



ASME International

**Federally Funded
Energy Research and Development:
Should it be Sacrificed to Help Balance the Budget?**

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EXECUTIVE SUMMARY

The Debate

A debate is currently brewing over the relative importance of performing federally funded research and development and balancing the federal budget. Congress, in an effort to balance the federal budget, is scrutinizing many areas of federal funding, including energy R&D. In doing so, the question arises: Should federal funding for energy R&D be sacrificed to help balance the budget? The answer to this question is debatable. One side of the debate views energy R&D as a sacrosanct investment in the United States. On the other side of the debate, energy R&D is seen as a wasteful expense worthy of sacrifice in the battle to balance the budget.

There are many considerations to be made when attempting to balance the budget or decrease energy R&D funding. Balancing the budget is an important first step in reducing an exorbitant \$5 billion national debt. However, to take this step at the expense of R&D could be detrimental to the future energy supply, economic health, environment, security, and standard of living of the U.S.

An attempt to resolve this debate resulted in the analysis of seven major concerns. Following is a list of these concerns and recommended policy options to alleviate them.

Concerns and Recommendations

National Priorities: Decisions regarding tradeoffs between national issues like balancing the budget and funding R&D are difficult and confusing due to a lack of consensus over their relative importance. Formulating and promulgating a set of Unified National Priorities with emphasis on both long term planning and cooperation between Legislative and Executive branches would provide a much needed framework from which to make these decisions.

National Energy Policy: The lack of a long term National Energy Policy may result in useless and inefficient spending on energy programs. In the absence of such a plan, decisions regarding energy R&D funding levels are often made in a myopic and capricious manner. The U.S. Energy Policy should be reassessed and revised to incorporate long term national goals in order to provide direction for policy decisions regarding Energy R&D.

The Federal Budget: Mandatory and interest spending has more than doubled as a percentage of the federal budget in the last 35 years. At their current growth rate, mandatory and interest spending will completely phase out discretionary funding by the year 2031. The chief source of mandatory spending, entitlements, are a swollen 53% of the federal budget, and unless their growth rates change, discretionary programs like energy R&D will face an incessant budget squeeze. The solution to the problem of exorbitant mandatory spending is to reduce and eventually eliminate uncontrollable entitlement spending. The solution to rising interest spending is to enforce annual budget caps on the federal budget to prevent

overspending. The longer it takes the government to realize and correct these trends, the more difficult it will become to ameliorate this situation.

R&D Funding: Incrementalism, the current R&D budgeting approach which consists of marginal changes in the previous budget of each year tends to perpetuate programs and organizations created to meet past goals. A merit based R&D funding process should be installed allowing programs to compete for funding base upon potential merit for achieving national goals.

Basic vs. Applied R&D: A current push for dictating percentages of basic and applied R&D has been lead by a Congressional coalition wishing to eliminate applied R&D with claims of corporate welfare. However, eliminating applied research would drastically hinder the advancement or results of the overall R&D program. Applied technology is often a necessary step in furthering basic research, and without it the synergistic R&D process would slow down. The R&D funding process should not be subject to rigid percentage requirements of basic and applied R&D. The process will work itself out as programs with the highest potential for achieving national goals receive funding regardless of their categorization as basic or applied R&D.

Management of Energy R&D: The majority (95%) of federally funded Energy R&D is managed by the DOE. Since its inception, the DOE has experienced incredible growth both in scope and depth of programs. This growth has produced an extremely complex agency riddled with expensive administrative burdens, rules, and regulations. Although efforts to reduce excessive administrative costs and redundancy have yielded minimal results, they should be continued. In doing so they should focus on simplification of the management structure as well as improving accountability.

Informing Congress: Congress is fiscally responsible for R&D funding and deserves accurate information for use in making relevant decisions. Unfortunately, in the area of energy R&D information regarding future energy needs and the benefits of current energy R&D programs is vague, unclear, and often nonexistent. The path toward solving this void of information begins with the formulation of National Priorities with the inclusion of Congress. Doing so would resolve discrepancies and concerns and produce a framework or plan from which to base policy decisions like balancing the budget and funding energy R&D. This upfront plan would make subsequent decisions regarding these issues simple and systematic.

Conclusion

The question of whether or not energy R&D funding should be cut to assist in balancing the budget does not have a definitive answer. However, an absolute tradeoff is not necessary. An analysis of policy options has revealed the possibility of both balancing the budget and performing federally funded energy R&D.

TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	i
TABLE OF CONTENTS.....	iii
1 INTRODUCTION.....	1
1.1 FEDERALLY FUNDED ENERGY R&D.....	1
1.2 FUNDING CONCERNS	1
1.3 RAMIFICATIONS.....	2
1.3.1 <i>A Balanced Budget</i>	2
1.3.2 <i>R&D Funding Cuts</i>	2
1.3.3 <i>Cutting Energy R&D</i>	3
1.4 PUBLIC REACTION	3
2 BACKGROUND.....	3
2.1 HISTORY	3
2.2 GOVERNMENT’S ROLE	4
2.3 ORGANIZATION	4
2.4 THE FUNDING PROCESS	4
2.5 BENEFICIARIES OF FEDERALLY FUNDED ENERGY R&D.....	5
2.5.1 THE WORLD.....	5
2.5.2 <i>The U.S.</i>	5
2.5.3 <i>Government Labs and Employees</i>	5
2.5.4 <i>Industry</i>	5
3 CONCERNS.....	5
3.1 NATIONAL PRIORITIES	5
3.2 NATIONAL ENERGY POLICY	6
3.3 THE FEDERAL BUDGET	6
3.4 R&D FUNDING	7
3.5 BASIC VS. APPLIED R&D	8
3.6 MANAGEMENT OF ENERGY R&D	8
3.7 INFORMING CONGRESS	9
4 POLICY ALTERNATIVES.....	9
4.1 NATIONAL PRIORITIES	9
4.2 NATIONAL ENERGY POLICY.....	9
4.3 THE FEDERAL BUDGET	10
4.3.1 <i>Spending Caps</i>	10
4.3.2 <i>Allotment By Priority</i>	10
4.4 R&D FUNDING	10
4.4.1 <i>Entitlement Transformation</i>	10
4.4.2 <i>Merit Based Funding</i>	10
4.5 BASIC VS. APPLIED R&D	11
4.6 MANAGEMENT OF ENERGY R&D	11
4.6.1 <i>A Subcabinet Agency</i>	11
4.6.2 <i>Revamped Management Practices</i>	12
4.6.3 <i>Elimination</i>	12
4.6.4 <i>Accountability</i>	12

4.6.5 Cooperation	12
4.7 INFORMING CONGRESS	12
5 RECOMMENDATIONS.....	13
5.1 UNIFIED NATIONAL PRIORITIES.....	13
5.2 RENEWED ENERGY POLICY	13
5.2.1 REASSESSMENT.....	13
5.2.2 <i>Coordinate Efforts</i>	13
5.3 FEDERAL BUDGET OVERHAUL.....	14
5.3.1 <i>Entitlement Elimination</i>	14
5.3.2 <i>Budget Cap Enactment</i>	14
5.4 EFFICIENT R&D BUDGETING.....	14
5.5 BASIC AND APPLIED R&D	15
5.6 IMPROVED ENERGY R&D MANAGEMENT.....	15
5.6.1 <i>Simplified Management</i>	15
5.6.2 <i>Accountability</i>	15
5.6.3 <i>Collaboration</i>	15
5.7 INFORM CONGRESS.....	15
ACKNOWLEDGMENTS.....	17
ABOUT THE AUTHOR.....	17
THE WISE PROGRAM.....	17
DISCLAIMER	17

1 INTRODUCTION

“There is no more important or timely issue to consider, and no greater challenge than to convey the long-term energy needs of the nation to Congress.”¹

The importance and timeliness of this task are derived from the current debate over the relative importance of federally funded research and development (R&D) programs and the paramount task of balancing the federal budget. Congress, in an effort to balance the federal budget, is scrutinizing many areas of federal funding, including energy R&D. In doing so, the question arises: Should federal funding for energy R&D be sacrificed to help balance the budget?

The answer to this question is not a simple yes or no. There are valid arguments supporting both sides of the debate. On one side, energy R&D is viewed as a sacrosanct investment in the United States. On the other side, energy R&D is seen as a wasteful expense worthy of sacrifice in the battle to balance the budget. Resolving the debate over balancing the federal budget at the cost of energy R&D requires an unbiased analysis of the federal budget, energy R&D, national priorities, future energy needs, and relevant policy options. An effective analysis would provide a framework of background information, introduce concerns and conflicts in a broad context, and provide policy options. Such an analysis would empower the reader to decide his/her stance on the issue.

¹ Dr. John Gibbons, director of the White House Office of Science and Technology Policy, briefing by the Chairman of the Presidents Committee of Advisors on Science and Technology, Washington, D.C., 6 June 1997.

The purpose of this report is to convey background information and policy options pertinent to the issue of balancing the budget at the expense of Energy R&D funding in a pithy yet explanatory manner. It is intended to be useful to the concerned citizen or to the legislator faced with decisions regarding Energy R&D and the federal budget.

1.1 Federally Funded Energy R&D

In the U.S., energy research and development is performed by the federal government, academia, and industry. The federal government funds areas of energy R&D such as basic energy science, energy efficiency, energy supply, and alternative forms of energy. Federal expenditures for energy R&D total approximately \$3 billion annually, 95 percent of which is managed by the Department of Energy (DOE)². The chief performers of this R&D are national laboratories, academia, industry, and partnerships amongst the three. Benefits of this R&D include the advancement of scientific knowledge, increased energy efficiency resulting in a cleaner environment, and numerous advanced technologies benefiting society through the expansion of energy variety and commercial capability.

1.2 Funding Concerns

Congress, faced with the paramount issue of balancing the budget, is searching with great resolve for areas to reduce federal spending. Federally funded research and development programs are facing projected cuts of 14 - 20 percent over the next 5 years.³ Energy R&D, facing accusations of inefficiency, mismanagement, and decreasing necessity, is definitely not exempt from these

² National Science Foundation, Federal R&D Funding by Budget Function: Fiscal Years 1994-96, NSF 95-342, 1995.

³ William J. Broad, “Study Finds Public Science Is Pillar Of Industry,” The New York Times 13 May 1997: C1.

cuts. Federally funded Energy R&D, after having decreased by 75 percent since the late 1970's⁴, continues to face cutbacks with no end in sight.

1.3 Ramifications

There are many considerations to be made when attempting to balance the budget or decrease energy R&D funding. Balancing the budget at the expense of energy R&D could be detrimental to the future energy supply, economic health, environment, security, and standard of living of the U.S.

1.3.1 A Balanced Budget

Balancing the budget will ostensibly affect the future economic health of the U.S. Without a balanced budget, the national debt which is currently more than \$5 trillion, will continue to soar and interest spending will constitute increasing amounts of the federal budget.

Currently, each United States citizen (man, woman, and child) owes approximately \$20,000 to pay off the national debt. If this gargantuan government credit card is not paid off soon, future generations will be stuck paying past debts. Time and resources allocated to paying off old debts can only hamper future economic growth and prosperity.

Investors whose capital is on loan to the U.S., many of which are foreign, may demand a return on their investment. This possibility yields a certain degree of control over our government to these investors. If the government is forced to pay off such debts, an instantaneous lack of government funding may ensue. If the government refuses to pay or

⁴ U.S. Department of Energy Secretary of Energy Advisory Board, Energy R&D: Shaping our Nation's Future in a Competitive World, June 1995: 1.

declares a moratorium, the result may be a devaluation of the American dollar resulting in the undermining of U.S. currency.

1.3.2 R&D Funding Cuts

“Cutting back on research at the dawn of a new century where research is more important than it has been for even the last fifty years would be like cutting our defense budget at the height of the Cold War.”--President Bill Clinton.⁵

An expected 14 - 20 percent decline of federal expenditures for R&D has prompted many studies to determine the dividends of federally funded R&D. One such study looked at recent patents to find out how many of them referenced the results of government research. It reported 70 percent of patent citations were public science related. The lead author of the study, Dr. Francis Narin, proclaimed: “Look at the things that are coming out of the research pipeline, we'd be fools to close it down.”⁵

However, cutting funding for R&D programs may also have its benefits. In fact, “budgetary pressures can act on R&D operations like Darwinian natural selection to improve the breed.”⁶ Decreases in R&D funding might be an impetus to make better decisions about what to spend the money on. “A bit of budgetary pain, it seems, could provide the incentive to both weed out wasteful science spending and develop sounder policies.”⁷

⁵ Office of Science and Technology Policy, Science and Technology Shaping the Twenty-First Century, Executive Office of the President, April 1997.

⁶ John Carey, “What Price Science?,” Business Week 26 May 1997: 168.

⁷ Carey 168.

1.3.3 Cutting Energy R&D

Energy R&D is of prime importance to this nation. Without energy what would we do? Our economy would halt, and we would immerse ourselves in war to acquire the resources to continue our way of life. Our economy is powered by energy and demands not only cheap but abundant sources of it. Without these, we would not be able to compete in the international market and our standard of living would decline.

Obviously, both balancing the budget and investing in energy R&D are vital to this nation. However, to cut funding of energy R&D on the pretense of balancing the budget is ludicrous and would most likely defeat the purpose. Even if energy R&D was completely eliminated it would only put a \$3 billion dent in the expected FY1998 \$90 billion deficit. More importantly, this \$3 billion dent may actually worsen the deficit by decreasing federal government revenues that would have otherwise incurred as the result of income taxes from jobs created by energy R&D.

With the future economic health, security, and prosperity of the nation at stake, decisions regarding the budget and energy R&D should not be taken lightly. These decisions will dictate the future course of this nation and therefore demand close scrutiny and in-depth analysis.

1.4 Public Reaction

The public wants the U.S. to remain technologically superior and believes the federal government has a large role to play in doing so through basic research as well as facilitating science and technology developments. In fact, in a study by the Roper

Center for Public Opinion Research⁸, 84% of the public believed “it is important that the United States be the world leader in technological progress.” Not surprisingly, 82% of the public also believed the federal government has an important role to play in encouraging new developments in science and technology, and approximately 2/3 of the public believed basic research is a good investment.

2 BACKGROUND

2.1 History

The U.S. has funded energy R&D since 1955. The first projects were small-scale, civilian, atomic energy projects. However, it took a 1973 Arab oil embargo to provide the impetus for the Federal Government to substantially expand and consolidate its energy R&D programs. In 1974, the Federal Energy Administration (FEA) was created to address energy policy issues and to initiate both energy efficiency and environmental research programs. Also created in 1974 was the Energy Research and Development Administration (ERDA), a compilation of national laboratories and energy R&D programs from the Atomic Energy Commission (AEC), National Science Foundation (NSF), and other government agencies. A consolidation of all energy related research or policy programs was finally achieved with the inception of the Department of Energy (DOE) on October 2, 1977. The scope of the DOE included all energy-related responsibilities, including those from the FEA and ERDA. Today, federally funded energy R&D is funded at annual levels of approximately \$3 billion (4% of total federal R&D expenditures).

⁸ National Science & Technology Medals Foundation, “American Views of Science & Technology,” released by the National Press Club: 25 July 1996.

2.2 Government's Role

The federal government funds energy R&D when it serves national interests that would not be adequately addressed in the marketplace. This funding is an investment in the nation's future, and is justified under the nation's overarching goal of U.S. R&D policy: "to assure for future generations that our nation's capacity to shape the future through scientific research and technological innovation is continually being renewed."⁹

Energy is fundamental for any industrial society to function. The oil crisis of the 1970's exposed the vulnerability of the U.S. to energy dependence. The federal government funds energy R&D to minimize our vulnerability to these problems as well as to continue fostering an environment where our economy can thrive in a world market.

2.3 Organization

Federal Agencies responsible for carrying out energy R&D include the Tennessee Valley Authority (TVA), the Nuclear Regulatory Commission (NRC), and the DOE. With an annual budget of approximately \$3 billion for energy R&D, the DOE is responsible for more than 95% of total federally funded energy R&D. This funding is used to perform two major classifications of R&D, namely basic energy sciences and applied energy R&D.

Basic energy science programs strive to further develop fundamental concepts in energy science. These research programs support facilities for scientific use, and carry out research through DOE's laboratories, and universities.

⁹ Energy R&D: Shaping our Nation's Future in a Competitive World: 6.

Applied energy R&D is performed for both near-term and long-term applications. Near-term applied R&D focuses on developing technologies for introduction into the marketplace. These programs are carried out largely in collaboration with energy intensive industries like the automotive industry and the power industry. Long-term energy R&D programs focus on areas of significant future potential. These programs are carried out mainly by DOE's laboratories but also in conjunction with academia and/or industry.

2.4 The Funding Process

Funding for energy R&D is dictated by the federal government in an intricate, year long budget process. This process begins every summer when government agencies prepare their budget estimates for the next fiscal year (starting October 1). These budget estimates are often the result of lengthy internal reviews and extensive strategic planning. The estimates are then sent to the Office of Management Budget (OMB) where they are reviewed, scrutinized, and agreed upon by both the agency and the OMB. Following the initial scrutinization, they are then approved by the President and submitted to Congress by early February for further consideration.

The first step for Congress in the budget process is to review the budget from a macrobudget point of view and produce a budget resolution. This budget resolution is basically a general budget plan including size and composition. The resolution is then simultaneously sent through both authorizing and appropriating committees.

Authorizing committees review programs and initiate necessary authorization bills which can either create new programs, eliminate old programs, or dictate restrictions on program spending. The appropriations

committees review the details of agency budgets and make final decisions on actual funding levels in appropriations bills. Finally, in early fall, authorization and appropriations bills are first voted on by Congress and then submitted for Presidential consideration.

2.5 Beneficiaries of Federally Funded Energy R&D

2.5.1 The World

As a powerful and technologically preeminent nation, the United States performs R&D that benefits the entire world. New energy related technologies developed from energy R&D in the United States often produce spill over benefits across the world. The United States is often called to assist developing nations in the development of energy production. U.S. energy R&D is a national investment that produces international benefits.

2.5.2 The U.S.

Energy R&D promotes the future prosperity and security of the United States. It will affect the future energy supply, environment, and energy dependence of the nation. Each U.S. citizen paid approximately \$10 last year to fund energy R&D.¹⁰ The ostensible benefits they receive from this expenditure include cheap, reliable sources of energy and an improved environment.

2.5.3 Government Labs and Employees

Government labs and employees are the chief performers of energy R&D. Federally funded energy R&D is their livelihood and outlet for benefiting the nation. Many of these labs and employees have become specialized to

the point of dependence on the continuance of energy R&D.

2.5.4 Industry

A substantial recipient of the spillover from R&D is industry. The results of energy R&D are difficult to quantify, but industry has benefited tremendously. New technologies and processes developed through energy R&D are constantly being adapted for commercial use by industry. An example of this is the \$1 million federally funded research and development of polycrystalline diamond drill bits which revolutionized the way oil companies look for oil. Within one year after this development, U.S. companies began manufacturing these bits and currently have annual sales over \$200 million.¹¹

3 CONCERNS

3.1 National Priorities

With the end of the Cold War, the nation can no longer cling to the overarching goal of Cold War domination. The U.S. is an extremely productive and successful nation when striving for a goal, but without direction may idle in complacency or worse yet chart a haphazard course to a less than preeminent future.

Current national issues like balancing the budget and planning for future energy are vital and should be recognized as such. Decisions regarding tradeoffs between such issues are difficult and confusing due to the lack of a consensus over their relative importance. A list of national priorities and their relative importance is beckoning construction. Without such information, our

¹⁰ (\$2577 million) / (265 million people)

¹¹ Energy R&D: Shaping our Nation's Future in a Competitive World: 15.

policymakers cannot accurately make decisions or tradeoffs regarding issues like the debate over balancing the budget and cutting R&D. In the absence of unified priorities, politics is the default impetus for many government decisions.

3.2 National Energy Policy

The lack of a long term National Energy Policy may result in useless and inefficient spending on energy programs. In the absence of such a plan, decisions regarding energy R&D funding levels are often made in a myopic and capricious manner. As a result of this, funding inefficiency becomes prevalent, and instead of solving the problem with long term planning, Congress simply opts to cut funding.

The U.S. does not have a complete plan dictating energy goals for the future. Without such a plan, energy goals may change annually and with them energy R&D funding levels in the budget. The absence of such goals will also increase the prevalence of politics in budgeting practices as each politician attempts to bring more to his constituents. Haphazard, sporadic budgeting processes are simply spending for the sake of spending and do not benefit the nation as a whole.

The lack of a long term Energy Policy is a sign of complacency. Historically, when a nation or society achieves preeminent status, such as the Ancient Roman Empire, they tend to become complacent and soon lose their status. No nation, regardless of how powerful, can afford to simply rely on their current status to provide future prosperity and security.

3.3 The Federal Budget

The federal budget can be divided into three main spending classifications: mandatory, discretionary, and interest. The largest

spending classification, mandatory spending, constitutes entitlements such as social security, Medicaid, veterans' benefits, welfare, etc. The government has little control over this classification of spending because entitlements are payments guaranteed by law. "Democrasclerosis"¹², the idea that once a program is institutionalized it is virtually impossible to eliminate, is vividly illustrated through many mandatory spending programs that have grown virtually unchecked. The second largest category of spending, discretionary spending, is strictly dictated and regulated by Congress and consists of programs like defense, infrastructure, and Energy R&D. The smallest classification of spending, Interest spending, pays off the interest on the national debt which is currently more than \$5 trillion.

During periods of budget reduction such as the current era of deficit reduction, discretionary spending programs bear most of the burden. The reason for this is abundantly clear: Congress has the most control over discretionary spending. For example: the FY 1998 budget of \$1692 billion has a deficit of \$90 billion which is scheduled for elimination within the next 5 years.¹³ Where will this \$90 billion reduction come from? It cannot come from the swollen \$890 billion of uncontrolled mandatory spending, and it cannot come from the constantly increasing \$249 billion interest payment on the national debt. It must therefore come from the 1/3 of the budget the government still controls: the \$553 billion of discretionary funding.

A \$90 billion reduction of the \$553 discretionary spending budget will translate

¹² Dr. Joseph Bordogna, National Science Foundation Assistant Deputy Director, WISE meeting, NSF Washington D.C. office, 27 June 1997.

¹³ George Hager, "Appropriations Season Begins With New Deal, Old Battles," Congressional Quarterly, 31 May 1997: 1249.

into a 16% reduction of this base of programs which includes energy R&D. This has been confirmed by the President's request of a 14% decline in R&D funding and the Congressional push for a decline of up to 20% in their efforts to meet the challenge of balancing the budget in the next five years.

The expected decline in discretionary programs over the next 5 years is only the beginning. A look at past budgetary trends reveals an incessant growth among mandatory and interest spending. In 1962 these spending programs constituted 32.5% of the budget and have mushroomed to 67.6% of the 1998 budget while during the same time period discretionary spending has decreased from 67.5% to 32.4%.¹⁴



long run, because money is wasted as Congressional desires change from year to year. Often times, such sporadic funding fails to achieve long term goals due to program despotism or simply inconsistency.

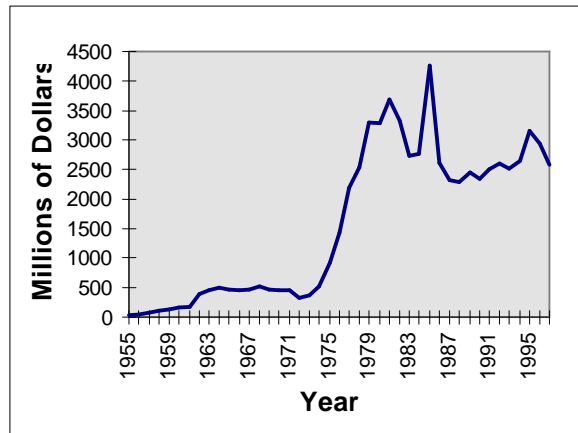


Figure 3.4: Energy R&D Funding Levels From 1955 to 1997.¹⁶

3.5 Basic vs. Applied R&D

A common area of debate within any research program is the necessity of basic science or applied technology and the appropriate proportions thereof. In the area of energy R&D, the demand from Congress has been for a larger percentage of basic research. This push comes from a coalition of Congressmen claiming applied research is the equivalent of corporate welfare. However, eliminating applied research would drastically hinder the advancement or results of the overall R&D program. Applied technology is often a necessary step in furthering basic research, and without it the synergistic R&D process would slow down.

¹⁶ Historical Tables, Budget of the United States Government, Fiscal Year 1998: 151-156, online via GPO access: [wais.access.gpo.gov], 18 July 1997.

3.6 Management of Energy R&D

Congressional concerns regarding Energy R&D lie not in its merits, but in its management. The majority (95%) of federally funded Energy R&D is managed by the DOE. Since its inception, the DOE has experienced incredible growth both in scope and depth of programs. In fact, Energy R&D only accounts for approximately 15% of current DOE funding. This growth has produced an extremely complex agency riddled with expensive administrative burdens, rules, and regulations.

DOE's exorbitant administrative costs will no longer be tolerated by a fiscally concerned Congress. According to Representative Sensenbrenner, Chairman of the House Science Committee: "In the last 20 years the DOE has been without a doubt, the worst managed agency in the U.S. government!"¹⁷ He believes Congress will reorganize the DOE within the next 4 years. If and when this organization occurs, it may have a large impact on the funding levels, efficiency, and political views of Energy R&D. Currently, "The House Budget Committee continues a rhetorical war on the DOE calling it a fix to a long-past problem - the energy crisis of the 1970's - that should be abolished."¹⁸ The committee reported: "Given the questionable origin of the department and its poor track record, this is an ideal place to start downsizing government."¹⁹

A major cause of inefficient energy R&D management is accountability. Unlike industry, government agencies are often

¹⁷ Representative F. James Sensenbrenner, Jr., WISE meeting, House Science Committee Chambers in Washington D.C., 26 June 1997.

¹⁸ Jonathan Weisman, "Programs Expected To Have Easier Time," Congressional Quarterly: 1257, 31 May 1997.

¹⁹ Weisman

unaccountable for results. Agencies like the DOE lack a watchdog or review process to assess effectiveness in meeting their prescribed goals.

3.7 Informing Congress

Congress is fiscally responsible for R&D funding and deserves accurate information for use in making relevant decisions. Unfortunately, in the area of energy R&D information regarding future energy needs and the benefits of current energy R&D programs is vague, unclear, and often nonexistent.

The problem with predictions of future energy needs is uncertainty. Uncertainty is inherent in such predictions and often becomes so convoluted that a Congressman or his staff simply cannot make any valuable use of the information.

Tabulating the benefits of Energy R&D is also a difficult process inundated with uncertainties and assumptions. Information needed to do so is often unobtainable, ambiguous, and simply monetarily intangible. The price of the environment or human life or the environment is incalculable and estimates to do so are simply opinions. Analyses using such data are therefore opinionated and biased.

The problem with conveying this information lies not only in the complexity of the information but also in the agendas of those doing the research. Often times, the science behind the information is biased due to lobbying groups or agencies who fund their own self-serving research. Recognizing this, Congress has learned to distrust the scientific information it receives.

4 POLICY ALTERNATIVES

4.1 National Priorities

An option to deal with a lack of clear direction with federal spending is the construction of a summary of national priorities. Such a summary could be agreed upon by Congress and the Executive Branch. This manifesto could then be reviewed and modified to meet the future needs of the nation. All parties involved can express their opinions and the prioritized plan can then be approved. Such a plan would allow for bickering and disagreement upfront rather than postponing it for battles over decisions like funding levels of Energy R&D.

With such plan already formulated, subsequent spending decisions can be performed in a more simplified, systematic manner. Funding levels of programs or departments can be decided in relation to their goals within the National Priorities. Necessary tradeoffs can also be made with the use of these priorities as a reference of relative importance.

4.2 National Energy Policy

Similar to the aforementioned national agenda, an energy policy agenda can be constructed among a group of chosen authorities in the area of energy policy. Such a policy may provide direction in a vitally important area. The advantages of allowing a chosen group of experts to design the policy include the elimination of political agendas and the capability of understanding and making effective use of increasingly complex information. The expert energy panel could develop a long term energy plan for the nation as well as evaluate spending practices and policy options necessary for the achievement of such a plan.

4.3 The Federal Budget

Many of the current concerns for Energy R&D can be mollified with modifications of the Federal Budgeting Process. One such salient concern is the constantly shrinking piece of the budget pie from which discretionary programs must compete. This can be alleviated through an implementation of spending caps as well as the use of allotment by priority within the budget resolution.

4.3.1 Spending Caps

A spending cap would set a limit on total spending for the federal budget. The limit could be the total revenues from the previous fiscal year. With the previous year's revenue as the cap, the possibility of inaccurately predicting revenues is eliminated and the budget is guaranteed not to run a deficit. If a proposed budget resolution exceeds the cap, an iterative process of exploring first the less important programs for areas of reduction begins. While this process forces spending levels to converge on the cap, unpopular decisions are often made but can be understood as a necessary part of the process.

A budget cap could also be used in conjunction with a summary of National Priorities. At the onset of the budget process, with the total allowable spending known to all parties involved, separate caps can then be applied to each National Priority keeping in mind their relative importance.

4.3.2 Allotment By Priority

Allotment by priority would entail a budget resolution that provides funding based on prioritized national goals instead of by budget function. This could eliminate the competition of justifiable programs within a budget function over inadequate funding. An example of this is the increasing competition of

valid R&D programs over a shrinking R&D budget.

A recent attempt at using budget caps has been made in order to balance the budget within the next five years, but these caps are flexible and suspect to much manipulation. Because of this inflexibility they simply serve as a benchmark but have no real teeth to promote budget restraint. Budget caps could only be enforced if Congress were to hold themselves to them by law. Passing budget cap legislation would be difficult because it limits the power of Congress in their spending

practices. However, budget caps would provide an impetus for frugal fiscal policies and alleviate some of the pressure by strong lobbying groups for increased funding.

4.4 R&D Funding

Methods for restructuring the energy R&D funding process include transformation to entitlement spending, merit based funding and multi-year budgeting.

4.4.1 Entitlement Transformation

Transforming R&D funding into entitlement spending is a proposed solution to funding problems. However, the federal budget is already inundated with entitlement programs which, due to their lack of budget scrutiny, often become inefficient and wasteful. For this reason, all spending programs should undergo the same type of budget scrutiny discretionary programs are currently facing. Such introspective analysis actually yields more direction and better results than a carefree, haphazard, R&D juggernaut.

4.4.2 Merit Based Funding

With a constantly decreasing discretionary budget, R&D programs are increasingly competing amongst themselves.

Competing for an allotment of funding for each budget function could be replaced by merit based funding competition. Such a process could include a complete analysis of each program, its merits, and relative importance to national goals. The results of such an analysis can then be used to decide a compilation of funding levels based upon their relative importance and potential to achieve promulgated national priorities.

Merit based funding could also be used in conjunction with multi-year budgeting. This type of budgeting funds multi-year projects upfront guaranteeing an annual disbursement of funds until project completion. The benefit of multi-year budgeting is that it forces a consideration of the merits of the project before any funding is approved. Without this type of budgeting, multi-year projects are often terminated prematurely due to capricious funding levels political agenda. Such premature elimination simply negates potential benefits from initial project funding and is a result of a superficial funding analysis. In essence, multi-year budgeting not only forces the merits of a project to be considered before any funding is wasted but also guarantees such projects funding through their completion.

4.5 Basic vs. Applied R&D

Options in deciding basic vs. applied R&D include dictating an amount or percentage of each before the budget process or simply letting the process decide for itself.

The difficulty inherent in dictating the percentage of basic and applied R&D is actually determining the levels of basic and applied energy R&D that will work together to yield the best results. The solution to this problem varies with the area of because research as well as the current goals of that area and cannot simply be calculated with a formula for insertion into the R&D budgeting process.

If the budgeting process begins with a certain dictated percentage of basic and applied R&D, the system will be too rigid to adapt to yearly needs. The R&D system is such that it will eventually regulate its levels of basic and applied R&D through programmatic needs in the annual budget. It is simply up to the decisionmakers to accurately discern these needs.

4.6 Management of Energy R&D

Restructuring energy R&D management is an attempt to gain value from federal spending by eliminating redundancy and unnecessary administration. As the chief manager of energy R&D, the DOE has been investigated by members of Congress resulting in a variety of legislation and policy options. Congress definitely wants to restructure the DOE, but has yet to decide on a unified option. Options for restructuring include making it a subcabinet agency like its predecessor the ERDA, an overhaul of management practices, and elimination.

4.6.1 A Subcabinet Agency

Opting to transform the DOE energy R&D program into a subcabinet agency may have its advantages in simplifying management, but it also has its drawbacks in managing collaborative, interagency R&D. The DOE has grown considerably since its inception and currently manages many programs and has a broad spectrum of responsibilities. Narrowing the amount of programs and responsibilities may reduce bureaucracy. This option ostensibly reduces layers of management in performing R&D by limiting the scope of the agency. However, it is the actual limited management scope that will increase the complexity of managing multi-agency R&D.

4.6.2 Revamped Management Practices

Overhauling the management practices of the DOE is an option to improve energy R&D efficiency. DOE has been conducting an introspective analysis of its management and business practices in an effort to strengthen a commitment to an open and accountable government. Frequent attempts at this option have failed in the past, but are nonetheless worthwhile. In a recent Senate Energy and Water Development Subcommittee meeting, the Chairman, Senator Pete Domenici, reported that the DOE has failed to reduce administrative costs this past year.²⁰ Proponents of this restructuring option say the DOE should be managed more like a business. Managing government agencies like businesses is a good idea and respectable goal, but many doubt the plausibility. This option may go through a few more iterations, but it appears to be merely a stepping stone until more drastic action can be decided upon.

4.6.3 Elimination

Elimination of DOE is a questionable option for restructuring energy R&D. The inherent problems concomitant with this option include the placement of energy R&D and other programs managed by the DOE. This option basically eliminates the present structure of the DOE and disperses its programs throughout other agencies. Whether this option simplifies the management scheme or makes it more complicated is arguable. This option appears to require drastic change without definite benefits.

²⁰ Senator Pete Domenici, Chairman's address, Senate Energy and Water Development Subcommittee meeting, Dirksen Senate Building in Washington D.C., 7 July 1997.

4.6.4 Accountability

A lack of accountability often promotes inefficiency in government programs. In an effort to curb this problem, administration and Congress have enacted laws and policies such as the Government Performance and Results Act of 1993 to reform government management. This act requires agencies to develop strategic plans and annual performance plans. Many other acts like this in the past few years have concentrated on regulating government.

Another option to improve accountability in the DOE is to establish a laboratory facilities commission to assess the performance of laboratories and their programs. This commission may also be responsible for considering closure and realignment of programs and laboratories.

4.6.5 Cooperation

During a period of budget cuts, one of the best ways to achieve more bang for the buck is to cooperate. Cooperation or collaboration on Energy R&D can occur between nations, laboratories, industry, and academia. One potentially fruitful option is to perform Energy R&D in cooperation with academia thus accomplishing important R&D while educating the next generation of scientists and engineers.

4.7 Informing Congress

The difficult task of informing Congress of the needs of the nation can be performed through the construction of both national priorities as well as policy plans for all areas of long term planning. In the absence of these, legislators are often forced to develop their own or develop those of their parties.

In relating national goals and policy plans to Congress, one valid and obvious option is to include them in the development process. National goals or policies are often written by agencies under the President but are not agreeable or understood by other decisionmakers in government. Forcing the actual policymakers to participate in a goal formulating process would allow them to come to a consensus over many national issues.

5 RECOMMENDATIONS

The question of whether or not energy R&D funding should be cut to assist in balancing the budget does not have a definitive answer. However, an absolute tradeoff is not necessary. An analysis of policy options reveals the possibility of both balancing the budget and performing federally funded energy R&D.

5.1 Unified National Priorities

Effective federal R&D spending begins with unified National Priorities. It is imperative that issues such as the relative importance of balancing the budget and providing for current and future energy needs are decided upon. Without this framework all subsequent funding decisions and actions are futile.

The development of Unified National Priorities should include the government officials that will write them into law as well as those who will execute them. Such inclusion would allow differences of opinion to be heard, debates to occur, and decisions to be made as a consensus. This would allow the subsequent funding process and decisions therein to be more systematic due to a framework of preexisting goals.

With an agreed upon set of goals for the nation, the government would be provided with a plan to work together to achieve them. Too often, governmental officials strive to achieve their own agendas and thus forgetting the overarching euphemism of the nation: "United We Stand, Divided We Fall."

5.2 Renewed Energy Policy

5.2.1 Reassessment

The U.S. Energy Policy should be reassessed and revised to incorporate long term national goals in order to provide direction for policy decisions regarding Energy R&D. A panel has been created "to provide recommendations on how to ensure the U.S. energy R&D program addresses the economic, environmental and national security needs of the nation for the next century."²¹ This panel, created under the auspices of the President's Committee of Advisors on Science and Technology (PCAST) will report its findings in October 1997.

The DOE has also been currently developing a new strategic plan for the nation's energy policy. The results of this plan are expected to be available September 30, 1997. This report will provide insight into achieving energy security, what percentages of basic and applied research to invest in, and which energy resources deserve funding.²²

5.2.2 Coordinate Efforts

These reports are a good start toward alleviating energy policy concerns. However, their findings will come 2 months too late to effect funding decisions for fiscal year 1998. Findings may also be outdated for use in

²¹ Stacy Jarboe, "A New U.S. Energy Policy," *Mechanical Engineering*: 36, July 1997.

²² "Department of Energy Strategic Plan: Working Draft," 16 June 1997.

FY1999 funding decisions. In the future, reports such as these should be conducted on a timely basis, thus allowing the promulgation and use of their information.

Both the PCAST and DOE reports are being produced at the same time. Since the information in these reports deals with the same subject, energy policy, such redundancy should be eliminated in the future. In the future, PCAST should complete reports by June, allowing their information to be used not only by Congress for funding decisions, but by agencies such as the DOE who are required to produce similar reports and can benefit greatly from the information.

5.3 Federal Budget Overhaul

With evolving national priorities and a decreasing budget, there is a need for a new approach to federal spending. The budget problem does not lie with a large or increasing demand for new R&D, it lies with the exorbitant amount of entitlements. Today, entitlements are a swollen 53% of the federal budget, and unless their growth rates change, discretionary programs like Energy R&D will face an incessant budget squeeze.

5.3.1 Entitlement Elimination

Taking advantage of government entitlements has become a prevalent and lucrative practice. Entitlements are currently more than half of the current budget and growing at an alarming rate. At their current growth rate, mandatory and interest spending will completely phase out discretionary funding by the year 2031.

Eliminating the exorbitant spending on entitlements will require extensive legislation by Congress. Such legislation will be unfavorable to those who have grown dependent on entitlements, but will allow

Congress to regain control of the budget. Entitlement spending programs don't have to be eliminated, simply transferred to discretionary programs. As such they can be regulated and scrutinized just as programs like Energy R&D. No government spending program should transcend scrutiny and funding cuts, and transferring existing entitlement programs to discretionary programs will bring this idea to fruition.

5.3.2 Budget Cap Enactment

Enticement to overspend has proven immense and must be curtailed. Congress should enact spending caps in order to curtail astringent spending habits. Such caps could provide great assistance in not only balancing the budget but paying off the national debt. Once the national debt is paid off, an annual budget cap equivalent to the previous fiscal year's revenue should be enacted. This would prevent future deficits and debts from incurring.

5.4 Efficient R&D Budgeting

The fact that energy R&D is a discretionary program is not the problem. The problem is that energy R&D competes with many other important areas of R&D for a shrinking discretionary budget. To solve this problem, merit based funding level analysis should be installed. Instead of competing based upon budget category, programs should compete based upon potential merit for achieving national goals. Competing for funding in this manner is beneficial because it ensures funding is allocated to programs with the highest potential.

Long term R&D planning should be encouraged and allowed through the use of multi-year budgeting. Construction, facility, or program costs that involve sunk investments should be initially evaluated in their entirety as opposed to superfluous annual evaluation

which might cut funding and waste investments.

5.5 Basic and Applied R&D

The R&D funding process should not be subject to rigid percentage requirements of basic and applied R&D. Percentage requirements may serve as a goal, but should not dictate the funding process. The process will work itself out as programs with the highest potential for achieving national goals receive funding regardless of their categorization as basic or applied R&D.

5.6 Improved Energy R&D Management

The track record of the DOE and/or its management practices is irrelevant when considering levels of energy R&D funding. If the management system of an agency is not working effectively, elimination of the agency and all of its programs, although alleviating much work for the decisionmakers, is not the panacea. The path to the solution begins with an experimentation of management approaches for deserving programs.

5.6.1 Simplified Management

The management practices of the DOE should be completely examined, simplified, and where possible, emulate a business environment. The DOE should be closely scrutinized for redundancy and unnecessary bureaucracy and administration costs. The DOE has become too large, accumulating too many programs and responsibilities. Where possible, DOE management practices should be simplified to prevent confusion and redundancy.

Business practices should also be incorporated into the DOE management scheme. Examples of these might include the

dispersion of program and employee rewards for producing successful R&D.

5.6.2 Accountability

DOE programs and laboratories need direct accountability for their specific goals and tasks. An effort toward improving this accountability was spearheaded by the Government Performance and Results Act of 1993 and should continue to be fostered.

Another effective addition to the DOE management scheme would be a laboratory or program closing commission that annually reviewed programs based upon achievement of their prescribed goals. This commission should be responsible for making recommendations for closures, changes in funding levels, and management improvements. This would serve to keep the programs and laboratories aligned with their respective goals, provide accountability, and prevent funding inefficiency.

5.6.3 Collaboration

All efforts involving collaboration between national laboratories, industry, and academia should be fostered and encouraged. It is through this collaboration that we will get more bang for our buck with the energy R&D dollar. Research without cooperation is ludicrous. Why research if we can not use or share the results? What should we research if we do not have a grasp of what is needed? Collaboration would allow cost-sharing in a period of budget scrutiny. It would also promote innovation and education. Collaboration is the recipe for R&D success.

5.7 Inform Congress

Congress needs to be included in a National Priority formulating process with the Executive Branch. This process will resolve discrepancies and concerns and produce a

framework or plan from which to base policy decisions like balancing the budget and funding energy R&D. This upfront plan will make subsequent decisions regarding these issues simple and systematic.

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THE WISE PROGRAM

WISE is a ten week internship program allowing approximately 15 engineering students to spend 10 weeks in Washington D. C. learning public policy during the summer of their senior year. Throughout the internship, the students are introduced to leaders in industry, Congress, and various governmental agencies. Each intern completes a research paper on a current public policy topic.

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