected to be sold in 1996. The Building Research Establishment is expected to be sold to a newly created nonprofit company called the National Center for Construction. The Secretary of State for the Environment has given the building industry until September 30 to complete a business plan for NCC. If a satisfactory plan is not produced by then, BRE will be offered to a commercial buyer or its management will be contracted out. The government also plans to sell AEA Technology, a research lab carved out of the Atomic Energy Authority in March 1996. According to *Privatisation International*, the company's management is eager to expand its private-sector and nonnuclear business. The sale is expected before the end of 1996.[11]

As these examples show, privatization of government laboratories is feasible, if carried out properly. Privatization may take the form of a nonprofit firm, direct sale to a private firm, or for those activities for which the government must remain responsible, operation by a contractor. The key is to prepare the laboratories for privatization by a process of

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8 "Next Steps," p. 67.

9 "Next Steps," p. 113

10 "Buyer for U.K. Transport Research Lab," *Privatisation International*, February, 1996, p. 10.

11 "Management Teams Purchase U.K. Laboratories," *Privatisation International*, May 1996, p. 17.

improving their performance, reducing costs, and requiring them to approach full cost recovery from sale of services. This process can take several years.

D. Applying The Lessons To The United StatesD. APPLYING THE LESSONS TO THE UNITED STATES

This study reviews privatization possibilities for R & D laboratories operated by the National Aeronautics & Space Administration, the Department of Agriculture, the Department of Energy, the U.S. Geological Survey, and the National Institutes of Standards & Technology.

While much of the concern about loss of the various government laboratories focuses on unique equipment or facilities in those laboratories, these may not be the most important consideration. A study of technology transfer from federal laboratories found that while access to facilities was one of the most important factors in a firm's deciding to *enter into* a technology transfer agreement with a laboratory, attitudes regarding commercialization within the laboratory were more important to the *success* of the technology transfer effort.[12] This suggests that the British approach, of weaning a laboratory from the government over a period of a few years, is important to the success of the privatization effort, since it allows time for the laboratory staff to adjust to the needs of commercial status.

In this country the David Sarnoff Laboratories (DSL), formerly the research laboratory of RCA, for which it was not considered a profit center, took six years to reach profitability after being acquired by SRI International.[13] It is now a profit center for SRI and has spun off two for-profit firms which manufacture DSL-developed products.

III. NATIONAL AERONAUTICS & SPACE ADMINISTRATION (NASA)[14]III. NATIONAL AERONAUTICS & SPACE ADMINISTRATION (NASA)

NASA is responsible for a wide range of technological activities, including both aeronautical and space technologies. The space shuttle, which is one of NASA's major space activities, is already slated to become contractor-operated as part of a cost-reduction effort. Moreover, the shuttle no longer competes with private launch services for commercial payloads, hence its remaining uses are primarily for government payloads. In addition, NASA is considering a "commercialization initiative" for the space station, its other major space activity.[15]

The other space activities of NASA are primarily basic research (planetary probes and landers and the Hubble space telescope). Thus NASA's nonshuttle space activities involve the question of the extent to which the government should be conducting or funding basic research. That question has been explored in depth elsewhere,[16] and will not be considered here.

This study will focus entirely on NASA's aeronautical R&D, with particular emphasis on those Centers whose primary function is aeronautical R&D. This is because the aeronautical R&D activities of NASA are, as will be shown below, essentially a subsidy to the aviation industry.

A. BackgroundA. BACKGROUND

The stated mission of NASA's Aeronautical Research and Technology program is to "conduct the fundamental long-term research to strengthen the United States leadership in aviation, and to pursue development of high leverage technologies required to support both the subsonic and high-speed civil transport economic viability." The goal of the

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[12] Eliezer Geisler & Christine Clements, "Commercialization of Technology from Federal Laboratories," College of Business & Economics, University of Wisconsin-Whitewater, National Science Foundation grant 94-01432, August 1995.

[13] DSL home page: http://www.sarnoff.com/Visitor/recpt.shtml

[14] Unless otherwise stated, all data about NASA centers was obtained from various NASA and Center sites on the World Wide Web.

[15] Albert DiMarcantonio, "Human Exploration and Development of Space: International Space Station Proposed Commercialization Initiative." Washington, DC: NASA Office of Space Flight, June 10, 1996.

[16] Joseph P. Martino, *Science Funding: Politics & Porkbarrel*, New Brunswick, Transaction Publishers, 1992.

Aeronautics Research and Technology program is to provide the nation with leadership in high-payoff, critical technologies, and to assure the effective transfer of research and technology products to industry, the Department of Defense (DoD), and the Federal Aviation Administration (FAA) for application to safe, economically superior, and environmentally responsible U.S. civil and military aircraft, and for a safe and efficient national airspace system.

NASA's Aeronautics program is focused around six strategic goals:

1. develop high-payoff technologies for a new generation of environmentally compatible, economically superior U.S. subsonic aircraft and a safe, highly productive global air transportation system;
2. ready the technology base for an economically viable and environmentally friendly high-speed civil transport;
3. ready the technology options for new capabilities in high-performance aircraft;
4. develop and demonstrate technologies for hypersonic airbreathing flight;
5. develop advanced concepts, physical understanding, and theoretical, experimental, and computational tools to enable advanced aerospace systems; and
6. develop, maintain, and operate critical national facilities for aeronautical research and for support of industry, FAA, DoD, and other NASA programs.

As is readily apparent from these mission statements and goals, the aeronautical activities of NASA are unequivocal subsidies to the aviation industry, primarily the commercial air transportation industry. Note that none of the goals is in direct support of general aviation (private flying, business flying, crop-dusting, fire-fighting, and similar activities). General aviation, to the extent it benefits at all from NASA's aeronautical programs, does so only indirectly. One benefit of privatizing NASA's aeronautical R&D would be to put these other potential users on the same footing as the air transportation industry. Each would be paying for services received, and NASA would have an incentive to extend its interests to these other potential users.

NASA expenditures for aeronautical science and technology are shown in Table 1.

Table 1: NASA Aeronautical R&D by Center ($Thousands)

Center	FY 1994	FY 1995	FY 1996
Johnson Space Center	600	400	100
Marshall Space Flight Center	800	700	200
Stennis Space Center	500	200	0
Ames Research Center - SAT	211,700	212,800	241,500
Ames Research Center - CoF	51,000	22,000	5,400
Dryden Flight Research Center	51,700	48,900	45,800
Langley Research Center - SAT	312,100	305,500	331,700
Langley Research Center - CoF	51	0	0
Lewis Research Center - SAT	234,300	243,700	247,300
Lewis Research Center - CoF	27	0	0
Goddard Space Flight Center	18,500	25,300	21,300
Jet Propulsion Laboratory	9,400	5,600	5,600
Total	$887,678	$865,100	$898,900

FY 1996 preliminary estimates

NASA has a substantial R&D budget. Privatization would require either that some of these activities be curtailed, or that equivalent funding be found elsewhere. However, large as it seems, the NASA aeronautical R&D budget amounts to only five percent of the $6.2 billion of industry funds spent annually for R&D by the "aircraft and missiles" industry.[17] Thus it is clear that NASA's funding for aeronautical R&D is a very minor contribution to the total. The aviation industry could readily assume the costs of the aeronautical R&D funded by NASA.

[17] Division of Science Studies, "National Patterns of R&D Resources: 1994," Washington, D.C., National Science Foundation, 1995.

To consider what would be involved in privatizing NASA's aeronautical R&D program, we need to look at each of the major research centers.

B. NASA CentersB. NASA CENTERS

1. NASA Langley1. NASA Langley

Langley Research Center, located in Hampton, Virginia, was the original center of the National Advisory Committee for Aeronautics, the forerunner of NASA. With the construction of three unique wind tunnels—the Variable Density Tunnel in 1922, the Propeller Research Tunnel in 1927, and the Full-Scale Tunnel in 1931—by the 1930s Langley had become the world leader in wind tunnel design and research. Five Collier Trophies—the award given annually for the greatest achievement in aviation in America—have been presented to Langley over the years. Especially notable was Langley's work in high-speed flight which led to the development of laminar flow airfoils, the swept wing and the variable sweep wing.

Langley's primary mission is basic research in aeronautics and space technology. More than half of Langley's effort is in aeronautics. The Center's wind tunnels, other unique research facilities, testing techniques and computer modeling capabilities are used in the investigation of the full flight range—from general aviation and transport aircraft through hypersonic vehicle concepts.

Langley's efforts are directed at developing technologies to enable aircraft to fly faster, farther and safer and to be more maneuverable, quieter, more energy efficient and less expensive to manufacture and maintain. The tools Langley uses in this quest are its 30 wind tunnels whose capabilities are unique in NASA.

2. NASA Ames
2. NASA Ames

The NASA-Ames Research Center (ARC) is located at Moffett Field, adjacent to the city of Mountain View, California. Its mission in aeronautics is to "research, develop and transfer leading edge aeronautical technologies through the integration of computation, simulation, ground and flight experimentation, and information sciences."

In pursuit of this mission, specific goals include:

- To excel in research and technology for aerospace systems that transport humans and materials to and from space, especially in fluid and thermal physics, reentry systems, and hypersonic vehicle flight research.
- To lead in computational analysis of fluid flow, wind tunnel research, flight simulation, and flight research by exploiting the synergistic integration of these powerful and distinct capabilities.
- To emphasize high-performance, powered-lift, and rotary-wing aircraft by probing previously unexplored flight regimes and focusing research efforts on accelerating technological readiness.

The work of Ames is largely dedicated toward meeting the needs of industry, such as its current projects on tiltroter and supersonic transport aircraft. For the most part, its projects dealing with human factors are directly related to transport aircraft design. However, its nuclear reactor operator project shows that at least some of Ames-developed technology can be utilized by other industries as well.

3. NASA Lewis3. NASA Lewis

NASA Lewis is located 20 miles southwest of the city of Cleveland. More than $480 million has been invested in the Center's capital plant which includes four major wind tunnels; estimated replacement cost is approximately $1.3 billion. The stated mission of NASA Lewis Research Center is to define and develop advanced technology for high priority national needs. The work of the Center is directed toward new propulsion, power, and communications technologies for application to aeronautics and space.

Lewis's current propulsion projects are all heavily oriented towards the commercial aviation industry. To the extent that these projects are genuinely useful to aircraft manufacturers, there is clearly a market for them. Of course, if

these projects are not useful, then they should not be done at all. If they are worth more than they cost, then they can be supported by user fees.

4. NASA Dryden Flight Research Center4. NASA Dryden Flight Research Center

The Hugh L. Dryden Flight Research Center is NASA's primary installation for aeronautical flight research. It is located at Edwards AFB, Calif., on the western edge of the Mojave Desert 80 miles north of metropolitan Los Angeles. NASA Dryden Flight Research is responsible for flight research and flight testing. It is utilized not only for testing supersonic aircraft which require unimpeded airspace, but also for testing experimental aircraft which require the large dry lakebed for a landing area.

The staff and budget of Dryden are fairly small as compared to laboratories in industry. The unique feature of Dryden is the large area available for test flying and landing. This capability is irreplaceable, and will always be in demand by the aviation industry. Privatization, with full costs borne by users, is definitely possible.

C. Privatization PotentialC. PRIVATIZATION POTENTIAL

The key feature of the several NASA aeronautical centers is their facilities. These are often one-of-a-kind facilities for conducting various kinds of tests or carrying out specific kinds of research. The capabilities of these centers, both staff and facilities, are in demand by industry and the Department of Defense, and to a lesser extent by other government agencies such as the FAA.

From the standpoint of the taxpayers, it is irrelevant whether expenditures for aeronautical research needed by the Department of Defense appear in the DoD budget or the NASA budget. Indeed, from the standpoint of governmental efficiency, it would be better to force DoD decision makers to face up to the full costs of their aeronautical research by including it in their budgets, instead of allowing them to think of it as "free" because it comes from the NASA budget. If the DoD were budgeting for the full cost of its aeronautical research, it could just as easily buy that research from privatized NASA labs as it can obtain the research under the present arrangement. Indeed, it might more readily direct the research to meet its needs, rather than having to negotiate with NASA for it.

From the standpoint of industry, NASA's aeronautical research represents a subsidy, primarily to the air transport industry but to a lesser extent to the general aviation portion of the industry. As has been documented by Lenz et. al.,[18] the savings to the airline industry resulting from all R&D on air transportation more than paid for the cost of the research. In fact, the research was a better investment than high-grade industrial bonds. However, from 1925 to 1975, the share of aeronautical research paid for by NACA/NASA never amounted to more than 10 percent of the total, and was usually less than 5 percent. Industry itself typically expended eight times as much on aeronautical R&D as did NACA/NASA, and the Department of Defense typically expended ten times as much as NACA/NASA. Current industry expenditures for aeronautical research are nearly seven times NASA's expenditures.

Thus while the NASA aeronautical laboratories represent a valuable capability, the Department of Defense and the aviation industry already spend far more on aeronautical R&D than does NASA. Paying for what they now receive "free" from NASA would result in only a modest increase in their R&D budgets, and the returns on their investment would be significantly greater than the returns on almost any other investment open to them.

D. Privatization Options D. PRIVATIZATION OPTIONS

Privatizing NASA labs requires that the facilities and the staffs be kept together. The staffs are necessary to operate the facilities efficiently, and conversely have for the most part invested their entire careers in developing and operating those facilities. This suggests two possible privatization options. First, the facilities might be bought out by a consortium of aviation firms, including those involved in air transport, those involved in military aircraft, and those in the general aviation industry (trainers, pleasure aircraft, corporate aircraft, agricultural and fire-fighting

[18] Ralph Lenz, John A. Machnic, and Anthony Elkins, "The Influence of Aeronautical R&D Expenditures upon the Productivity of Air Transportation," University of Dayton Technical Report UDRI-TR-81-72, July 1981.

aircraft). The consortium would hire the staffs and own the facilities. Alternatively, the facilities might be the object of an employee buyout. The facilities would then be owned by the staffs, who would manage them and sell their services to industry and government.

It is not necessary that the entire set of facilities described above be maintained as a package. Individual centers might be privatized separately, or might even be divided into pieces which could be privatized separately. For instance, Dryden has not only a set of test flight facilities, but an extensive computer simulation facility. There is no reason why these need to be privatized together. It might be better to treat them separately than combine them as a package. A detailed study of the NASA aeronautical R&D facilities would be needed to determine the best privatization option. It is clear, however, that there is a market for the services provided by the NASA facilities and staff, and the value of the services far exceeds their cost. Given time to prepare for privatization, as in the British model, the various NASA centers could be self-supporting as private or nonprofit entities.

IV. DEPARTMENT OF AGRICULTURE[19]IV. DEPARTMENT OF AGRICULTURE

On May 15, 1862, President Lincoln signed an act authorizing a U.S. Department of Agriculture. On March 2, 1887, the Hatch Experiment Station Act was signed, which provided Federal grants for agricultural experimentation and a cooperative bond between USDA and the nation's land grant colleges. On May 8, 1914, the Smith-Lever Act was signed, providing for cooperative administration of extension work by USDA and the state agricultural colleges. The major goal was to assist individual farmers in increasing productivity. This work resulted in the establishment of the Cooperative Extension Service. Subsequent to that time, the Department has established laboratories and experimental stations throughout the United States.

A. MissionA. MISSION

Most of the activities of the Department of Agriculture deal with food inspection, regulation, or economic issues (price supports, food stamps, etc.). The only mission of interest to us here is research, education, and economics, under which the Department

> *strives to develop cutting edge technologies that improve food and fiber production and enhance the safety of the national food supply. USDA research finds many new uses for the nation's agricultural bounty, improves crop varieties and prevents crop losses and animal diseases caused by various pests and pathogens. The CSREES mission area joins this effort in partnership with land-grant institutions and private sector firms in science, technology and education activities relating to food and agriculture.*
>
> *The Agricultural Research Service provides access to agricultural information and develops new knowledge and technology needed to solve technical agricultural problems of broad scope and high national priority. The goal is to ensure an adequate supply of high quality, safe food and other agricultural products to meet the nutritional needs of consumers, sustain a competitive food and agricultural economy, to enhance quality of life and economic opportunity for rural citizens and society as a whole, and to maintain a quality environment and natural resource base. The agency maintains a network of geographically dispersed national and overseas laboratories and the National Agricultural Library.*

Research objectives of the Agricultural Research Service (ARS) include:

- reducing the degradation of the soil, air and water
- enhancing plant and animal productivity
- improving the processing of agricultural commodities
- improving human nutrition and well-being

[19] Unless otherwise stated, information about the Department of Agriculture and its laboratories was obtained from various sites on the World Wide Web.

These research objectives are carried out at over a hundred individual research stations and laboratories. Rather than try to describe each of these entities, only some selected laboratories and experiment stations will be discussed. These will illustrate the nature of the work carried out by the Agricultural Research Service. In particular, the work done and the customers for that work will be identified.

B. Research Labs And Experimental StationsB. RESEARCH LABS AND EXPERIMENTAL STATIONS

1. Beltsville Agricultural Research Center

Beltsville Agricultural Research Center, located in Maryland, near Washington, D.C., is the flagship research center of the ARS. It includes a large number of individual laboratories, each devoted to a specific aspect of agriculture or animal husbandry. Some of the individual laboratories are as follows.

- Climate Stress Laboratory
- Environmental Chemistry Laboratory
- Fruit Laboratory
- Growth Biology Laboratory
- Gene Evaluation and Mapping Laboratory
- Horticultural Crops Quality Laboratory
- Hydrology Laboratory
- Livestock & Poultry Sciences Institute
- Nematology Laboratory
- Parasite Biology and Epidemiology Laboratory
- Soybean and Alfalfa Research Laboratory
- Vegetable Laboratory
- Weed Science Laboratory

This wide range of activities at Beltsville is focused on improving the quality of food products, devising better pest control methods, and reducing environmental damage from agricultural chemicals. While these activities are unquestionably valuable, the also represent a direct subsidy to growers and food processors. The direct users of this information should bear the full costs of developing it.

2. Specimen Collections

Many of the ARS units specialize in collecting seeds or other samples of materials of importance to agriculture. Some of these are as follows.

- The U.S. National Parasite Collection
- Nematology Laboratory
- Microbial Properties Research Unit
- Maize Genetics Cooperation
- The National Seed Storage Laboratory
- The National Clonal Germplasm Repository
- Subtropical Horticulture Research Station

These various specimen collections are useful to plant breeders, and to researchers developing improved pest control methods. They represent a valuable resource, which would take years and great expense to duplicate or replace. While their value is not in question, it is not at all obvious why the government should be subsidizing plant breeders and pesticide manufacturers by maintaining these collections. The direct users should bear the full cost of operating, maintaining and extending these collections.

3. Agricultural Research Center

The Department of Agriculture maintains research centers throughout the United States. Most of the field sites of the Agricultural Research Service are devoted to research on specific crops, or to the agricultural problems of a specific region including:

- The US Dairy Forage Research Center
- Tree Fruit Research Laboratory
- Horticultural Crops Research Laboratory and Small Fruits Center
- Cereal Rust Laboratory
- National Soil Erosion Research Laboratory
- Water Management Research Laboratory
- Western Cotton Research Laboratory

Each of these laboratories, as well as many others not listed, is dedicated to researching the problems of agriculture in the immediately surrounding region, and developing improved strains of the crops now grown there. For all practical purposes, each laboratory is a subsidy to the growers and processors in its area.

C. Privatization Potential C. PRIVATIZATION POTENTIAL

There is no question that agricultural research has had an enormous impact on American society. By greatly increasing the productivity of farm workers, research has made it possible for one farm worker to feed 50 persons today, whereas in 1890 one farm worker fed only five persons. This enormous payoff from agricultural research has an important implication, however. The farming industry (including not only farmers but manufacturers of agricultural equipment, agricultural chemicals, and seeds) could have afforded to pay for the research. The return on investment would have been far greater than the return on investment in additional land or additional machinery. The problem would have been devising mechanisms by which that payment could have been made. This is the problem privatization must address.

The laboratories and research centers of the Department of Agriculture fall into three broad categories, each of which must be treated separately from the standpoint of privatization.

1. Beltsville Agricultural Research Center1. Beltsville Agricultural Research Center

Although Beltsville includes a large number of individual laboratories, there is considerable interaction among them. Moreover, many of the problems they address are national in scope rather than limited to the region around the Center. Hence for the purpose of privatization, it is best to treat the center as an entity, rather than breaking it into its individual parts. Since many firms in the agricultural machinery and agricultural chemicals industries already contract with Beltsville for specific kinds of research, there definitely is a market for its services. Therefore privatization should focus on keeping the entire Center together, except possibly for individual laboratories which turn out to have little market value, or those such as specimen collections which might better be combined with other centers (see below).

2. Agricultural Research Centers2. Agricultural Research Centers

As shown above for selected cases, the various research centers specialize in particular crops or other aspects of agriculture relevant to conditions in the area where the center is located. As such, these centers represent a national subsidy to regional agriculture. At best, they involve transfers back and forth, with each region subsidizing all the others, and being subsidized in return, all very inefficiently. At worst, they represent porkbarrel spending, with regions receiving funds according to their degree of political influence rather than on the basis of the quality of their work or the importance of the crops they specialize in. .

To the extent that agricultural research still has a payoff for the agricultural industry in a given region, there is a market for the services of the individual research centers, and a payoff to that market.[20] Hence these centers could be privatized provided means could be devised for funding them from the industry in the regions they serve.

[20] Of course, if there is little or no additional payoff from additional research, there is no justification for a national subsidy either.

3. Specimen Collections3. Specimen Collections

These collections, representing years of work by experts in various fields, potentially have enormous commercial value. The seed collections, in particular, are extremely important to seed companies as a source of genetic characteristics which may be bred into improved strains of crops (better yields, more resistance to pests or drought, etc.). Likewise, the collections of parasites and crop diseases are extremely important to companies selling agricultural chemicals or other pest control techniques. They will become even more important in light of the current emphasis on developing pest control methods which take advantage of hormonal changes in the life cycle of a particular pest, rather than indiscriminate pesticides such as DDT. Privatizing these collections must allow for their continued development, while charging the costs to those users who benefit directly.

D. Privatization OptionsD. PRIVATIZATION OPTIONS

Even though there is a market for the services and products of each of the various elements of the Agricultural Research Service, they cannot all be treated alike from the standpoint of privatization. Each must be treated separately. Possible approaches to privatization for each of the different types of activity are presented below.

1. Beltsville Agricultural Research Center1. Beltsville Agricultural Research Center

If Beltsville is to be privatized as an entity, several possible alternatives present themselves:

- **User Consortium—**one possibility is to have the Center owned by a consortium of users of the Center's research. Such a consortium might include manufacturers of farm equipment, manufacturers of food processing machinery, and manufacturers of agricultural chemicals. This would have the advantages of ready access to capital, and market-based direction for the Center's research.
- **Research Consortium—**another possibility is to have the Center owned by a consortium of research institutes and land grant colleges. This would help avoid the potential problem of too short-term an orientation in selecting research projects, while assuring that the research is peer-reviewed and of high quality.
- **Employee Ownership—**yet another possibility is employee ownership of the Center. This would require external financing, but would have the distinct advantage that each of the individual units would have an incentive to seek out customers, as well as an incentive to cooperate with other units in joint programs.

Each of these alternatives would have to be examined in more detail before selecting the best one. However, it does appear that Beltsville can be privatized successfully, utilizing one or another of these approaches.

2. Agricultural Research Centers2. Agricultural Research Centers

One of the worst features of the present system of cross-regional subsidies for these centers is that the various centers have little or no incentive to operate efficiently or effectively. Funds are distributed to the centers on the basis of history and politics, not through peer review of research proposals or market-based analysis of needs. Numerous studies of the Department of Agriculture's system of research centers have reported serious problems. In 1987 the National Academy of Sciences (NAS) issued a report on the Agricultural Research Service laboratories which was very critical of the performance of the centers. The report quoted one member of the NAS review committee as saying, "It was one of the most depressing things I have ever done. We saw hundreds of millions wasted on people who haven't published in 20 years. It was appalling."[21] Moreover, the environment at the centers tends to drive out good scientists. Maureen Hanson, director of the Center for the Experimental Analysis and Transfer of Plant Genes at Cornell University, served on the NAS review committee. She was quoted as saying, "USDA loses many good people even though the money is easy. They are bound up in paperwork. It is a depressing environment."

[21] Anne Simon Moffat, "Critics Rip Agriculture Department's Funding Methods," *The Scientist*, January 9, 1989, pp. 14 –15.

Since each of the research centers serves an identifiable local industry, that industry is in the best position to evaluate the quality of work done by the centers, and to provide direction for the work of the centers. Privatization would make the centers accountable to that local industry. After privatization, the responsiveness of the centers would be improved, and the quality of their work increased. Moreover, after privatization, the scientists at the centers would be relieved of much of the red tape and paperwork which go with government bureaucracies. Thus better science would be done, and the working environment would be more attractive to good scientists.

It might be argued that the local agricultural industry is too fragmented to support a local research center. However, it is already commonplace for farmers marketing a particular commodity to pay a quantity-based "tax" (e.g., so many cents per bushel or per pound) to support advertising and market promotion for that commodity. A similar scheme could be worked out for supporting regional research centers. If the payment were voluntary, then only the farmers (or the seed companies, or the equipment or chemical manufacturers) making the payment would have access to use the results. Conversely, if the payments were levied on all involved parties in a region (perhaps by majority vote of those growing a particular crop, as is currently done for promotional funding for particular crops), than the results would be available to all. Moreover, seed companies and manufacturers of agricultural equipment and chemicals are in an even better position than individual farmers to contract with the research centers for specific work, which could be protected by patents and licensed only to those who paid part of the cost. In short, the problem of a fragmented constituency can be solved, and the "free rider" problem of benefits going to all whether or not they have contributed is not a serious one.

Since most of the research centers are operated by universities, one approach to privatization would be for the host institution to take over ownership and responsibility. The host institution would then receive the payments collected from the various beneficiaries. Another possibility is to have the centers owned by cooperatives involving the farmers who grow the crops which are the focus of the centers' work. Ownership by a farmers' cooperative would simplify the problems of collecting funds and providing direction to the researchers. Depending upon the circumstances of each individual center, one of these alternatives might be more appropriate than the other.

3. Specimen Collections3. Specimen Collections

These collections are of primary value to seed companies and manufacturers of agricultural chemicals. It would probably be best if the entire set of centers could be privatized as a group, since that would reduce unnecessary duplication of specimen collections at different sites.[22] Two alternatives for privatization present themselves. One is ownership by a consortium of seed and pesticide manufacturers. The second is employee ownership. The first has the advantage of ready availability of capital. The second has the advantage that the employee-owners will have a strong incentive to maintain and upgrade the collections. The second also avoids any potential antitrust problems which might be perceived if the owning consortium did not include all firms in the business.

Different approaches need to be taken to privatizing each of the different elements of the Agricultural Research Service. However, there seems to be significant potential for privatization, and several alternative arrangements seem possible.

V. DEPARTMENT OF ENERGY[23]V. DEPARTMENT OF ENERGY

The origin of the Department of Energy was the Manhattan Project of World War II, to develop an atomic bomb. The Department still retains the mission to develop, test, and maintain the nation's nuclear weapons stockpile. In the postwar era, an additional mission was added: the peaceful uses of atomic energy. The 1973 oil embargo led to an expanded mission: responsibility for fossil fuels and utility distribution, as well as solar and geothermal energy. The several Department laboratories also have a mission in cleanup of nuclear waste.

[22] Some duplication is desirable, to protect against disasters which might wipe out an entire site.

[23] Except as otherwise stated, all information about the Department of Energy and its laboratories was obtained from various DoE sites on the World Wide Web.

A. BackgroundA. BACKGROUND

The Department has 30 laboratories, in addition to several production facilities. Of these 30 laboratories, 26 are so-called Government-owned, Contractor-Operated (GOCO) facilities. The various contractors include universities, non-profit organizations, and for-profit corporations. The remaining four are government-operated, staffed with Civil Service personnel.

As of FY 1994, the relative funding for the Department of Energy activities were as shown in the following table.

As noted by several studies of the Department's laboratories, most notably the recent Galvin Report, the individual laboratories do not have well-defined missions.[24] Hence the focus in what follows will be on laboratory capabilities and existing programs. Moreover, issues such as nuclear waste cleanup will not be considered, since these are really part of the cost of the nuclear weapons program and should remain the responsibility of the federal government.

B. Department Of Energy LaboratoriesB. DEPARTMENT OF ENERGY LABORATORIES

1. Lawrence Berkeley National Laboratory1. Lawrence Berkeley National Laboratory

Lawrence Berkeley Laboratory (LBNL) is located in Berkeley, California, and is operated by the University of California. LBNL has capabilities in a wide range of scientific disciplines.
Lawrence Berkeley has developed several projects alone or in conjunction with private industry that would be commercially viable. Projects range from an improved technique for underground drilling used to clean up toxic waste sites, an x-ray beamline to help them determine the cause of defects in solar cells, a technique for identifying those cells within living organisms that have reached old age, to the ability to clone genes involved in diabetes and obesity. LBNL also possesses a unique facility, the Advanced Light Source, that gives it a competitive advantage in certain fields.

2. Lawrence Livermore National Laboratory (LLNL)2. Lawrence Livermore National Laboratory (LLNL)

Lawrence Livermore was established in 1952, to extend the bomb-design capabilities of the then Atomic Energy Commission. It is located about an hour's drive from San Francisco, outside the town of Livermore. LLNL is also operated by the University of California. The stated mission of the Laboratory is "to apply science and technology in the national interest. LLNL's focus is on global security, global ecology, and bioscience."

Table 2. Relative Funding of DoE Activities

	$ Million	Percent of DoE
National Security	5,543.0	29.2
Energy-Related	3,504.4	18.5
Science & Technology	3,355.8	17.7
ERWM*	6,175.8	32.6
Total	18,955.1	100

ERWM = Environmental Restoration & Waste Management
Source: William C. Boesman, "The DOE Multiprogram Nuclear Weapons Laboratories," Congressional Research Service, November 7, 1994 (Hereafter Boesman, "Multiprogram"), p. CRS-10.

A major portion of LLNL's activities are devoted to National Security. The focus of LLNL's national security programs is "to reduce the global nuclear danger while maintaining a strong U.S. defense. LLNL's national security program has three strong elements: nonproliferation, stockpile stewardship, and inertial confinement fusion." An important part of the Laboratory's mission is to maintain the integrity of the U.S. nuclear weapons stockpile in the absence of testing.

LLNL has developed a wide variety of services in partnership with industry that it provides to outside clients. Examples include a technology which would permit early detection of metal corrosion in aircraft,[25] advanced

[24] "Alternative Futures for the Department of Energy National Laboratories," Task Force on Alternative Futures for the Department of Energy National Laboratories, February 1995 (hereafter "Galvin Report"), p. 23.

[25] Paul Proctor, "Industry Outlook," *Aviation Week & Space Technology*, July 7, 1995, p. 17.

fabrication processes such as precision machining and other near-net-shape processes that reduce the amount of waste generated, increase productivity, and reduce material and labor costs, and an extreme-ultraviolet projection lithography, which enables manufacturers to "write" very highly integrated circuits with feature sizes smaller than 0.25 micrometers. These products demonstrate that the capabilities of LLNL are useful to industry, and have the potential to bring in revenue.

3. Los Alamos National Laboratory (LANL)3. Los Alamos National Laboratory (LANL)

Los Alamos was established in 1943, as part of the Manhattan Project. It is located 35 miles northwest of Santa Fe, New Mexico, and is operated by the University of California.

Some recent projects conducted at LANL indicate the range of its capabilities, and the potential external demand for them. For example, LANL recently developed a light-weight armor for use in Air Force C-141 transport aircraft flying relief supplies into Bosnia. LANL was able to develop the armor and produce enough to outfit five C-141s within a few months.[26]

Other projects include a metallic membrane that allows hydrogen to pass through it, but does not allow other gases to penetrate,[27] a High-Density Read-Only Memory for digitized information which would permit storing 180 times as much information on a comparably sized disk as the conventional CD-ROM [28], and a directed laser fabrication process that does not require any molds, patterns, or dies to form dense, complex parts.These examples illustrate that LANL has the potential to bring in revenue from external customers who can benefit from its capabilities.

4. Oak Ridge National Laboratory
4. Oak Ridge National Laboratory

Oak Ridge National Laboratory (ORNL) is located 20 miles west of Knoxville, Tennessee. It is operated by Lockheed Martin Energy Systems, under contract to the Department of Energy.

ORNL has already completed projects for outside clients including a thin-film lithium battery with applications in small and light-weight devices,[29] a computerized command and control system for the Atlanta police force, for use during the 1996 Olympic Games, and in conjunction with 3M, has developed a ceramic filter which is sturdier and capable of operating at much higher temperatures than previously available filters. The filter received an R&D 100 Award in 1995 as being one of the year's most significant innovations. As these examples show, ORNL has the capability to provide valuable services to external clients, and has experience in working with industrial partners.

5. Sandia National Laboratory
5. Sandia National Laboratory

Sandia is located on Kirtland Air Force Base, near Albuquerque, New Mexico. It is operated by Lockheed-Martin.

Sandia is not limited to nuclear weapons work and can provide marketable services to private industry. Some recent projects include a "light induced voltage alteration" method for identifying defects in microchips,[30] a flashlight for use by aircraft inspectors which can identify defects under an evenly diffused beam better than is possible with conventional flashlights[31] and a computer program that generates a protein structure resembling the final folded shape of the synthesized protein.[32]

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[26] William B. Scott, "New Ceramic Armor Protects Crews on Peacekeeping Flights," *Aviation Week & Space Technology.*

[27] Paul Proctor, "Industry Outlook," *Aviation Week & Space Technology*, July 17, 1995, p. 17.

[28] "Technology Newsletter," *Electronic Design*, August 1995, p. 26.

[29] Paul Proctor, "Industry Outlook," *Aviation Week & Space Technology*, December 4, 1995, p. 13.

[30] "Technology Newsletter," *Electronic Design*, August 1995, p. 25.

[31] "Technology Newsletter," *Electronic Design*, August 1995, p. 26.

[32] "R&D Bulletin," *R&D Magazine*, November 1995, p. 13.

6. Continuous Electron Beam Accelerator Facility (CEBAF)

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The Continuous Electron Beam Accelerator Facility (CEBAF) is managed by the Southeastern Universities Research Association (SURA), Inc. for the U.S. Department of Energy (DoE). It is located near Norfolk, Virginia.

CEBAF's mission is to "provide…scientific facilities, opportunities, and leadership…for discovering the fundamental nature of nuclear matter, to partner with industry to apply its advanced technology, and to serve the nation and its communities through education and public outreach…"

While the primary focus of CEBAF is basic research, industrial application is also a consideration. As one example of technology transfer to industry, CEBAF's superconducting radio-frequency cavities were seen to have utility as a driver for high-power free-electron lasers (FELs) to provide tunable, monochromatic laser light for industrial processing applications. The Laser Processing Consortium was formed to take advantage of this new technology. Some members of the Consortium are DuPont, 3M, IBM, Xerox, AT&T, Newport News Shipbuilding, and Northrop-Grumman.

7. Idaho National Engineering Laboratory (INEL)

7. Idaho National Engineering Laboratory (INEL)

The Idaho National Engineering Laboratory was established in 1949 as the National Reactor Testing Station. The INEL contains the largest concentration of nuclear reactors in the world. Fifty-two reactors, most of them first-of-a-kind facilities, were built there. It is operated by Lockheed Martin Idaho Technologies Company.

The stated INEL mission is to be "the applied engineering, multi-purpose laboratory within the national laboratory system, supporting basic science and research and development laboratories."

The unique facilities at INEL will be important either for expansion of the nuclear power industry, or for decommissioning of nuclear power plants at the end of their operating lives. Thus, regardless of the future of the nuclear power industry in the United States, the capabilities of INEL will be needed.

C. Privatization PotentialC. PRIVATIZATION POTENTIAL

As noted in the descriptions of the individual laboratories, some important technological developments have been generated. However, the commercial potential of these laboratories should not be overestimated. As the Galvin Report observes,[33]

> *[T]he laboratories are not now, nor will they become, cornucopias of relevant technology for a broad range of industries. A significant fraction of the laboratories' industrial competitiveness activities concern technologies which are of less than primary importance to their industrial collaborators and/or which these partners could obtain from other sources. There are only a relatively few instances in which the laboratories have technology that is vital to industry and that is uniquely available at the laboratories. Many firms also find it attractive to collaborate with the laboratories because of the availability of Federal cost-sharing funds. In practice the government subsidy is often very substantial relative to the new resource commitments that the firms are making in these projects.*

This view of the laboratories' lack of competitiveness was echoed by Dr. Erich Bloch, former Director of the National Science Foundation: "Up until now the labs have not been very important to American competitiveness."[34]

Despite the shortcomings of the various laboratories with regard to industrial competitiveness, there is still considerable justification for attempting to privatize them. Any attempt to maintain them as federal laboratories,

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[33] Galvin Report, 45.

[34] Quoted in Richard Miniter, "From Weapons to Widgets," *The American Enterprise*, July/August 1995, p. 79.

while allowing them to turn their talents toward industrial technology, will run into severe problems. As the Galvin Report notes,[35]

> *We are also concerned that the expansion of the laboratories' roles in serving the technology needs of private enterprise will create additional managerial problems within DOE. For any organization to be effective, the activities it manages need to be associated with a coherent set of objectives. Otherwise, it is virtually impossible to allocate resources rationally, or to evaluate the various activities and programs in terms of how they contribute to the performance of the organization as a whole. This is amply borne out by experience in private enterprise which indicates that most conglomerates do badly, especially in managing technological innovation…We are concerned that "porkbarrel" criteria for program funding might increasingly replace more rational resource allocation, and that the laboratories might be more likely to propose industrial programs merely based on "make work" criteria.*

In addition to the concerns about management of a complex operation, and the possibilities for porkbarrel project selection, the Galvin Report had a much stronger comment to make.[36] "[O]ne critical finding is so much more fundamental than we anticipated that we could not in good conscience ignore it. The principle behind the finding is: Government ownership and operation of these laboratories does not work well." The report then goes on to enumerate the familiar litany of excessive oversight, micromanagement, duplicative management by Department of Energy field offices, too many review groups, and too great influence of outside advisory boards. Thus despite any shortcomings the Department of Energy laboratories may have in industrial competitiveness, to gain full benefit from their technological capabilities, they must be privatized, if only to get them out from under the bureaucracy which has grown up since 1945. As John T. Preston, Director of Technology Development at Massachusetts Institute of Technology has observed, "There is no issue that they [the labs] have the technical talent, but do they have the culture? The bureaucratic culture at Sandia and all the labs survives by being very risk averse, and that impedes commercialization."[37]

The Department itself seems to agree with this criticism: In an official publication, it observes that

> *The Department uses more resources and is less efficient than it should be due to excessive layers of management and duplicative work. Bureaucratic layers and organizational redundancies are the result of confusion over roles and responsibility, a lack of vigilance in eliminating duplicative work, and failure to eliminate non-value-added layers and processes.*[38]

Privatization thus seems to be the only option for salvaging the technical capabilities of the Department of Energy laboratories. Even Energy Secretary Hazel O'Leary has come to this same conclusion: "We need to discard old work and privatize, eliminate, or transfer functions that can be performed better elsewhere."[39] Moreover, there is even the question of whether the laboratories should be undertaking commercial activities. As the Galvin Report noted, "Development of technologies for which private sector companies are the major beneficiaries is not an appropriate mission for the national laboratories."[40]

The quality of some DoE laboratories is quite high. The "citation rate"[41] of DoE papers in physical sciences and engineering, and published from 1990 to 1994 by the 10 multipurpose DoE laboratories, was higher than the citation rate of papers in the same fields published by researchers at the top 110 research universities in the United States.

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35 Galvin Report, 48.

36 Galvin Report, 53.

37 Quoted in Richard Miniter, "From Weapons to Widgets," *The American Enterprise*, July/August 1995, p. 79.

38 Department of Energy, "Saving Dollars and Making Sense," May 1995, p.5.

39 Hazel O'Leary, Secretary of Energy, statement to House Commerce Committee Subcommittee on Energy and Power, June 21, 1995, p. 20.

40 Galvin Report, 7.

41 This is the frequency with which published scientific papers are "cited," or referred to, by subsequent authors. A citation is evidence that a subsequent author found the work in the cited paper to be useful, and the citation rate is considered to be a measure of the quality of a published paper.

The average DoE paper received 6.41 citations, compared with an average of 5.32 for university papers. These citation rates were 14 percent above the norm for DoE papers, and 7 percent above the norm for university papers.[42] Robert Cook-Deegan, who directed a study of government laboratories by the National Academy of Sciences, pointed out that the DoE multipurpose laboratories are run by contractors, and are therefore not subject to government personnel regulations, thus they would be expected to perform better than the typical government laboratory. This tends to lend support to the idea that under privatization, these laboratories would perform even better than they do now.

Thus both from the standpoint of effective utilization of the laboratories' capabilities, and of eliminating a subsidy to industry, privatization of the Department of Energy laboratories is both possible and necessary.

D. Privatization Options
D. PRIVATIZATION OPTIONS

Two important issues must be considered in any plan for privatizing the Department of Energy laboratories. The first is the need to maintain nuclear weapons capability. The second is environmental cleanup at the various sites dealing with nuclear weapons or nuclear energy.

1. Nuclear Weapons Capability1. Nuclear Weapons Capability

Even if the United States agrees to a complete ban on nuclear weapons testing, it will remain necessary to maintain a stockpile of weapons. There must be assurance that these weapons will not degrade, will not become dangerous as a result of deterioration, and will function as intended if they are ever needed. In addition, weapons design capability must be retained, both to design new weapons if the need arises, and to assure that nonproliferation efforts are based on an understanding of all the alternatives open to foreign weapons designers. Hence any privatization plan must allow for retention of weapons design, maintenance and testing capability.

One of the reasons for the establishment of the Atomic Energy Commission, which took over responsibility for all weapons and nuclear power efforts from the Army's Manhattan Engineering District after the end of World War II, was that the issue of atomic energy was "too big" to be left to the Army. In retrospect, this was unquestionably a wise decision. However, it is time to re-examine some aspects of that decision, particularly the issue of whether weapons design should be kept separate from the Department of Defense (DoD). The Defense Nuclear Agency of DoD coordinates nuclear weapons R&D and testing with DoE, and manages the DoD nuclear weapons stockpile. A RAND corporation report observed "it is unclear whether there remains any important, enduring interest served by keeping responsibility for the nuclear infrastructure split between DOD and DOE." The report went on to recommend:

> *Over the long term…consolidation within the DOD of all U.S. nuclear weapons-related activities should be seriously considered as a primary organizational option for a much smaller, but enduring and robust U.S. nuclear infrastructure for the 21st Century.*[43]

Hence, all nuclear weapons-related activities of the Department of Energy should be consolidated within the Department of Defense, under a civilian Undersecretary rather than within any of the military services. Privatization should then focus on the DoE activities related to energy and fundamental research.

2. Environmental Cleanup
2. Environmental Cleanup

One barrier to privatization of the Department of Energy labs has been the issue of liability for cleanup of nuclear wastes. This should be treated as part of the cost of the nuclear weapons program, so that liability should remain with the Federal government. This would follow the pattern of the United States Enrichment Corporation, which produces enriched uranium for nuclear reactors. This was formed into a government corporation, initially owned by the

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[42] "Academia vs. DOE Labs: Who Does Better Research?" *Science*, February 2, 1996, vol. 271, p. 585.

[43] Richard O. Hundley, *An Assessment of Defense Nuclear Agency Functions: Pathways Toward a New Nuclear Infrastructure for the Nation*, Santa Monica, CA, National Defense Research Institute (RAND Corp.), June 1994, p. 97, 99. Quoted in Boesman, "Multiprogram," p. CRS-24

Department of the Treasury, but scheduled for privatization in 1996. Liability for all nuclear wastes generated before July 1, 1993, the date of formation of the corporation, remains with the Department of Energy.[44] Hence, the first step toward privatization should be a declaration that future private owners of DoE facilities will not be responsible for cleanup of any waste generated before they acquire the facilities. Even in the case of contractors now operating government-owned facilities, the same should apply. Wastes generated before they take ownership should remain the responsibility of the federal government.

3. Privatizing "the Rest" of DoE

3. Privatizing theRest of DoE

Once issues of weapons design and liability for cleanup are resolved, attention can be focused on privatizing the remainder of DoE.

A) Single-Purpose Laboratories

DoE has a number of single-purpose laboratories, such as the Stanford Linear Accelerator Center, and the Continuous Electron Beam Accelerator Facility. For the most part, these laboratories exist to operate a specific piece of equipment or a collection of related facilities. If the purpose for which these laboratories were established is no longer required, the laboratories themselves should be terminated. If the purpose is still valid, privatization should be the first option, with contract management as the second option, if privatization is not feasible. Consideration should be given to privatizing them completely, through sale to the current contractor or to the highest bidder. If there is not a sufficient market to sustain the use of the laboratories' specialized equipment, including not only industry funding but research grants, termination would be warranted.

B) Multiprogram Research Laboratories

The multiprogram laboratories, such as Oak Ridge and Lawrence Berkeley, and the research laboratories, such as the Environmental Measurements Laboratory, support multiple purposes. Once the functions directly related to nuclear weapons design, testing and maintenance have been removed from these laboratories, privatization should be considered for the remainder.

The strengths of these laboratories are not particular pieces of equipment, but the expertise of their staffs. This expertise is often of the highest caliber, attracting industry clients. However, none of these capabilities represent the whole answer to any technical or commercial problem. When the laboratories work with a commercial client, their effort is one piece of a larger problem, with the remainder of the problem being solved elsewhere by the client.[45]

Moreover, there does not appear to be any "synergy" among different elements of the laboratories. Each small unit within the laboratory utilizes its specialized expertise to solve a specific problem. That is, the laboratories represent collections of specialized units which may originally have been established to support one of the major functions of the laboratory, but which are capable of existing independently.

One direct approach to privatization, then, is to privatize these individual units, rather than trying to find a buyer for the laboratory as a whole. The individual scientists in a unit might be encouraged to "set up shop" for themselves, as a private firm. They might even be permitted to purchase the equipment they have been using, at the equivalent of scrap prices.

Some of these laboratories, such as the Laboratory of Biomedical & Environmental Sciences, already receive half their support from outside sources. Such laboratories should be able to retain their existing customers if they were privatized, and would be able to seek out other customers which they cannot now serve. Putting such laboratories on the same course successfully demonstrated by the British would be an approach to privatization. The laboratory might be sold to a commercial concern, or the researchers might be permitted to undertake an employee buyout.

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[44] Richard Minter, "From Weapons to Widgets," *The American Enterprise*, July/August 1995, p. 80

[45] Recall that the activities listed above in this report were selected by the laboratories themselves, as the best examples to showcase their capabilities.

Once the issues of weapons development and cleanup liability are resolved, then, privatization can be undertaken on the basis of the specialized skills of the laboratory staffs. In some cases, entire laboratories may have commercial potential. In other cases, individual elements within the laboratories may be commercially viable, on the basis of specialized expertise.

As the Galvin Report noted, the laboratories today are not very competitive. Industry is attracted to them at least as much because of their subsidized nature as because of their expertise. Hence privatization must be undertaken through a phased plan such as that used in Britain. Year by year, the laboratories must move steadily toward full cost recovery, reduced cost of operation, and greater customer satisfaction. This will be true regardless of the actual privatization option chosen.

VI. U.S. GEOLOGICAL SURVEY[46]VI. U.S. GEOLOGICAL SURVEY

A. BackgroundA. BACKGROUND

The U.S. Geological Survey was established in 1879. Its original mission was classification of the public lands, and examination of the geological structure, mineral resources, and products of the national domain. That is, the U.S. Geological Survey was originally intended to cover the public lands of the United States. Since then, its mission has grown to cover the entire nation, the surrounding oceans, and other planets. Its mission is to collect, analyze, and disseminate the scientific information needed to answer the following questions :

> *As a Nation we face serious questions concerning our global environment. How can we ensure an adequate supply of critical water, energy, and mineral resources in the future? In what ways are we irreversibly altering our natural environment when we use these resources? How has the global environment changed over geologic time, and what can the past tell us about the future? Will we have adequate supplies of quality water available for national needs? How can we predict, prevent, and mitigate the effects of natural hazards?*

USGS Headquarters is in Reston, Virginia. However, its most important activities are located at field sites throughout the nation. USGS carries out a wide variety of programs, all related in some way to earth sciences and mapping.

In support of the U.S. Geological Survey's (USGS) mission to provide information about the Earth and its physical resources, the National Mapping Program (NMP) provides geographic, cartographic, and remote sensing information, maps, and technical assistance, and conducts related research responsive to national needs.

B. U.S.G.S. Field SitesB. U.S.G.S. FIELD SITES

The actual research for the various U.S.G.S. programs is for the most part carried out at field sites. Some of the most important sites are the following. The actual research for the various U.S.G.S. programs is for the most part carried out at field sites. Some of the most important sites are the following.

- **The Flagstaff Field Center** was established in 1963 to provide geologic information about the Moon and to help train astronauts scheduled for flights to the Moon. Planetary geology continues as the principal research effort at the Flagstaff Field Center.
- **The Center For Environmental Geochemistry And Geophysics** identifies and characterizes the natural environmental hazards caused by geologic sources, identifies, characterizes, and evaluates the environmental effects from historic mining activities or from the development of new mineral resources and characterizes and assists mitigation of human-induced contamination.

[46] Unless otherwise noted, the information presented here was obtained from the USGS site on the World Wide Web.

- **Earthquake Information Center** determines the location and size of all destructive earthquakes that occur worldwide and disseminates this information immediately to concerned national and international agencies, scientists, and the general public, collects and provides to scientists and to the public an extensive seismic database and pursues an active research program to improve its ability to locate earthquakes and to understand the earthquake mechanism.
- **Mid-Continent Mapping Center** (MCMC) is one of several mapping centers in the National Mapping Division of the U.S. Geological Survey. It is one of the sources of Digital Raster Graphic maps of the United States.
- **National Landslide Information Center** is dedicated to collection and distribution of all forms of information related to landslides.**National Landslide Information Center** is dedicated to collection and distribution of all forms of information related to landslides.

C. New ResponsibilitiesC. NEW RESPONSIBILITIES

As part of the current program to eliminate government agencies, the Survey has actually received increased responsibilities. The National Biological Service will be transferred to the U.S.G.S., as will the Minerals Information Center of the Bureau of Mines.[47] At this writing it is not certain how many people will be acquired by the Geological Survey, nor what services of the acquired elements will continue to be provided. However, the two acquisitions seem to fit well with the range of activities already conducted by the Geological Survey.

D. Products AvailableD. PRODUCTS AVAILABLE

Some of the products available from the USGS are listed here, to illustrate the commercial potential of the data collected by the USGS, and the research conducted by the USGS.

- USGS 1:2,000,000 Digital Line Graph Data are now available on compact disc-read only memory (CD-ROM). For each State, the following six or seven categories of data are offered: boundaries, hydrography, roads and trails, railroads, miscellaneous transportation, manmade features and U.S. Public Lands Survey System.
- Arctic Environmental Data Directory is maintained by the U.S. Geological Survey. The AEDD contains descriptions of data on global change studies, environmental interactions, earth sciences, social sciences, and policy and management.
- Digital Raster Graphics (DRG) is a raster image of a published map. The DRGs will be sold on CD-ROMs.
- The U.S. Geological Survey Photographic Library is a collection of about 300,000 photographs taken during geologic studies of the United States and its Territories from 1869 to the present. All photographs are in the public domain.
- Software—the USGS maintains a library of scientific and other applications software developed by or for the Bureau to support its programs and activities, including cartography, map production, and mapping products access. Certain software programs and related documentation files have been placed in on-line libraries and may be downloaded by the public at no cost. These, and additional programs and documentation, may also be obtained in "softcopy" form (on tape or diskette) through any Earth Science Information Center.
- Ground Water Atlases—the USGS monitors the quantity and quality of the nation's water resources at more than 45,000 sites across the nation. The information obtained from this monitoring is combined with geological data and published in ground water atlases. The atlases includes information on current and historical ground-water conditions as well as the quantity and chemical quality of water pumped from each principal aquifer in the five states.

[47] "Geological Survey Gains From Demise of 2 Agencies," *Science & Government Report*, Vol. XXVI, no. 3, February 15, 1996, p. 1.

- Earthquake Data is available from the National Earthquake Information Center. The information is available on CD-ROMs, maps, periodicals, and on-line data bases.
- Landslide Data are maintained by the Survey. These include maps, reports, and photographic materials. In addition, the Survey keeps a file of worldwide news reports on landslides, and copies of legislation, ordinances, and codes regarding landslides. An inventory of names, addresses, and phone numbers of landslide researchers worldwide is also available.

E. Privatization PotentialE. PRIVATIZATION POTENTIAL

The data compiled and published by the USGS are widely used by government and industry. As just one example, the petroleum industry depends heavily upon estimates of the oil to be found beneath the Arctic National Wildlife Refuge (ANWR). The estimates prepared by the USGS will be influential in determining whether Congress opens ANWR to oil drilling.[48] In effect, USGS is sitting on a gold mine of data about the continental United States.

The various products listed above are in demand by federal agencies, local and state governments, developers, natural resource industries, and other customers. Currently, much of the data can be downloaded at no cost, or is sold at the cost of printing a map or creating a CD-ROM. If these customers were charged the cost of producing the data, USGS would be self-supporting. Moreover, if USGS were privatized, it could seek out additional customers, develop additional products for which there is a market demand, and could operate more efficiently.

Any privatization plan must take into account the heavy dependence of USGS on basic research. USGS gathers and manipulates data, but at least as important as the data-gathering function is the development of improved instrumentation and software. In addition, USGS must often collect data in advance of any apparent need for it. Just as one example, a USGS researcher conducting research on heat flow in the earth's crust, with no immediate application intended, realized that the initial plans to bury the Alaska Pipeline under the surface would result in melting the permafrost. By presenting his data, he was able to demonstrate the need to elevate the pipeline above the surface.[49] This basic research would be crucial to the continued viability of a privatized USGS. Thus any privatization plan must allow for continued basic research.

F. Privatization OptionsF. PRIVATIZATION OPTIONS

The wide diversity of customers who seek USGS products precludes privatizing by forming any type of consortium among data users. The two most attractive possibilities are sale to an entity which will market the data, and an employee buyout. Sale to a private entity would allow operation in the same manner as the private firms which sell data from the Landsat earth-observing satellites. The major difference would be that the privatized USGS would gather the data as well as package it for sale. An employee buyout would serve the same purpose, but would have the additional advantage that the employee-owned firm would have a strong incentive to continue the basic research needed for future viability of the organization.

One possible exception to privatizing is the Flagstaff center which is heavily involved in planetary and lunar science. It might be best to transfer this organization to NASA, since at the present there are few if any private customers for its products.

VII. NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY[50]VII. NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY

[48] Allanna Sullivan, "Alaska Refuge Oil-Reserve Estimates Are Slashed," *The Wall Street Journal*, August 7, 1995, p. A3.

[49] Richard A. Kerr, "Downsizing Squeezes Basic Research at the USGS," *Science*, vol. 268, p. 1840, June 30, 1995.

[50] Unless otherwise stated, the information presented below was obtained from the NIST site on the World Wide Web.

A. BackgroundA. BACKGROUND

The National Institute Of Standards & Technology has its headquarters at Gaithersburg, Maryland with an additional site at Boulder, Colorado. The current NIST grew out of the former National Bureau of Standards (NBS). The NBS was established to bring about a set of uniform standards of weights and measures throughout the nation. Since establishment of the NBS, U.S. industry now has accessible to it one of the most rigorously maintained systems of national standards in the world.

In 1988 the Omnibus Trade and Competitiveness Act established the National Institute of Standards and Technology, expanding the mission beyond the provision of standards. The current mission of NIST is "to assist industry in the development of technology...needed to improve product quality, to modernize manufacturing processes, to ensure product reliability...and to facilitate rapid commercialization...of products based on new scientific discoveries."

NIST carries out this mission through four programs:

- An Advanced Technology Program providing cost-shared grants to industry for development of high-risk technologies with significant commercial potential;
- a grassroots Manufacturing Extension Partnership helping small and medium-sized companies adopt new technologies;
- a laboratory effort planned and implemented in cooperation with industry and focused on measurements, standards, evaluated data, and test methods; and
- a quality outreach program associated with the Malcolm Baldrige National Quality Award.

Only the measurements and standards program came from the original NBS. The remainder were added as part of the "competitiveness" emphasis.

B. NIST ProgramsB. NIST PROGRAMS

The FY 94 budget for NIST was $609 million, including revenue from all sources. Staff includes 3200 scientists, engineers, technicians and support personnel, as well as 1200 visiting researchers annually. The F 95 budget for NIST was $854 million.[51] NIST's budget and staff are thus well within the size range of American industrial laboratories.

1. Standards Activities1. Standards Activities

This is still the core function of NIST, employing the majority of NIST's funding, staff, and facilities. Some of the major activities include:

- **Chemical Science and Technology Laboratory** performs basic research in measurement science develops and maintains measurement methods, standards, and reference data, and develops models for chemical, biochemical, and physical properties and processes.
- **Computing and Applied Mathematics Laboratory** conducts research, collaborates with, and provides support to all Institute activities and to other federal agencies in selected fields of the mathematical and computer sciences important in science and engineering.
- **Electronics & Electrical Engineering Laboratory** provides the basis for all electrical measurements in the United States including practical measurements for the electronics and electrical industry sectors, advertised calibration services and artifact standards (Standard Reference Materials) and research to advance the future of electrical measurement.
- **NIST Measurement Services** provide standard services such as calibration, standard reference data, standard reference materials and standard weights and measures to external customers.

[51] Andrew Lawler, "Science at Risk in Commerce Breakup," *Science*, vol. 269, September 22, 1995, p. 1664.

- **Manufacturing Engineering Laboratory** helps U.S. industry turn technological opportunity into competitive advantage. MEL works with the nation's diverse manufacturing sector to develop and apply technology, measurements, and standards.
- **Physics Laboratory** supports United States industry by providing measurement services and research for electronic, optical and radiation technologies.

The standards activities of NIST are focused primarily on meeting the measurement and standardization needs of industry, with federal, state and local governments also being important customers. NIST supplies reference standards, reference materials, and tables and handbooks to users.

2. Manufacturing Extension Partnership[52]2. Manufacturing Extension Partnership

The Manufacturing Extension Partnership was established in 1988 to assist small and medium-sized businesses. These businesses make up over 98 percent of all U.S. manufacturing establishments, but according to the National Research Council, lack the expertise and information to upgrade their capabilities in order to remain competitive.[53] The MEP was established to provide federal assistance to these firms. Funding for the MEP started at $6.1 million (1994 dollars) in 1988, jumped to $66 million in 1993, and jumped again to $138 million (1995 dollars) in 1995.

Only an estimated seven percent of all eligible U.S. manufacturing firms have made use of MEP.[54] A sample of MEP users interviewed by the Government Accounting Office (GAO) found that in terms of "output" measures (sales, profits, or customer satisfaction), about 50 percent to 60 percent reported a favorable impact. A comparable survey of nonusers found that these firms obtained services equivalent to MEP primarily from vendors & suppliers, consultants, and trade or professional associations. MEP is thus not only a subsidy to a small segment of industry, but is in direct competition with private firms and organizations which sell advice which is judged by the users to be worth more than it costs, and with suppliers and vendors who supply it free. Thus providing this service is not an appropriate activity for government.

3. Advanced Technology Program3. Advanced Technology Program

This program supports R&D in industry. Individual firms may submit proposals for R&D projects in response to formal competitions announced in the *Commerce Business Daily*. The competitions are in areas selected to be of great importance to national competitiveness.

For 1995, proposals were solicited in the following areas:

- Advanced Vapor Compression Refrigeration Systems
- Catalysis & Biocatalysis Technologies
- Component-Based Software
- Digital Data Storage
- Digital Video in Information Networks
- Information Infrastructure for Healthcare
- Manufacturing Composite Structures
- Materials Processing for Heavy Manufacturing
- Motor Vehicle Manufacturing Technology
- Technology for the Integration of Manufacturing Applications

Two 1995 awards were received by firms in Ohio, as reported in local newspapers. These are presumably typical of awards nationwide, and illustrate the problematic nature of the program.

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[52] The information in this section was obtained from: United States General Accounting Office, "Manufacturing Extension Programs: Manufacturers Views of Services," GAO/GGD-95-216BR, August 1995, hereafter GAO216.

[53] GAO216 p. 3.

[54] GAO216, p. 9.

One award was made to the Copeland Company, of Sidney, Ohio, for further research on scroll compressors.[55] Copeland will receive $1.95 million to complement $1.072 million of the firm's own funds. Copeland was a pioneer in scroll compressor technology, and is known world-wide for its successful development of this technology. The ATP award is to complete development on a co-rotating scroll compressor which Copeland has already patented. The project is intended to permit Copeland to retain its lead over Japanese competitors.

Another award was made to Applied Sciences, Inc., of Cedarville, Ohio, for development of a manufacturing process to incorporate carbon fibers into plastic automobile components.[56] ASI will receive $2.3 million, to develop an efficient process for producing vapor-grown carbon fibers. ASI and four other firms will put an additional $2.8 million into the project. ASI already holds 10 patents on a proprietary process for producing carbon fibers. The award will be used to "fine tune" the process.

These two awards raise several questions. Why should the taxpayers be funding a firm which is already a leader in a particular technology, when it is in the interest of that firm to maintain its lead, and it already plans to spend money to that end? Why should the firms and individuals in the rest of the U.S. be taxed to strengthen the automotive components industry in Ohio, and to maintain the jobs of coal miners in a region of poor quality coal?

"Industrial policy" programs such as the Advanced Technology Program are often criticized as attempts to "pick winners" in advance of a market decision. However, it appears that the ATP program is not so much in the business of "picking winners" as in "picking nonlosers." The two projects described above, which received awards, were extensions of work already partially successful, and protected by patents. Risk of failure is low, because the market has already "spoken" in favor of these technologies. In effect, taxpayers' money is being invested in projects to which private firms had already made commitments. This is the proper role of venture capitalists, not of taxpayers.

4. Malcolm Baldrige Quality Award4. Malcolm Baldrige Quality Award

Public Law 100-107, the Malcolm Baldrige National Quality Improvement Act of 1987 established an annual U.S. National Quality Award. The purposes of the Award are to promote awareness of quality excellence, to recognize quality achievements of U.S. companies, and to publicize successful quality strategies. The Secretary of Commerce and the National Institute of Standards and Technology were given responsibilities to develop and administer the Award with cooperation and financial support from the private sector.

Businesses located in the United States may apply for Awards. Each written application is evaluated by members of the Board of Examiners. High-scoring applicants are selected for site visits by a Panel of Judges who recommend Award recipients to the Secretary of Commerce from among the applicants site visited. The Board of Examiners is comprised of quality experts selected from industry, professional and trade organizations, universities, government agencies, education and health care organizations, and from the ranks of the retired.

Past Baldrige Award winners include Motorola, Inc., Commercial Nuclear Fuel Division of Westinghouse Electric Corporation, Cadillac Motor Car Division, Federal Express Corporation, The Ritz-Carlton Hotel Company, and Corning Incorporated Telecommunications Products Division.

5. Facilities5. Facilities

The facilities listed here are those associated with the standards activities of NIST. The other NIST programs do not involve facilities other than office space. This is a partial list of facilities, emphasizing the major items.

- Cryogenic Materials Laboratory
- Low-Background Infrared Radiation Facility
- Medical-Industrial Radiation Facility
- Metals Processing Laboratory
- Neutron Interferometer And Optics Facility

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[55] "Copeland gets federal funds for further scroll research," *Sidney Daily News,* August 19, 1995, p. 10A.

[56] Gene Fox, "Fiber Research Begins," *Dayton Business Reporter*, November 1995, p. 1.

- Polymer Composite Fabrication Facility
- Powder Characterization And Processing Laboratory
- Radiopharmaceutical Standardization Laboratory
- Synchrotron Ultraviolet Radiation Facility
- High-Resolution Ultraviolet (UV) And Optical Spectroscopy Facility

The major facilities listed here, as well as numerous minor facilities at NIST, are for the most part unique in the United States, and many are unique world-wide. Their primary function is to provide measurements and standards for industry and government. Some are available to industry and government users. Others are utilized by NIST staff to measure or calibrate samples or devices supplied by customers.

While the scientific facilities at NIST contain for the most part world-class equipment, the NIST infrastructure is seriously deficient. Most of NIST's buildings and support facilities were built between 25 and 40 years ago. This has led to two types of problems. The first problem is obsolescence of much of the support infrastructure, such as power supplies and environmental control systems such as heating and cooling, vibration isolation, ventilation, and dust filtration. The lack of predictable and stable conditions hinders accurate measurements. The second problem is a degraded level of safety.

> *Smoke detection and sprinkler systems are lacking, serious structural deterioration in building foundations must be repaired, exhaust systems for chemical fumes fail to meet modern standards…The Boulder site…has overloaded power lines that are put out of service regularly by high winds and underground water pipes so clogged with rust that water pressure at hydrants is currently less than 40 percent of fire code requirements.* [57]

Upgrading NIST to current standards of safety and predictability will require a significant investment. An outside firm estimated that to bring NIST's infrastructure up to the required safety and operational standards would require an investment of $1.2 billion.

C. Privatization PotentialC. PRIVATIZATION POTENTIAL

Each of the four NIST programs must be considered separately from the standpoint of privatization potential.

1. Standards Activities1. Standards Activities

NIST establishes standards, provides calibration and reference services, and devises measuring instruments, which are widely used in industry and government. Most of these services are provided at no cost, or at nominal cost to the user. However, their value to the user is quite high. This indicates that NIST's standards activities could readily be sold at a price which would cover the cost of production. The services and data are valuable enough that they could even be sold at a premium, to cover the cost of basic research needed to develop further standards, references, and measuring instruments. The standards activities of NIST, then, appear to have great potential for privatization.

The progress of Britain's National Physical Laboratory, and the Laboratory of the Government Chemist, towards self-support and privatization clearly indicate that privatization of NIST's standardization activities is feasible.

2. Manufacturing Extension Partnership2. Manufacturing Extension Partnership

As noted above, this program competes with private consultants, and is therefore not appropriate for government activity. Moreover, the technical assistance provided through MEP is often provided, on a much larger scale by vendors and suppliers, at no charge to the user. There is therefore no justification for government subsidy to a small fraction of potential users.

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[57] The information in this section is taken from "Report on the Facilities of the National Institute of Standards and Technology," U.S. Department of Commerce, 1992.

3. Advanced Technology Program3. Advanced Technology Program

As noted above, the Advanced Technology Program essentially puts the government in the role of venture capitalist. The government is making investments on behalf of the taxpayers, which the taxpayers have not chosen to make on their own. Moreover, any financial returns from the investment go directly to the firms receiving the ATP grants, not to the "investors." This is not a proper role for government.

4. Malcolm Baldrige Quality Award4. Malcolm Baldrige Quality Award

There appears to be no good reason why this program needs to be conducted by the federal government. To the extent that the program has merit, it could equally well be conducted by a private institute or a professional society. This is especially true since the bulk of the expertise comes from the private sector.

D. Privatization OptionsD. PRIVATIZATION OPTIONS

1. Standards Activities1. Standards Activities

The best option for privatizing NIST's standards activity appears to be sale to a contractor who will operate the facility, provide services to industry and government at a price which covers capital and operating costs, and conduct the necessary research to keep the enterprise viable. As noted above, Britain has completely privatized part of its standards activity. It has contractorized another part of its standards activity, although retaining government ownership. However, the contractor has an option to buy the activity at the end of the contract. Hence the British experience indicates that privatization through sale to a private firm is feasible.

An employee buyout is also a possibility, turning NIST into an employee-owned enterprise. However, the size of investment needed to restore the physical facilities and infrastructure to satisfactory levels would seem to preclude this option. An employee-owned corporation would find itself starting out under an enormous burden of debt.

2. Manufacturing Extension Partnership and Advanced Technology Program2. Manufacturing Extension Partnership and Advanced technology Program

This program should be terminated.

3. Malcolm Baldrige Quality Award3. Malcolm Baldrige Quality Award

This program should be privatized by turning it over to a professional society such as the American Society for Quality Control, or by establishing a nonprofit Institute similar to any of several private foundations which make awards for public service, heroism, or other noteworthy actions.

VIII. ESTABLISHING THE SALE PRICE VIII. ESTABLISHING THE SALE PRICE

One of the benefits of privatizing the various laboratories is revenue to the government. In some cases, the laboratories can be sold for significant amounts, providing funds which might be applied to the national debt. In other cases, it might be necessary to pay someone to take over a specific laboratory. Even in that case, privatizing the laboratory means that it will no longer require further funding. Annual expenditures will be reduced by the amount of the laboratory's budget. Because the prospect of revenue from sale of the laboratories can be an incentive to proceed with privatization, an attempt will be made here to estimate the potential revenues from privatization.

In principle, the selling price of a laboratory should be related to the Net Present Value of the stream of revenues and costs which will be incurred by the laboratory. Unfortunately, there is no good way to estimate that. As a proxy for this NPV of the stream of revenues less costs, an attempt will be made to estimate replacement value of the laboratories. There are two reasons for this. First, if the laboratories are sold for significantly less than replacement cost, the sale is subject to the "populist" objection that "they're giving away the labs!" Second, if the NPV of the net revenue stream for a laboratory is significantly less than replacement cost, this means that some of the laboratory's capital equipment must either be mothballed or scrapped when it is worn out. It may very well be the case that some capital equipment in the laboratories cost more than can be justified on the basis of the net revenue it can generate. However, that can only be determined by actual sale in a real market. This cannot be determined *a priori*. Hence replacement cost may be an overestimate of the potential sale price.

On the other hand, one of the assets of the laboratories is the skills and institutional memory of their staffs. It is always hard to put a price on these assets. The replacement cost of a laboratory might be an underestimate of its true market value, since it omits the value of the staffs.

Unfortunately, replacement cost estimates are available for only two of the laboratories considered here. The only basis for estimating replacement costs for the rest of the laboratories is their staffs, on the assumption that an average capital investment per staff member can be estimated.

Typical laboratory construction costs for physical science and engineering laboratories are $392 per square foot.[58] Assuming 150 square feet per staff member, building cost can be estimated as $58,800 per staff member. This is an underestimate, since it does not include cost of research equipment, computers, etc., but only buildings and infrastructure.

In American manufacturing industry, the capital investment per worker averages $110,000, including buildings, tools, and production machinery. Capital investment per staff member in a heavily capital-intensive laboratory would be higher than this. For the two NASA laboratories for which investment data are available, capital investment is about $650,000 per staff member.

These numbers provide a wide range of variation. However, they probably bracket the true replacement costs for the laboratories under consideration.

It might be objected that basing estimates of replacement costs on staff size are inflated because federal laboratories are overstaffed by comparison with industry. Thus a comparison with an industrial laboratory is appropriate. Bellcore, the Bell companies' research arm, has revenues of $163,000 per staff member. The budgets for the various laboratories analyzed above range from a low of $75,000 per staff member at the U.S. Geological Survey to a high of $325,000 per staff member at NASA Lewis Research Center. These numbers are not grossly out of line with those of an industrial research laboratory which recovers all of its costs from sale of R&D services. Hence it does not appear that these laboratories are seriously overstaffed.

To obtain a first estimate of sale value, then, those laboratories which are capital-intensive will be evaluated at $500,000 per staff member. Those which do not require a great deal of equipment for the conduct of research will be evaluated at $75,000 per staff members. Using these planning factors, then, the estimated sale prices of the laboratories are as follows.

A. National Aeronautics & Space AdministrationA. NATIONAL AERONAUTICS & SPACE ADMINISTRATION

These laboratories are valued at $500,000 per staff member. Based on Table 3, the estimated total value is $5.65 billion.

[58] National Science Board, *Science & Engineering Indicators - 1993*, Washington, D.C.: U.S. Government Printing Office, 1993. (NSB 93-1), p. 402.

Table 3- NASA Labs Valuation Estimate		
Center	Staff	Value ($B)
Langley	2,500	1.25
Ames	1,600	0.80
Lewis	2,600	1.30
Dryden	460	2.30
Total	7,160	5.65

valued at $75,000 per staff member. Based on a staff of 7900, the estimated value is $3.95 billion.

B. Department Of AgricultureB. DEPARTMENT OF AGRICULTURE

The Agricultural Research Service laboratories are

Table 4— DoE Labs Valuation Estimate			
Laboratory	Staff	% Privatization	Value ($B)
Bio/Env	183	100	.09
Berkely	2,000	81	.81
Livermore	7,330	19	.70
Los Alamos	7,000	20	.70
Oak Ridge	5,000	88	2.20
Sandia	8,500	13	.55
INEL	8,700	24	1.04
Total	38,713	--	6.09

C. Department Of EnergyC. DEPARTMENT OF ENERGY

As noted above, the national security portions of the DoE laboratories should be treated separately. Only, the remainder of the laboratories, after national security elements are subtracted, should be considered for privatization. Estimates of the non-national-security portions of the laboratories can be obtained from a recent DoE publication which shows , for each laboratory, expenditures for national security, environmental quality, energy resources, and science and technology.[59]

These laboratories are valued at $500,000 per staff member (see Table 4 below).

Hence, the total for seven labs is $6.1 billion.

D. U.S. Geological SurveyD. U.S. GEOLOGICAL SURVEY

These laboratories are valued at $75,000 per staff member. With 10,000 staff, their estimated value would be $750 million.

E. National Institute Of Standards & TechnologyE. NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY

These laboratories are valued at $500,000 per staff member. Bases on 3,300 staff, their value would be $1.65 billion. However, subtracting the needed $1.2 billion worth of required infrastructure upgrading leaves a net value of $450 million.

* * *

With the exception of NIST, it appears that significant returns might be obtained from sale of these laboratories. Moreover, sale of the laboratories means not only a one-time revenue increment; it also means that they are removed from the annual budget. From the time they are privatized, the only further government expenditures required will be the direct costs of R&D purchased from these laboratories by the government.

[59] "Draft Strategic Laboratory Missions Plan." March 1996, from laboratory Operations Board, U.S. Department of Energy, 1000 Independence Avenue., Washington D.C. 20585 (2 volumes).

IX. OBSTACLES TO PRIVATIZATIONIX. OBSTACLES TO PRIVATIZATION

Despite the possibilities for privatization discussed above, the road to privatization will not be easy. Since each of the laboratories represents a subsidy to some sector of the economy, it can be expected that the beneficiaries of that subsidy will object to privatization. In addition, members of Congress will be reluctant to see these laboratories privatized. This includes both those in whose district a laboratory falls and those who serve on the committees which have jurisdiction over the laboratories. Privatization means that these people will lose some degree of power or ability to "bring home the bacon" to their districts. Finally, senior administrators in the various laboratories, who have made their entire careers in the civil service, may be reluctant to trade their seniority and security for the risks (and rewards) of the marketplace. Any strategy for privatization must consider how these obstacles can be overcome.

A. National Aeronautics & Space AdministrationA. NATIONAL AERONAUTICS & SPACE ADMINISTRATION

The primary beneficiaries of the NASA aeronautical laboratories are the major engine and airframe manufacturers, the Federal Aviation Administration (FAA), and the military services. The work of the laboratories is a direct subsidy to these firms and agencies. These may seem like serious opponents to privatization, but their opposition can be minimized if handled properly.

The FAA and the military services receive the services of NASA "free," but from the standpoint of the federal government, this is simply a bookkeeping exercise. If the funds currently appropriated to NASA for R&D in support of the FAA and Department of Defense were instead added directly to the budgets for those agencies, the R&D could still be purchased directly. Moreover, since the agencies would then be spending "their own money," they would be more careful to assure that the R&D represented the most productive use of their budget. In addition, they would obtain more control over the R&D done on their behalf, since they would then be a paying customer, not just another government agency.

The R&D which NASA performs for the aeronautical industry can be divided into two parts: that done in support of government contracts held by airframe or engine firms (e.g., wind tunnel work for a new military aircraft), and that done in support of commercial projects undertaken by the firms. After the labs were privatized, the R&D conducted for a government contract would be a legitimate charge to that contract. Thus the airframe or engine contractor would be reimbursed under the contract for any R&D purchased from the privatized labs. However, R&D purchased from the privatized labs for a new commercial aircraft or engine would be an increased cost to the firm sponsoring the work. This might lead these firms to oppose privatization. To overcome this, two approaches can be taken. First, it can be emphasized that once the firms are paying for their own R&D, they will have more control over it. Indeed, they can keep confidential the results which they have paid for. These results would no longer be available to the entire industry (including their competitors) but only to the firm(s) paying for them. Second, there are important segments of the aviation industry (general aviation, agricultural and fire-fighting aircraft) which currently receive little or no support from NASA. These segments of the aviation industry might be persuaded to support privatization. Once NASA aeronautical R&D is privatized, the NASA laboratories will have a strong incentive to seek out work from these other segments of the aviation industry.

B. Department Of AgricultureB. DEPARTMENT OF AGRICULTURE

The Department of Agriculture laboratories may be the most difficult of all to privatize, from the standpoint that they have a long history of being involved in porkbarrel politics. Members of Congress have long viewed the laboratories in their districts or states as something to be protected and to point to as benefits from Washington. Since there is at least one laboratory in each state, this can be a serious obstacle.

On the other hand, the beneficiaries of the subsidy provided by these laboratories are dispersed. This fragmentation of agriculture is in fact one of the reasons offered as to why the government must conduct agricultural research. However, as pointed out above, the problems of fragmentation can be overcome. The steady progress of the equivalent laboratory in Britain shows that privatization is possible.

The approach to members of Congress should emphasize that once the laboratories in their districts are privatized, they can be run more efficiently and can seek out additional customers. They can become profitable enterprises, and their employment may even increase as additional customers are found.

The approach to the users should emphasize that with privatization, the laboratories will be run more efficiently, and will be more responsive to the needs of the users.

C. Department Of EnergyC. DEPARTMENT OF ENERGY

The Department of Energy laboratories support a great many different industries, including construction, biomedical, and aviation, as well as energy. Each of these industries is substantial, and might be expected to oppose privatization. To minimize their opposition, proponents of privatization can emphasize that once these beneficiaries are paying for the R&D they now receive "free," they will have more control over the nature and direction of that R&D.

Another source of significant opposition will be the senior administrators who are currently micromanaging the laboratories from Washington and the various field offices. Once the laboratories are privatized, these people will no longer be needed. There is already a historical example of this opposition to privatization. One DoE facility, the National Institute for Petroleum and Energy Research (NIPER) was already privatized once. In 1983, the Illinois Institute of Technology Research Institute (IITRI) won a 5-year contract with DoE under which the staff became employees of IITRI, and IITRI was responsible for running the laboratory and obtaining outside funding. Over the period of the contract, the line-item budget for NIPER was reduced to zero (NIPER obtained funding from DoE, but only on a competitive contract basis). However, in 1994, "DoE was unhappy with the loss of 'their' facility," and reclaimed NIPER.[60] It reverted to being a government-owned, contractor-operated facility. While this tendency toward turf protection may still exist in the DoE bureaucracy, its effect can be minimized by offering early retirement or other forms of "buyout" to the senior administrators.

D. U.S. Geological SurveyD. U.S. GEOLOGICAL SURVEY

The current customers of the U.S.G.S. are widely dispersed. Ending the subsidy to them, by raising the price of maps, data, and other products sufficiently to cover costs and additional research, will in fact increase the costs to these users. However, the additional cost to each user will be fairly small, and should not lead to serious objections to privatization. Moreover, after privatization, the U.S.G.S. will have an incentive to provide a greater variety of products and services to users. Currently the range of products is limited by how much U.S.G.S. is permitted to lose in selling products below cost.

Since the U.S.G.S. laboratories are small and few in number, privatization should not face much opposition from members of Congress. To the extent they do oppose privatization, it can be minimized by emphasizing that privatization will allow the centers in their districts to seek out additional customers and to operate more efficiently. The result is likely to be even more jobs and revenue than under current circumstances.

Since the primary asset of U.S.G.S. is the data accumulated over more than a century of operation, and the expertise of the employees in putting that data into useful form, the employees themselves should be enlisted in support of privatization. It can be emphasized to them that with privatization, they will have the opportunity to seek out additional customers, to identify and collect data for which there is a commercial need, and to find ways to make their data more useful to current and potential clients. In this respect, it is helpful that the employees of the U.S.G.S. are not unionized, since government employee unions tend to oppose privatization.

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[60] Richard I. Mateles, letter, *Science*, vol. 272, April 19, 1996, p. 339.

E. National Institute Of Standards & TechnologyE. NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY

NIST is at the apex of standardization activities in the U.S. Every measurement of any physical quantity, and the calibration of any measuring instrument, can in principle be traced back to a standard maintained by NIST. For industry, this traceability is important, since it means that products manufactured to a specified tolerance will in fact match up or fit with complementary products manufactured by another firm whose measurements are also traceable to NIST.

Instrument calibrations performed by NIST, or reference standards obtained from NIST, are either provided for free or require a fee which does not cover the full cost. Virtually all of American industry is to some small degree subsidized by NIST. This could mean that there would be widespread opposition to privatizing NIST. However, raising the prices for calibration or reference standards until they covered the cost of operating NIST would not levy a large burden on any single firm. Hence while opposition to privatizing NIST might be widespread, it probably would not be very intense.

What opposition there might be could be reduced by emphasizing that a privatized NIST would be more responsive to user needs. Moreover, since users would be paying the full cost of operation, the scope of NIST's activities would not be limited by congressional appropriations. If there was a market demand, a privatized NIST could hire more people or add more equipment, just as any private firm does when demand increases. In addition, a privatized NIST would be able to replace the deteriorated infrastructure it is currently plagued with, thereby increasing efficiency. This might actually result in lower operating costs than at present. Thus the increase in fees might be very small.

X. SUMMARY & RECOMMENDATIONSX. SUMMARY & RECOMMENDATIONS

There are many different kinds of R&D activities being conducted within the agencies discussed in this report. Each has its own characteristics. Each will require its own approach to privatization. The privatization recommendations made for each of the agencies are summarized here.

The British model can be very helpful in carrying out the privatization of the several laboratories. First, for each agency or laboratory, a steering group should be established. This steering group should include representatives of employees, users, and the parent agency. The steering group should assure that all reasonable privatization options are explored for each laboratory. Once a privatization option has been selected, the parent agency should establish a privatization schedule. Following the British precedent, this schedule should set annual goals for cost recovery, efficiency (cost of services), and performance (quality, timeliness, and other appropriate measures), up to the point of privatization. Note that if the laboratory is to be sold to a private firm, complete cost recovery need not be achieved before the sale. The steering group should monitor the laboratory's performance, to assure that the goals are met, and advise the laboratory on steps to take to improve goal achievement. At the time of privatization, the steering group can be disbanded.

Individual recommendations for each agency are given below.

A. National Aeronautics & Space AdministrationA. NATIONAL AERONAUTICS & SPACE ADMINISTRATION

Each of the aeronautical centers should be privatized. It may be possible to privatize the entire group as an entity. However, the centers do operate independently, and there are enough differences among the centers that it would be possible to privatize each separately. Moreover, some of the centers might be divided into separate entities before privatization. Dryden, in particular, might be partitioned into its computer simulation and its test flight portions, with

each privatized separately. Three possible privatization options exist. One is for the centers to be sold to a consortium of users. The second is for the centers to be sold to employee-owned corporations. The third is for each center to be sold to an entity which is independent of any users, and thus can be impartial in conducting work for users. A careful study should be made to determine which of these options is best for each center. The study should take into account the interests of employees and current users, as well as potential users such as general aviation.

Following the British model, a steering group should be formed to oversee the privatization of NASA. This group should include representatives from current users (engine and airframe manufacturers, airlines, Department of Defense, Federal Aviation Administration) as well as other potential users (manufacturers of general aviation aircraft and engines). Employee representatives should also be included. The steering group should establish year-by-year goals for cost recovery, and for measures of performance such as timeliness and cost. The steering group should also have the privatization alternatives (e.g., employee buyout, sale to a consortium of users, etc.) examined through an appropriate study, and determine which alternative is in the best interests of the nation. The selected alternative should then be implemented

It should be noted that recent actions taken by NASA to reduce costs can be considered steps along the way to privatization. NASA Headquarters is to be reduced from its current heaD.C.ount of over 1400 to no more than 700 by October 1997.[61] In addition, responsibilities for various programs are being transferred to the Centers from NASA Headquarters. This reduction in overhead will increase the NASA Centers' efficiency and bring them closer to being able to recover full costs from users.

B. Department Of AgricultureB. DEPARTMENT OF AGRICULTURE

The Department of Agriculture R&D activities conveniently divide into three types. Each requires a different approach to privatization. There are three options for privatizing the Beltsville Agricultural Research Station. One is sale to a user consortium, the second is sale to a research consortium, the third is sale to an employee-owned corporation. The first option has the advantage of providing ready access to capital. The second has the advantage of maintaining high quality research. The third has the advantage that the employees would be motivated to market their capabilities and be customer-oriented. Following the British model, a steering group should be established to identify the best privatization option.

Each of the several dozen Agricultural Research Centers can be privatized separately, since each is oriented toward the local agricultural community. Most of these are located at universities. Hence one option for privatization is that they be turned over to their host universities. Another is that they be owned by cooperatives made up of the farmers or food processing industries which they serve. In either case, support for their research should come from fees levied on the farm products in which they specialize. A major advantage of local ownership is that the centers would be more responsive to the needs of their clients. Another advantage is that by making them self-supporting through user fees, their budgets would more closely reflect the perceived benefits to users.

The specimen collections are of primary use to seed growers and manufacturers of agricultural chemicals. Two possible privatization options are sale to a consortium of users, and sale to employee-owned corporations. Sale to a user consortium would provide the centers with ready access to capital. An employee buyout would avoid any possible antitrust implications of the first option, and would provide the employees with an incentive to upgrade their collections.

The steering privatization group should include representatives from farmers growing the relevant crops, food processors, and manufacturers of agricultural machinery and chemicals. Employee representatives should also be included. The steering group should establish year-by-year goals for external support, and for measures of performance such as timeliness and cost, for each laboratory. The group should also have the privatization alternatives (e.g., employee buyout, sale to a consortium of users, etc.) examined through an appropriate study, and determine which alternative is in the best interests of the nation. The selected alternative(s) for each of the components of the Agricultural Research Service should then be implemented

[61] Ferster, Warren, and Jennifer Heronema, "NASA Cuts Headquarters Jobs Deeper, Faster," *Space News*, April 22–28, 1996, p. 4.

C. Department Of EnergyC. DEPARTMENT OF ENERGY

Privatization of the Department of Energy laboratories is complicated by two issues: nuclear weapons design and maintenance, and environmental cleanup. Nuclear weapons design and maintenance should be transferred to the Department of Defense. Environmental cleanup should be considered part of the cost of the nuclear weapons program. All contamination occurring before privatization should remain the responsibility of the federal government. With these two issues disposed of, privatizing the remainder of DoE involves dealing with two types of laboratories: single-purpose laboratories and multiprogram research laboratories. Each requires a different approach to privatization.

The single-purpose laboratories typically exist to operate a specific piece of equipment, or to perform a specific service. Most are contractor-operated. These should be sold to the highest bidder. The current contractor should be permitted to bid, but should be given no more preference than would be the case if the operating contract was up for bid. Employee-owned corporations should likewise be permitted to bid, but not given any preference.

There are two possibilities for privatization of the multiprogram labs. One is to privatize each laboratory as an entity. If this option is chosen, the laboratory could be sold to the highest bidder. If the laboratory is already contractor-operated, the current contractor should be permitted to bid, but should be given no more preference than would be the case if the operating contract was up for bid. The second possibility is to privatize individual portions of each laboratory. Since these will usually be based on employee skills and talents rather than on specialized or unique equipment, employee buyouts are the most promising option for privatization. However, sale to an outside buyer, with the approval of the employees in the unit, should also be considered.

The DoE privatization steering group should include representatives from the energy industry, the construction industry, and Department of Defense as well as employees. Its function should be the same as the others.

D. U.S. Geological SurveyD. U.S. GEOLOGICAL SURVEY

The Geological Service neatly divides into two portions for purposes of privatization. The Flagstaff Center, which deals with lunar and planetary geology, should be transferred to NASA rather than privatized. The remainder of U.S.G.S. is primarily involved in collecting and distributing data about the United States. The goal of privatization is to support the data collection and distribution through charges to users. One privatization option is to sell the U.S.G.S. to an entity which would handle the marketing of the data, in the same way Landsat data are marketed privately. The other option is to sell U.S.G.S. to an employee-owned corporation. This latter option has the advantage that the employees would be motivated to conduct the basic research and data collection needed to maintain the viability of the organization.

The U.S.G.S. privatization group should include representatives of the mining industry, construction industry, petroleum producers, cartographers, and map users as well as employee representatives. Its function would be the same as those for other types of labs.

E. National Institutes Of Science & TechnologyE. NATIONAL INSTITUTES OF SCIENCE & TECHNOLOGY

The National Institutes of Science & Technology's Advanced Technology Program and the Manufacturing Extension Program should be terminated as inappropriate activities for government. The Malcolm Baldrige National Quality Program should be privatized by being turned over to a professional society such as the American Society for Quality Control, or to a nonprofit institute established for the purpose.

There are two options for privatizing the standards laboratory: sale to a contractor or employee buyout. Given the deterioration of the infrastructure of the standards laboratory, considerable investment will be needed to bring it up to current building codes. This consideration seems to favor purchase by a contractor. However, if an attractive bid is made by an employee-owned corporation, this should be considered. Given the size of the investment which will be required to bring the buildings up to current codes, the government should not expect a very high price for the sale.

It may even have to pay to have someone take over the laboratory, as was the case with the National Engineering Laboratory in Britain.

The privatization steering group for NIST should include representatives of manufacturing firms, standardization groups such as American National Standards Institute, industrial research laboratories, instrumentation manufacturers, and university researchers as well as employees. Its function would be the same as the other steering groups.

F. Privatization ProceduresF. PRIVATIZATION PROCEDURES

For several of the laboratories, there are alternative possibilities for privatization. In each case, the best option must be chosen. In addition, it will be necessary to assure that privatization is undertaken in a manner fair to the taxpayers, the employees, the current users of the laboratory's services, and the purchaser, whether the latter be a consortium, a cooperative, an employee-owned firm, or a private contractor.
Whatever the route to privatization chosen for each laboratory, it need not be a traumatic event. As British experience with privatization has shown, a transition period can be valuable. During this transition period, while still remaining a government entity, a laboratory can reduce overhead, reassign technical staff from administrative to technical duties, and build up a clientele in the private sector. Thus at the time of privatization, the laboratory will have achieved most if not all of the changes needed to make privatization successful. This pattern should be followed by the laboratories and agencies described earlier in this report. While the transition to full cost recovery may take several years, by following this route, the laboratories can be privatized successfully.

ABOUT THE AUTHORABOUT THE AUTHOR

Dr. Joseph P. Martino is a Senior Research Scientist at the University of Dayton Research Institute. While in the Air Force, he served several tours of duty in Air Force laboratories, as a research engineer, and later as a staff planner. He was elected a Fellow of the Institute of Electrical and Electronics Engineers "for contributions to R&D planning and R&D resource allocation." He is Associate Editor of the journal *Technological Forecasting & Social Change*, and a member of the Editorial Board of *Transactions on Engineering Management*. He is the author of *Science Funding: Politics and Porkbarrel* (Transaction Publishers 1992) and *R&D Project Selection* (John Wiley, 1995).