S. Hrg. 109–349

AN ASSESSMENT OF FEDERAL FUNDING FOR PRIVATE RESEARCH AND DEVELOPMENT

HEARING

BEFORE THE

FEDERAL FINANCIAL MANAGEMENT, GOVERNMENT INFORMATION, AND INTERNATIONAL SECURITY SUBCOMMITTEE

OF THE

COMMITTEE ON HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS UNITED STATES SENATE

ONE HUNDRED NINTH CONGRESS

FIRST SESSION

MAY 26, 2005

Printed for the use of the Committee on Homeland Security and Governmental Affairs

U.S. GOVERNMENT PRINTING OFFICE

21–826 PDF WASHINGTON : 2006

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
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AN ASSESSMENT OF FEDERAL FUNDING FOR PRIVATE RESEARCH AND DEVELOPMENT

THURSDAY, MAY 26, 2005

U.S. SENATE,
SUBCOMMITTEE ON FEDERAL FINANCIAL MANAGEMENT,
GOVERNMENT INFORMATION, AND INTERNATIONAL SECURITY,
OF THE COMMITTEE ON HOMELAND SECURITY
AND GOVERNMENTAL AFFAIRS,
Washington, DC.

The Subcommittee met, pursuant to notice, at 2:37 p.m., in room SD–562, Dirksen Senate Office Building, Hon. Tom Coburn, Chairman of the Subcommittee, presiding.

Present: Senators Coburn, Carper, Levin, and Lieberman.

Chairman COBURN. The Subcommittee will come to order. I thank each of you for attending.

OPENING STATEMENT OF SENATOR COBURN

Senator COBURN. Last year, venture capitalists in this country, through the private sector, invested over $20 billion in various projects in the United States. The Federal Government outside the ATP program invested over $50 billion in research.

The hearing today is not to say that there are not some good things that come out of every government program, but is to assess the relative dollar contribution versus the benefit of the programs that we are investing in.

I think one of the things that every American can agree on is that having a deficit each year, and I would preface that the last time we had a real surplus in our country was 1973. All you have to do is look at the national debt to assess whether or not that is a true statement because it rose in each of those years.

The fact is this year it will be over $620 billion. The only thing that lasts longer than life are government programs. The purpose of this hearing today is to take a good hard look at one of those particular programs that has been recommended for elimination through President Bush's budget recommendation, and assess and evaluate the quality, the impact and the potential future impact and cost benefit for that program.

With that in mind, I will ask for unanimous consent that my entire opening statement be made a part of the record and I would introduce to you our Ranking Member, Senator Carper and ask for his opening statement.

[The prepared statement of Senator Coburn follows:]

PREPARED OPENING STATEMENT OF SENATOR COBURN

Last year, venture capitalists invested over $20 billion into various projects in the U.S. economy. Industries including biotechnology, telecommunications, and health care services received hundreds of millions, if not billions, of dollars in funding from private investors. All of that venture capital funding also doesn't even take into account the massive amount of money spent each year on research and development, or R&D, by publicly-traded American companies. Just to give a few examples, IBM in 2004 spent more than $5 billion on R&D, while Motorola spent more than $3 billion on R&D. In short, the private sector of the U.S. economy is researching new technologies and products at a feverish pace.

This hearing today has been convened to provide an assessment of Federal funding for private research and development, with a focus on the Advanced Technology Program, or ATP. Created in 1988 by the Omnibus Trade and Competitiveness Act, ATP is a Federal program charged to support research that accelerates the development of high-risk technologies in order to increase the global competitiveness of American industry. On its web site, ATP states that its goal is to help companies meet challenges that "they could not or would not do alone." Many of the program's most vocal supporters believe that without the Federal funding provided by ATP, countless research projects would receive no money at all, and that ATP exists to remedy the failure of the market to fund research and development.

Evidence to support those claims, however, is quite limited. Time after time, ATP is shown to fund initiatives that have already been undertaken by the private sector. Year after year, multi-billion dollar corporations receive millions of dollars from ATP. For example, General Electric, or GE, one of the most widely known corporate brands in the world, has received more than $100 million in grants from ATP. Last year alone, GE reported revenues of $152 billion. IBM, with revenues of nearly $100 billion in 2004, has received $91 million in Federal funds from ATP. In total since 1990, Fortune 500 corporations have received more than $730 million from ATP. If this does not constitute corporate welfare, then corporate welfare does not exist.

Regarding the claim that ATP primarily funds research that does not already exist in the private sector, the U.S. Government Accountability Office (GAO), found in a 2000 report that ATP had funded research on handwriting recognition that began in the private sector in the late 1950s. GAO found that inherent factors within ATP made it "unlikely that ATP can avoid funding research already being pursued by the private sector in the same time period." Furthermore, according to the Program Assessment and Rating Tool used by the Office of Management and Budget, ATP does not address a specific need and is not designed to make a unique contribution.

While many supporters of ATP point to the broad societal benefits of scientific research as justification for ATP, the merits of scientific research are not at issue here today. As a physician, I know first-hand the benefits that have been realized due to breakthroughs in the field of medical research. The main issues before us today are the Federal financing of research that may very well be duplicative and the Federal subsidization of multi-billion dollar global corporations.

We are pleased to have with us here today distinguished scholars from the Government Accountability Office, the Heritage Foundation, and the National Academies. On our first and only panel, Robin Nazzaro, Brian Reidl, and Dr. Charles Wessner will give us their assessments of Federal funding of private research and development.

OPENING STATEMENT OF SENATOR CARPER

Senator CARPER. How is that for timing. It is not always that good.

I just left about 50 screaming kids from Cab Calloway School in Delaware in my office, saying do not go to that hearing, stay here and take our questions. I thought I would come here and ask some questions of my own.

To our witnesses today, welcome and thanks for joining us.

I think this is my fifth hearing today and I think it is the last one.

Senator COBURN. You were not in a 5-hour markup for asbestos.

Senator CARPER. How did that go?

Senator COBURN. It is going to the floor.

Senator CARPER. That is exciting.

I have actually quite a long statement here and rather than go through it, if I could, let me just ask unanimous consent to enter it for the record and we will just get right to these witnesses and get this show on the road. Thank you.

Senator COBURN. Without objection.

[The prepared statement of Senator Carper follows:]

PREPARED OPENING STATEMENT OF SENATOR CARPER

Thank you, Mr. Chairman. I appreciate the dedication you've shown so far in using this subcommittee to closely examine programs—even very popular ones—to make sure that the taxpayer dollars we dedicate to them are spent wisely and are getting results.

There's probably room for improvement in every program. I'm sure the Advanced Technology Program is no exception. I think it's clear, however, that ATP has been a success. I think it's also clear that ATP and programs like it should be seen as an integral part of our nation's economic policy, especially in times like these with U.S. industry under so much pressure from overseas competition.

A recent assessment of ATP conducted by the National Academies shows that the program is achieving the goals Congress set out for it when it was created back in the late 1980s. According to the panel's findings, "The ATP emphasizes economic growth and advances the competitiveness of U.S. firms by fostering technologies with potentially large net social value that might not otherwise emerge in time to maximize their competitive value."

I know there are some critics of ATP who would disagree with this assessment. I believe GAO will testify today that flaws in the program's application review process may lead to the funding of research projects that duplicate work already being done in the private sector without ATP assistance. There have been others who've criticized ATP for giving too much assistance to large companies or concentrating it in a handful of states. Others say ATP simply isn't needed and that much of the work it funds would happen with or without its help. I think some of this criticism misses the point.

Data collected by ATP's Economic Assessment Office shows the projects funded under the program have had a real economic impact across the country. ATP has funded projects in 40 states across the country, plus the District of Columbia. The vast majority of these projects were led by small businesses.

The Economic Assessment Office was able to analyze the impact a few dozen ATP-funded projects more closely and learned that they provided American taxpayers a return on investment of some $17 billion. When you consider that ATP has only distributed about $2 billion in grants since it's founding I'd say that's an example of remarkable success.

In simple terms, I think ATP's mission is to find good ideas and help turn those ideas into something that can benefit our economy. It shouldn't matter where those ideas come from. And I don't know that it would ever be possible to guarantee that a company receiving an ATP grant would never be able to get funding for their project through some other means.

It's clear to me that there are some good ideas out there that private venture capital firms probably won't touch. If those ideas have merit, I think the Federal Government, through ATP or some other means, should try to help them along.

ATP has probably made some bad funding decisions in the past, Mr. Chairman, and I'm sure they'd acknowledge that themselves. They'll probably make more in the future. That's the nature of what they do—some research projects bear fruit, others don't. But the program is making an impact in a number of ways. The Economic Assessment Office found that ATP grants in most cases help bring products to market faster. Grant recipients are able to obtain more patents and hire more people. Growth for small firms that receive ATP funds is apparently quite dramatic. Fifty-nine small firms surveyed by the Economic Assessment Office doubled in size after receiving ATP grants. A handful of others grew even more.

Mr. Chairman, I'll close with this. Just over 6 years ago now, when I was serving as Governor of Delaware, I asked the General Assembly for $15 million to start up the Delaware Biotechnology Institute. What we were seeking to do was to create a partnership involving the State Government, the academic community, and the private sector—a partnership that would put Delaware at the forefront of research, development and the commercialization of new life science products. We also sought

to work with our partners to create and retain quality jobs and help our State better compete with our neighbors and with other States in the biotechnology field.

I also worked as Governor to help create the Delaware Technology Park—a partnership between the State, the University of Delaware and the private sector that gives technology companies—both small and large, some of them start-ups—a place to grow their businesses.

I'm proud to say that the Delaware Biotechnology Institute and the Delaware Technology Park are still working to keep jobs in my State and make it a place where companies and researchers involved in science and technology want to come to do business.

I think these snapshots of what's happening in one small State in the economic development arena show the kind of good that government intervention like ATP can do—and are doing. When I was Governor, I thought a major part of my job was to help grow our economy and attract quality, well-paying jobs. I think ATP does similar work for our Nation as a whole.

Thank you again, Mr. Chairman. I look forward to hearing from our witnesses and to discuss ATP's work further.

Senator COBURN. We are going to have one panel today, so I would like to introduce our panel of witnesses. Robin Nazzaro has been with GAO since 1979, has a wealth of audit experience, as well as an incredibly diverse array of issue expertise. For several years she worked on tax and financial management issues and later in the area of information technology.

Most recently, Ms. Nazzaro oversaw GAO's work on federally funded research and development, including responsibility for research into the National Institute of Technology and the National Science Foundation.

Also here today is Brian Riedl, who currently serves as Grover M. Hermann Fellow for Federal Budgetary Affairs at the Heritage Foundation. Mr. Riedl's research has been featured in the *New York Times,* the *Wall Street Journal,* the *Washington Post,* a myriad of other publications.

Before coming to Washington, Mr. Riedl worked as a policy analyst for Governor Tommy Thompson of Wisconsin.

Our first witness to present today is Dr. Charles Wessner, esteemed Director of the National Research Council. He has a long history of public service, having worked for the Department of Treasury, the U.S. Diplomatic Corps, the Organization of Economic Cooperation and Development (OECD), in Europe. Dr. Wessner currently works as Director for Technology and Innovation at the National Academies.

In the interest of time, your full statements will be made a part of the record and I would ask that you try to limit your testimony to 5 minutes and we will give you a chance to offer additional comments as we start the questions back and forth.

Dr. Wessner, if you would please begin.

TESTIMONY OF CHARLES W. WESSNER, PH.D.,[1] DIRECTOR FOR TECHNOLOGY AND INNOVATION, BOARD ON SCIENCE, TECHNOLOGY AND ECONOMIC POLICY, THE NATIONAL ACADEMIES

Dr. WESSNER. Thank you very much, Senator. It is an honor to be here to speak before you both. And I would like very much to welcome your suggestion that we take a hard look at the program.

[1] The prepared statement of Dr. Wessner with an attachment appears in the Appendix on page 37.

Indeed, at the National Academies, one of the things that we specialize in is advising the Congress with hard looks at programs. A hard, that is to say, objective look is our goal.

My goal specifically today is to talk to you briefly about what the Advanced Technology Program (ATP) is, what it is not, and why it is important to continue supporting what we have found to be an innovative and effective program. In the course of that discussion, Senator, I would hope we would have the opportunity also to explore some of the myths and realities about innovation in the United States.

Let me say first off that the National Academies' assessment of ATP was conducted under the leadership of Gordon Moore of Intel. It found that the ATP is meeting its mission goals. In short, we found after careful analysis that the program contributes to our Nation's innovation, economic growth and national security.

The good news is that ATP investments are already yielding high returns. Innovative technologies for knee repair and early breast cancer detection enable more productive lives and can lower medical cost. ATP has also helped to fund work on supporting U.S. manufacturing, such as printed wiring boards, and supported promising new technologies ranging from fuel cells to DNA diagnostics that will potentially revolutionize drug discovery.

There are a lot of common questions about ATP, and let me go to some of them. Let me first quote a promising young entrepreneur in Silicon Valley. She was asked why the government should fund the development of enabling technologies. And since you can read faster than I can talk, I thought I might just let you take a look at Elizabeth Downing's point. Elizabeth Downing, 3D Technology Laboratoris, NRC Report, states on page 65, "Why should the government fund the development of enabling technologies? Because enabling technologies have the potential to bring enormous benefits to society as a whole. Yet private investors will not adequately support the development of these technologies because profits are too uncertain or too distant."

We all recognize the potential of new innovative technologies. The problem is that private investors cannot adequately support them, and for good reason. One of the things that troubles me is people often refer to this as just a government program, picking winners and losers. The point is that the program is industry driven. Unlike many research programs in the Federal Government, the projects have to be proposed by industry, they are directed and carried out by industry, they are funded by industry on a cost-shared basis. This is why the program was adopted on a bipartisan basis when it was established. The awards often serve a catalytic function, bringing together partners from large companies and from small companies as well as universities.

The bulk of the ATP awards, nearly 70 percent, go to small businesses. Why is that important? Because small business drives innovation, employment and growth in the U.S. economy.

Does the program work well? Yes, it does. How do we know this? We know this because the ATP program, ironically, is the most intensively studied, rigorously scrutinized, and carefully assessed of any of the U.S. technology programs over the past 50 years. By itself, the National Academies' review consumed 2 years, three

major meetings, two major reports and numerous detailed studies led by a 15-person steering committee chaired by Gordon Moore. It involved leading economists and wide consultations with the venture community, corporations, small companies, and government officials.

Why do I tell you that? Because the conclusions that we reach here today about the program were done laboriously, carefully and according to the highest standards of the Academy.

One of the things I would like to draw to your attention is a common myth. Many in the policy world believe that because we have a robust venture capital market, VC finance alone is the solution to many of the challenges of early-stage finance.

But I think what you may realize is that, as Congressman Verne Ehlers pointed out years ago, there is actually a valley death where it is very difficult to take the ideas from federally funded research and take them across the valley to the promised land, as it were, of product development, innovation and commercialization. These problems are especially severe for risky but promising new technologies.

One of the things to recognize are the limitations of venture capital. Basically, venture capitalists are not focused on early-stage finance. This is not a failing. They are not supposed to be focused on early-stage finance. The venture capital goal is not to develop the U.S. economy in the abstract. The goal of venture capital funds is to have a return on the funds that are given to them by their investors. If you look at this pie chart,[1] you can see that the seed funding available is actually quite small.

I would like to quote a member of our board, David Morgenthaler, who is one of the past presidents of the National Venture Capital Association. David Morgenthaler, Morgenthaler Ventures, NRC Report, on page 66 states, "[The ATP] is an excellent program for developing enabling, or platform, technologies, which can have broad applications but are long-term, risky investments."

"Venture capitalists are not going to fund these opportunities, because they will feel that they are at too early a stage of maturity. Government can and should fund these technologies. In fact, it should do more than it is doing."

What he points out there again is simply that the program is an excellent program. It is one that has proven itself, and it is one that venture capitalists endorse.

There is also another myth about the program. Some still ask "would not private capital support an ATP project anyhow?" The short answer is "usually not." Why? Because the type of projects that ATP invests in are usually too risky, the technology often requires competencies that are not controlled by one firm, or the cost is simply too high. These are the very factors that the program addresses. Our research supports this view.

Looking at 1998 ATP applicants one year after, NRC researchers found most of the non-winners had not proceeded with their research.

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[1] The pie chart entitled "Large U.S. Venture Capital Market is Not Focused on Early-Stage Firms," submitted by Dr. Wessner appears in the Appendix on page 41.

I realize that my time is short here but I would like to emphasize that we are not alone. There are a variety of programs around the world like ATP. One of the analogies that I like is that I am not sure I would actually favor the Air Force in the abstract, sir. But if other countries have an Air Force, I think it is a jolly good idea that we have one, too, and that it be the best.

The list below describes some of the Chinese programs in the semiconducter sector.

There is the related problem with some of the programs. When they garner share in leading technology industries, even if what they did to get them is illegal, they still keep that position.

But they are not alone in having extensive programs. Look at some of the smaller countries: TEKES in Finland, a country of 5 million people, has a program very similar to ATP. It is funded at $540 million for a country of 5 million people. In Belgium, a nation of 10 million people, they have a consortium for microelectronics research called IMEC that has budgeted $157 million. The EU has a 5-year Framework programme at $22 billion, and they are planning to double that. Taiwan, where I just visited as an adviser to the prime minister, has the Industrial Research Institute which is funded at over $500 million.

I do not want to abuse my time here, sir, but I think it is very important to understand that first we have a sunken cost of $132 billion in research each year that we need to capitalize on, and ATP helps us do that. We need to understand the inherent challenges of early-stage finance and the limitations of venture capital, both in terms of when they invest in the development cycle and what they will invest in.

In a global economy, as I have pointed out, there are large programs, many large well-funded programs, that are successful in what they are trying to do.

We should also keep in mind historically that the U.S. Government has long played a major role in developing the U.S. economy. There was a period when we did not, Senator, from about 1792 to 1798. Since then the government has helped to develop many technolgies from interchangeable parts for muskets to the telegraph. I am very proud of what the Congress did in 1842 when it gave Samuel Morse a $30,000 grant, a huge sum at that time, to prove this complicated idea that you could actually transmit signals and messages down electric wires.

Examples also include aircraft frames, turbines, and radio, nuclear energy, computers, semiconductors, the internet, and the genome.

Senator COBURN. Dr. Wessner, could you try to sum up?

Dr. WESSNER. Thank you, sir, because I am just reaching my conclusion.

I would lastly like to recall that these contributions to our economy are central elements in our national security. ATP has made significant contributions to our national security, to homeland security. They have developed an x-ray technology that lets you see what is inside containers. This is very useful for national security, very useful for border security.

So in sum, sir, I would like to give you the final conclusion from the NRC report. I think again you can read this more quickly than

I can state. But my point is that we gave a very careful assessment.

And I would like to stress, in closing, that someone described me as a friendly witness. No sir, we are not, at the Academy, a friendly witness. We are an objective witness. After careful analysis, we found that the program works and that it achieves its objectives, and we would hope that you would continue to fund this well managed, effective innovation program.

Thank you, sir.

Senator COBURN. Thank you, Dr. Wessner.

I would welcome our other Member, Senator Levin. If you would care to make an opening statement now or you would care to defer, it is your privilege, sir.

Senator LEVIN. Thank you very much, Mr. Chairman, for your graciousness. And I think I will make a short opening at the beginning of my questions. But I would like to submit my entire prepared statement at this time.

[The prepared statement of Senator Levin follows:]

PREPARED OPENING STATEMENT OF SENATOR LEVIN

America's tradition of pursing government policies that stimulate economic growth, create jobs, and establish self-sufficiency in industries critical to national defense dates back to the founding of our Republic. One of our most forward thinking and prolific founding fathers, Alexander Hamilton, not only created the Nation's banking system and laid the foundations for the stock exchange, but he urged a Federal role in developing the U.S. economy.

Alexander Hamilton understood that the wealth and strength of a nation is founded on its ability to innovate, create and manufacture new and useful products. Although much has changed since the early days of the Republic, this basic premise continues to hold true.

Today, American manufacturers and businesses face unprecedented foreign competition. Cheap imports from low-wage nations with weak labor and environmental standards put pressure on American manufacturers to shutter their facilities and move offshore to remain competitive. According to the Bureau of Labor Statistics, nationally we have lost nearly 2.8 million manufacturing jobs since January 2001.

As a nation, we can't compete with low wages and weak environmental standards. Instead we should compete with cutting edge research and advanced technology. Indeed, America's strength is our intellectual, inventive and creative capacity and our ability to constantly innovate through technological developments to increase productivity. Public-private partnerships and collaboration have been a critical part of that process, increasing investment in R&D, leveraging dollars and resulting in overall benefits to the economy and society.

Manufacturers' investment in innovation accounts for almost two-thirds of all private-sector research and development; this investment in turn leads to advances in other manufacturing sectors and spillover into non-manufacturing activities in the United States. We should be doing all we can to promote programs that help create jobs and strengthen the technological innovation of American companies.

The Advanced Technology Program (ATP) administered by the Department of Commerce's National Institute of Standards and Technology is one of the few Federal programs available to help American manufacturers remain competitive in the global economy. In particular, ATP helps improve manufacturing efficiency and competitiveness which lead to growth in productivity. ATP is a bipartisan program that was established under the Reagan Administration and funded under President George H.W. Bush's Administration, which recommended significant increases in the program in its FY 1993 budget. This high octane economic development engine should be supported by Democrats and Republicans alike.

The ATP was created in part to ensure that the U.S. economy benefited from Federal R&D investment through partnerships. ATP bridges the gap between the research lab and the marketplace by providing cost-share funding in high-risk R&D with broad commercial and societal benefits that would probably not be undertaken by the private sector because the risk is too great or because rewards to the private company would be insufficient to make it worth the investment.

Less than 1.5 percent of venture funding is available for proof-of-concept (seed funding) and early product development. It has been said that the ATP facilitates so called "Valley of Death" projects that private capital markets are unable to fund. The Valley of Death is the gap between research and commercialization. As one small high-tech start-up participating in the ATP put it:

> "Technology commercialization is HARD. It is also CRITICAL to the growth and economic competitiveness of the United States. For those of us out here in the trenches, the ATP is a vital source of support. ATP is unique in that it specifically focuses on helping bridge the chasm from the lab to the marketplace."

These investments promote the development of new, innovative products that are made and developed in the United States, helping American companies compete against their foreign competitors and contribute to the growth of the U.S. economy. For example, some of the technologies in which ATP was an early investor include DNA diagnostics for medical devices and nanotechnology.

ATP was also an early investor in nanotechnology research. Nanotechnology has the potential to revolutionize almost every aspect of our lives—from smaller and faster computers, to miniaturized medical devices, to highly sensitive detectors to detect chemical and biological warfare agents. Unlike some of the more traditional research investments in nanotechnology—the ATP program is structured to ensure significant industry investment—which helps the commercialization of this high risk technology.

An example of this is the work being done with ISSYS, a small company in Ypsilanti, Michigan, on the development of a portable multidrug infusion system. The need for multidrug infusion has not been met by existing infusion pumps because of their size, weight, and power consumption. Many diseases require multiple drugs to be administered with high accuracy. Cancer treated with chemotherapy and infectious diseases treated with drug "cocktails" are two examples of disease areas needing multiple drugs delivered in accord with a strict regimen. Programs like ATP that are supporting the commercialization of nanotechnologies will ensure that the U.S. retains its position as the world leader in this critical technology area.

ATP is also playing an important role in developing new energy and power technologies that will improve our ability to generate and distribute power efficiently and effectively. This is important for our global economic competitiveness and our national security systems, and to help reduce our dependence on foreign oil. ATP programs invested $225 million (including cost share from industry) between 1997 and 2003 in advanced power technologies, including fuel cells. An example of this is the work of ECD Ovonics in Michigan which, leveraging ATP investment, has developed new materials used to store hydrogen to power fuel cells. This research led to a $40 million development program with Chevron Texaco for commercialization, and to work with the U.S. Army to develop refueling stations for military fuel cell vehicles.

ATP investments in advanced manufacturing technologies are helping companies develop and adopt leaner and more efficient manufacturing processes. This improves their competitiveness and helps strengthen the U.S. industrial base. As we are seeing in Iraq and Afghanistan, a strong and vital industrial base is necessary for us to produce the systems we need for our military, including body armor, combat vehicles, and electronics for advanced weapons and communications systems.

Such technological innovations are also critical to homeland security. ATP through its own investments and industry cost share has invested over $500 million in homeland security technologies like biological sensors.

A March 1999 study found that future returns from just three of the 50 completed ATP projects—improving automobile manufacturing processes, reducing the cost of blood and immune cell production, and using a new material for prosthesis devices—would pay for all projects funded to date by the ATP. According to the Department of Commerce's own 2004 report, returns for the American people, as measured from 41 of 736 ATP projects (just 6 percent of the portfolio), have exceeded $17 billion in economic benefits, more than eight times the amount invested by ATP. That's a good return on taxpayer dollars. DOC further reports that resulting technologies have been delivered to the nation in new or improved industrial processes, products, and services, ranging from more efficient energy sources to improved medical tests.

ATP involvement accelerates the development and commercialization of new technologies. Time to market was reduced by 1 year in 10 percent of projects; by 2 years in 22 percent of projects; and by 3 years in 26 percent of projects.

The ATP has received applications from 50 states and made awards to high technology businesses in 40 states plus the District of Columbia. Over 170 universities have participated in ATP awards.

One criticism of ATP is that it has funded research projects by large businesses. In fact, small businesses are the primary benefactors of the program. About 75 percent of all ATP projects include a small business with 66 percent (508 of the 768) being led by or involving only a small business. But some amounts of large company joint venture ATP participation has been found to be beneficial. The National Academy of Sciences' National Research Council found that the diversity of the ATP awards, involving both large and small companies, is an important feature of the program, and should be retained. It found that large companies bring unique resources and capabilities to the development of new technologies and can be valuable partners for technologically innovative small companies new to the market. ATP requires large businesses to contribute more matching funds to ATP projects: At least 60 percent of project costs.

The ATP has been extensively studied and time and again it has been found to be effective. OMB and the National Academies have rated the ATP proposal review process very highly. One of the most comprehensive evaluations of the program was undertaken in 2001 by the National Academy of Sciences' National Research Council. Dr. Wessner, the editor of that report is testifying today. As I'm sure Dr. Wessner will elaborate in his testimony, the National Academy found the ATP to be an effective Federal partnership program that is meeting broad national needs. The Academy recommended that the program receive additional funding so that it can further achieve its goals. Mr. Chairman, I ask unanimous consent to insert a summary of the Academy's findings in the hearing record.

The Biotechnology Industry Organization (BIO), the Industrial Research Institute, the Alliance for Science and Technology Research in America, the American Chemical Society, the U.S. Advanced Ceramics Association, the National Center for Manufacturing Sciences, the Optical Society of America and many other organizations have also expressed support for ATP. The Senate recently confirmed its support for ATP on a budget resolution amendment I authored with Senator DeWine.

I ask unanimous consent to include in the hearing record a number of letters of support for the ATP and other important Federal research and development programs.[1]

Senator COBURN. That is great, Senator Levin. Ms. Nazzaro.

TESTIMONY OF ROBIN NAZZARO,[2] DIRECTOR, NATURAL RESOURCES AND ENVIRONMENT TEAM, GOVERNMENT ACCOUNTABILITY OFFICE

Ms. NAZZARO. Thank you, Mr. Chairman, and Members of the Subcommittee. I am pleased to be here today to discuss our work on the Advanced Technology Program.

ATP was established in 1988 to support research that accelerates development of high-risk technologies with the potential for broad-based economic benefits for the Nation. Between 1990 and September 2004, ATP funded 768 projects at a cost of about $2.3 billion in Federal matching funds. Under the provisions of the Omnibus Trade and Competitiveness Act, which established ATP, program administrators at the National Institute of Standards and Technology are to ensure that they are not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance.

Research can provide both private benefits which accrue to the owners of the research results and societal benefits which accrue to society as a whole. In some instances, the private sector does not fund research that would be beneficial to society because doing so might not provide an adequate return on the firm's investment.

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[1] The letters appear in the Appendix on page 183.

[2] The prepared statement of Ms. Nazzaro appears in the Appendix on page 52.

To address this situation, the Federal Government supports research that has very broad societal benefits. However, there is a continuing debate over whether the private sector has sufficient incentives to undertake research on high-risk, high payoff, emerging and enabling technologies without government support such as ATP.

In this context, we determined whether, in the past, ATP had funded projects with research goals that were similar to projects funded by the private sector and, if identified, whether ATP's award selection process ensures that such research would not be funded in the future.

Our objective was not to provide an evaluation of the quality of the research funded by ATP or the private sector nor the impact these projects may or may not have had on their respective industries.

To determine whether ATP had funded projects similar to the private sector projects, we chose 3 of the first 38 completed projects, each representing a different technology sector: Computers, electronics, and biotechnology. These 3 sectors represented 26 of the 38, or 68 percent of the ATP projects completed by 1999. We found that the 3 completed ATP funded projects addressed research goals that were similar to those already funded by the private sector. These projects included an online handwriting recognition system, a system to increase the capacity of existing fiber optic cables for the telecommunication industry and a process for turning collagen into fibers for human prostheses.

In the case of the handwriting recognition project, ATP provided $1.2 million to develop a system to recognize cursive handwriting for pen-based computer input, in other words, without a keyboard.

We identified several private firms that were conducting similar research on handwriting recognition at approximately the same time the ATP project was funded. In fact, in this line of research, which began in the late 1950s, we identified multiple patents as early as 5 years prior to the start of the ATP project in the field of handwriting recognition. We found similar results on the other two projects.

Two inherent factors in ATP's award selection process, the need to guard against conflicts of interest and the need to protect proprietary information, make it unlikely that ATP can avoid funding research already being pursued by the private sector in the same time period. These factors, which have not changed since 1990, make it difficult for ATP project reviewers to identify whether similar efforts are being funded in the private sector.

For example, to guard against conflicts of interest, the program uses technical experts who are not directly involved with the proposed research. Their acquaintance with ongoing research is further limited by the private sector's practice of not disclosing its research efforts or results so as to guard proprietary information.

In conclusion, we recognize the valid need to guard against conflicts of interest and to protect proprietary information. However, as a result, it may be impossible for the program to ensure that it is consistently not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance.

Mr. Chairman, that concludes my prepared statement. I would be happy to respond to any questions that you or Members of Subcommittee may have.

Senator COBURN. Thank you.

Senator Lieberman, while you were out I offered an opportunity for you to make an opening statement now or when you start your questions, whichever would be your prerogative.

Senator CARPER. And I spoke on your behalf.

Senator LIEBERMAN. You gave an opening statement on my behalf? Very nice of you.

I will wait until the last witness and then, if it is all right, make an opening statement. Thank you.

Senator COBURN. Absolutely. Mr. Riedl.

TESTIMONY OF BRIAN RIEDL,[1] GROVER M. HERMANN FELLOW FOR FEDERAL BUDGETARY AFFAIRS, THE HERITAGE FOUNDATION

Mr. RIEDL. Thank you, Mr. Chairman, and the Subcommittee for scheduling this hearing.

My name is Brian Riedl. I am the Grover M. Hermann Fellow for Federal Budgetary Affairs at the Heritage Foundation. The views expressed in this testimony are my own and should not be construed as representing any official position of the Heritage Foundation.

Federal spending now tops $22,000 per household, the highest inflation-adjusted total since World War II, and $5,000 per household more than the government spent in 2001. Budget deficits topping $400 billion are forecast as far as the eye can see. Given the Nation's budgetary challenges, the Advanced Technology Program remains one of the least justifiable programs. The President and the House of Representatives both support ATP's abolition. The Senate should join them.

ATP was created in 1988 supposedly to provide research and development grants to help small businesses develop profitable technologies. In reality, ATP funnels taxpayer dollars to Fortune 500 companies. Between 1990 and 2004, 35 percent of all ATP funding was granted to Fortune 500 companies. For example, IBM has received $127 million in ATP subsidies. General Electric has received $91 million. General Motors has received $79 million. Motorola and 3M have each received $44 million. All in all, 39 Fortune 500 companies have received a total of $732 million from the Federal Government in ATP subsidies.

Mr. Chairman, this is the kind of spending that outrages taxpayers. At a time when the Federal budget is deep in the red, there is no justification for taxing waitresses in Tulsa or cashiers in Flint in order to lavish hundreds of millions of dollars on Fortune 500 companies.

ATP defenders will say that these subsidies generate greater technological innovation. They can point to many technologies on the market that ATP has funded. Of course ATP has funded some successful products. But the key question is whether the market

[1] The prepared statement of Mr. Riedl appears in the Appendix on page 104.

would have produced those products even without ATP. Both economic theory and practice say yes.

ATP does not fund basic science research like the National Science Foundation. Rather it funds the commercialization of research so the businesses can profit from it. Basic economic theory tells us that profit seeking firms have every incentive to fund profitable R&D themselves. If these projects are as promising as claimed, the company should have no problem convincing their shareholders to fund the projects or tapping into the $150 billion that private investors annually spend on R&D.

The 39 Fortune 500 companies that have received ATP funds report a combined $1.4 trillion in annual company revenues. To suggest that these companies cannot afford their own R&D is baseless. Yes, ATP has funded HDTV and flat-panel televisions. But if they had not, a line of investors and businesses surely would have.

The economic argument that ATP merely subsidizes existing R&D is also backed up by surveys of ATP participants themselves. Although the program is supposed to be a financier of last resort for companies that have exhausted all other options, a survey shows that two-thirds of ATP applicants never bothered to seek any private funding before going to the government.

And among the near winners who had claimed that ATP was their final hope, half of them found private funding after they were rejected. Among the other half who did not find private funding, most never bothered to apply for private funding. They just continued to play the ATP lottery year-to-year.

Not only is ATP a giveaway for wealthy companies that merely subsidizes existing research, but evidence shows that Uncle Sam is a poor investor. Only one out of three ATP projects ever brings a new product to the markets. One reason for this abysmal track record, as stated by the last presenter, is that ATP officials try to minimize conflicts of interest by seeking outside grant reviewers with little or no knowledge of the technology markets. And even if they sought market knowledge, most private companies in these markets conceal their research agendas, leaving ATP officials to guess where the market openings are. This blindness results in grants for projects that either duplicate existing private research or are doomed to fail.

Consequently, ATP has granted money for technologies that had already been developed, patented and marketed by other companies years earlier. It has granted money to projects that have been discredited by their entire industry.

Simply put, investors have better knowledge and more skill investing than government officials.

In conclusion, technological advancement is vitally important to this Nation's economy. Yet when the governments try to pick the winners and losers by micromanaging technological innovation, the results will always disappoint. ATP subsidizes Fortune 500 companies that already have the money and incentive to fund their own profitable projects. And too many companies see ATP as little more than an ATM for the projects they would never spend their own money on.

With Federal spending at $22,000 per household and growing by $1,000 per household each year, ATP should be the first target lawmakers seek for savings.

I will be happy to answer any questions.

Senator COBURN. Thank you. We will start the questioning with our Ranking Member, Senator Carper.

Senator CARPER. Dr. Wessner, I just want to ask you to respond just briefly to some of the comments we have just heard.

Dr. WESSNER. Thank you. I appreciate the opportunity.

I have gone over Mr. Riedl's commentary on the ATP program, and I apologize, but I think some of the references there illustrate some of the basic flaws in the analysis.

First, when he refers to basic economic theory, and while economic theory is a really interesting thing, it does not have a lot to do with how the economy actually operates, particularly in the murky stage of early-stage finance.

The idea that the references to profitable R&D, which strike me as something like an oxymoron, decrying that the ATP program only succeeds one of three times. The last time I checked, a .333 batting average was a pretty good batting average.

In the venture capital community, if you succeed 2 out of 20 times, you are doing well. I am not sure that ATP actually succeeds 3 out of 10 times. But the point is that for early-stage finance, that is a very high success rate.

I would also point out, just for a second, if we want to talk about economics, that there is a serious selection bias here. Two-thirds of the program goes to small firms and all the Heritage criticism is devoted to the funds going to large firms. It misses the very conception of the ATP program, which was to do both grants to small firms with promising technologies and to encourage cooperation between large and small companies, which is good for the large companies and good for the small companies. It is a way of strengthening the industrial fabric in the United States on which our national security ultimately rests.

There are also claims that have been made, for example, regarding the Communications Intelligence Corporation on the cursive handwriting recognition. There is a factual error there. That program ultimately succeeded. That ATP program has been adopted by the Palm Operating System.

But fundamentally, what it is important not to leave out, when we talk about how well ATP does, is a point of comparison. What are we comparing it to? We are working in an area where we want to convert research investments into products that help us in our lives, that enhance our national security, improve the ability of the government to complete its missions. ATP does all that. It does it arguably better and with more careful assessment than any other program we have.

I am very pleased to see this status report here. Have you ever tried to get a status report on the success of projects from the Department of Energy or the Department of Defense? We have been mandated by you, the Congress, to look at the SBIR program. We cannot get this kind of data on the SBIR program.

What this data underscores is in fact one of the strengths of ATP. It has one of the most rigorous and effective assessment pro-

grams in the U.S. Government. Its assessment program is considered a best practice model around the world.

Let me just close by saying, that 2 hours ago I left a Dutch delegation at the Academies. They were here to talk with us about how they might adopt SBIR and expressed their interest in ATP. The rest of the world thinks that what America is doing with these programs is really quite interesting and quite effective.

Senator CARPER. Dr. Wessner, how do you measure success at ATP?

Dr. WESSNER. That is a good question, sir. One of the ways you can measure success is in commercial sales. You can also measure it in terms of patent licensing. You can also measure it in whether you have effective spillovers.

Let me give you a quick case. In the early 1990s there was an investment with Bell Labs in extreme ultraviolet lithography. That did not seem to work out for about 3 years. And then Intel decided that was actually the technology it would need to maintain its global position, and it began a consortium based on this technology with Sandia National Laboratories. I think that illustrates the synergies that this program can develop—and particularly, for enabling technologies.

I would consider a metric of success for the funding of Afametrics, which may revolutionize how we develop drugs. As many of you know, we have a serious problem in drug development in this country.

I would also suggest that the investments in microturbines and fuel cells, where ATP has more success than much larger programs elsewhere, are a way of enhancing our energy security and a way of enhancing our national security by being able to provide secure and portable energy supplies.

There are a whole range of things, but let me just close on one of the most amazing set of investments, in nanotechnologies, in Zyvex in Dallas. I was inspired by a speaker who described how important ATP was to developing his nanocompany. And that is exactly were ATP should be in that early phase, where it is hard for the companies to obtain funding and too risky for venture capitalists to invest.

And I would want to stress here that this is not an either/or. We need the basic research. We need the applied research that often comes out of the military. We need other programs like SBIR that are designed to encourage this. And we need ATP. Asking which one is more important is like asking which rung in the ladder do you think you need. You need all the rungs on the ladder. That is how you get there. You may be able to skip one, but it gets very hard to skip two.

Senator CARPER. Dr. Wessner, my staff tells me that the percentage of funds that are invested in larger firms, you mentioned GE, General Motors, and others, that the percentage of funds going to large firms like that has declined over time and that now the percentage of monies that are going to smaller firms is closer to 75 or 80 percent. Is there any truth to that or is that a bold-faced lie?

Dr. WESSNER. No, that is absolutely true, sir. It has gone up sharply. In fact, to illustrate the power of the synergies of working with large and small firms, thanks to an ATP grant GE and a

small company were able to develop a new digitalized breast imaging that has offered serious health advantages to women and to the society.

Very briefly, the advantages are not that it is better than what a very experienced doctor can do, but it is better than what the average doctor can do. Because it is digitalized, you can get a second opinion easily. It has fewer false positives, which has enormous consequences. My understanding is that biopsies are running in the $20,000 to $25,000 range. So not having false positives that result in unnecessary biopsies, not to mention the terror imposed on the woman, is a major gain for society.

And because it was with GE, imagine if the company just did it alone. Here is Joe New Company——

Senator CARPER. Dr. Wessner, I am going to ask you to wrap up.

Dr. WESSNER. My point is that by working with GE they were able to extend this across the Nation, lower the cost, and get it out to areas where there is less coverage. So it is working with poorer people and more geographically thinly populated areas. It is a positive sum that was only possible by the double combination.

Senator CARPER. Thank you. Thanks, Mr. Chairman.

Senator COBURN. I would just make one comment. GE has digitalized every area, every radiographic area, that they work in. This had no impact in terms of doing it. Because GE would have spent the money to do that anyway.

The cost on a biopsy is about $4,000, not $25,000, and digitalization has been taking place in the radiographic industry for years with the plan that everything would become digitalized. And the fact that a company that spends $5 billion a year on its research needs ATP to accomplish this one goal is a way of supporting a small company, I would grant you. But in an environment when we have $622 billion that we are going to spend, over $22,000 per man, woman and child, that we do not have the money for today, to say that ATP is responsible for that and extrapolate it out is not good science.

That is an anecdotal observation that would not have happened had you all not been there. And I would tell you that in every other area of contrast radiography, CTs and everything else have been completely digitized. That would have happened anyway. They were going to spend the money on it because they had to spend the money on it to get it to the point it needed to be so that all x-ray technology can be digitalized. And it is all digitalized today.

They all read them from home at night or in the afternoon, sipping tea.

Senator Lieberman, welcome.

OPENING STATEMENT OF SENATOR LIEBERMAN

Senator LIEBERMAN. Thanks, Mr. Chairman. thanks for your kindness to me. We ought to get together and sip a little tea.

Senator COBURN. And read an x-ray or two.

Senator LIEBERMAN. Yes, read an x-ray or two.

I thank you for calling the hearing. I am an unabashed admirer of ATP, so I disagree with respect.

There is no question about the overall point that Mr. Riedl spoke to, which is that we have an imbalance between our revenues and

expenditures in the Federal Government that we have to work to close. But I would not start here.

Last time I looked, I think this was about $140 million or $150 million a year out of a budget now of $2.7 trillion. And I think this has a multiplier effect that is powerful for our economy.

It is also in the best tradition of public/private partnerships that have made the United States the world's technological and economic leader. We have to continue to do that if we want to stay there.

Our history actually shows that from the telegraph to the Internet, from the automobile to the airplane, it really was Federal support and investment that helped bring those products to the market to spur commercial and consumer demand, and to create jobs.

One that I love is that when Samuel Morse sat in the Supreme Court building in 1844 and typed out that history telegraph message, "what hath God wrought," he was doing it in a demonstration fully funded by Congress, less of a multiplier effect, I guess, in dollars, than what we are talking about. This is the spirit of ATP, which has nurtured the kind of breakthroughs that Dr. Wessner has talked about.

The numbers I have say that overall ATP has invested $2 billion in nearly 800 projects, helping attract another $2.1 billion in private investment. And that the current portfolio of ATP investments is expected to return at least $17 billion in benefits to the American people, which I think is a really good return.

Senator Carper made the point that I wanted to make, that the vast majority of these ATP investments go to small businesses. There was some earlier inclination to try to involve some of the larger businesses cited and to try to push them into collaboration with the smaller businesses. But that has receded now.

To me, ATP is a success story that has earned our continued support, particularly at a time when we are facing competition from abroad exactly in this area. I cite a few countries, Sweden, Finland, Israel, Japan, and South Korea each spend more on research and development as a share of GDP than we do in the United States. That is a bad sign.

Also, today foreign-owned companies and foreign-born inventors account for nearly half of U.S. patents. Of the 25 most competitive IT companies, only 6 are based in the United States and 14 are based in Asia. By the end of 2005, there are going to be 59 advanced semiconductor fabrication plants worldwide and this industry, which was essentially founded in the United States, only 16 of those 59 are going to be based in the United States.

So we have got a problem here and I think de-funding ATP would really be withdrawing from the field and could mean losing economy changing new technologies to foreign countries, to innovators who could not finance their research and development efforts here.

The point is this, that we are living in an age of technological advances at very high speed. The famous fable aside, in this case, in this global economy and technological world, the hare will always beat the tortoise. There are a lot of hares waiting to get out of their cages but cannot unless they receive the kind of support

that ATP gives that they cannot find from the venture capital community.

So I really hope that we will sustain this organization.

I want to just ask one question and not indulge on your goodness in giving me time. Dr. Wessner, I wanted to ask you this, if you could think about and speak to what other public or private entities would be available to accomplish the goals of ATP if ATP were eliminated? In other words what are we at risk of losing?

Dr. WESSNER. Thank you, Senator. At least, I think I thank you. That is actually an interesting, which is to say a difficult, question. I think the short answer is twofold. First, there is not a program like ATP. You would open up a gap in the innovation system. And I think over time there would be a loss for the U.S. economy and for our competitiveness.

I am not, by any means sir, predicting immediate disaster. That would be unwarranted. I would argue that there would be things that we would lose out on having funded here and lose out on having those benefits and technological——

Senator LIEBERMAN. If I hear you correctly now and in your earlier statement, what we are talking about here is that point between the breakthrough discovery and commercialization where venture capital often does not tread, which I have heard some people refer to as the valley of death in the innovation cycle.

Dr. WESSNER. Yes, absolutely. And the program is uniquely designed to address the valley of death. And something that has impressed us in the course of the Academy study, and we do not say this about some of the other programs we are looking at, is that the program has developed exceptional expertise in evaluating these applications and in processing them. I think that some of the difficulties they have about knowing whether or not other research is going on is to be expected. That is true in the venture community. That is true in the banking community, as well. This is not unusual.

But they do have valuable institutional knowledge. There is a substantial body of work about the importance of what economists call intermediating institutions. Between the very powerful, and very positive, private marketplace, which characterizes the U.S. economy, and the sunken costs of the basic research that we carry out, these intermediate institutions act as a bridge across that valley of death. In short, ATP would be very hard to replace. The accumulated expertise is invaluable.

And could I suggest, sir, that there are two areas of application. One is on the health care side where, when we held our first meeting on this, senior officials from the National Cancer Institute argued that this program could be very helpful to them in capitalizing on the increased R&D investments. And second, we are coming out shortly with a report that stresses the importance of public/private partnerships in developing new technologies against terrorism. The fight against terrorism is exactly the type of area where you want to bring new technologies and products forward faster than the market alone would.

The fact that ATP already has helped in some important areas of the war on terror is important.

Senator LIEBERMAN. Thank you. Thanks, doctor. Thanks, Mr. Chairman.

Senator COBURN. Senator Lieberman, I would like to just put in the record to note that according to the testimony we had, the written testimony, the U.S. market share of high technology from 1988 until 2004 has remained exactly the same at 31 percent. I, like you, worry about how we are going to compete in terms of globalization. But I am also concerned that the economics of production favor production outside of this country. And to the point that we are facing today, it is starting to support the research outside of this country. I think that is a valid point.

I wanted to clarify that the hearing today is not about whether research is important to us. The hearing is about are there other ways to do it? And are there other ways to spend the money? And contrast that with the effectiveness of what we are seeing today versus maybe spending that money in other areas.

We spend a ton of money through NIH and through the National Science Institute. It is not a question of decreasing the research. It is a question of is there a better way to spend the money to get more bang for the buck?

Senator LIEBERMAN. Mr. Chairman, I would just respond briefly. Of course, I believe that this ATP does fill a space in the apparatus uniquely that is not filled elsewhere. But I agree with the two other things you said very strongly, which is the real danger now, you are right, we have lost jobs for economic factors, basically that people can get things done more cheaply elsewhere in the world.

The danger now is exactly what you have said, which is that we will lose the research and development base of our country abroad, including the research and development base of American companies, because now they can find highly skilled, highly educated workers abroad who are still working for much less in comparable here. That means we are going to lose the engine of innovation which drives the new jobs.

The other thing, and this is a topic for a separate conversation between me and you, but particularly in the health area I have been talking to people and trying to put some legislation together, and I am going to give you a call and sit down with you, aimed at—I am focusing now for a moment on NIH—on making sure that we get more from what we are investing there and that we develop systems for—and here is the big term that I have learned in the last few months, Mr. Chairman—translational research.

That we figure out a way, as I put it in lay language, to take the clinical breakthroughs and move them more rapidly to the bedside, to the doctor's office, to the medicine chest. That is a real gap that is not being filled now. Thank you.

Senator COBURN. Senator Levin.

OPENING STATEMETN OF SENATOR LEVIN

Senator LEVIN. Thank you, Mr. Chairman. I was really intrigued, Mr. Riedl, when you made reference to that waitress in Flint. I have talked to a lot of waitresses in Flint. And they are deeply concerned about 2.7 million lost manufacturing jobs in this country the last 4 years. And ATP is one of the few programs that we have which is directly aimed at trying to see if we cannot have some fu-

ture manufacturing jobs in America where the government is actively involved in supporting technologies which might otherwise not be supported.

Would they otherwise be supported? That is the question that we can argue over. But we have got some good evidence on that from people who are right there on the front line. We have a lot of folks who have received these grants who have said that but for these ATP grants, they would not have produced the technology. That is pretty direct evidence. There are a lot of people who have said this.

Here is a letter from RAPT Industries in Freeport, Pennsylvania.[1] "My company, RAPT Industries, was the recipient of an ATP award from 2003 to 2005. RAPT is developing a revolutionary new process for manufacturing precision optics. ATP has played a critical role in our success, funding our technology development when NO OTHER source of commercial funding was available."

So it is kind of easy for us to talk about theory, and we do a lot of that. But there are an awful lot of folks out there who have received these grant awards, who have said to us that but for that support they would not have been successful and that they could not have produced what they produced. And what they produced has been a success.

So I am willing to put an awful lot of stock in those stories that we receive from people who have actually been recipients of these grants.

I am also deeply concerned about what other countries do, compared to what we do. I am talking here governments. We look at worldwide government funding for nanotechnology. Japan spent $800 million in 2003 compared to our $774 million. We used to spend more than Japan on nanotechnology, by the way. They have now caught us and overtaken us.

I think that there is a philosophical issue here in terms of the role of government. You just described this as government picking winners and losers and that is it for you. We pick winners and losers all the time.

In energy we pick winners and losers. We decide we are going to provide this kind of tax credit for this kind of energy development or oil exploration. We are going to supply this kind of tax credit for biotechnology. We are going to produce Ethanol. I guess the credits for Ethanol is picking a winner or loser is it not?

Mr. RIEDL. Not one that we support, either.

Senator LEVIN. That is exactly my point, that there is a real philosophical issue here. This is not just a question of whether or not this specific program has produced more than it has invested, and I will get to those numbers in a minute.

But there is a philosophical issue, a philosophical backdrop to your testimony here, which has to do with the role of government and just how active do we want our government to be in terms of giving incentives or in terms of giving the kind of support that some public policy would suggest we ought to support, whether it is energy production or whether it is putting in energy saving windows. We decided at one point we were going to give tax credits

[1] Letter from Dr. Peter Fiske, Co-founder—RAFT Industries, Inc., dated May 20, 2005, to Senators Carper and Levin appears in the Appendix on page 183.

to people who will put in energy saving windows as a matter of public policy. There were a lot of folks who asked what are we doing that for? They said let the market decide that.

We decided well, if you let the market decide that we may stay on the same course that we are on relative to energy, which is a huge deficit in energy. So we cannot just let the market work its will or else we are not going to do things that we need to do in energy conservation. We are not going to do the things we need to do in global warming. Do we want to let the market do what it wants to do in global warming? Or is there a public policy that is telling us hey, if you keep going down that road, we are going to pay a heavy price. You cannot just let the market play out and have its will on everything.

That does not mean you do not believe in the market. It just means you believe in a government role as well. I think there is a difference here, a significant difference in emphasis, that lies behind your testimony than lies behind Dr. Wessner's testimony.

Now in terms of what this produces, what does the ATP program produce? There is a report from the Department of Commerce. It is the 2004 Report on Economic Progress measuring the impact of the Advanced Technology Program. It is a Department of Commerce publication. It says the following: Returns for the American people as measured from 41 of the 736 projects, which is just 6 percent of the portfolio, have exceeded $17 billion in economic benefits, more than eight times the amount invested by ATP. Resulting technologies have been delivered to the Nation in new or improved industrial processes, products and services ranging from more efficient energy sources to improved medical tests.

I would ask that the report be made part of the record. It may have already been made part of the record.[1]

Senator COBURN. Without objection.

Senator Levin, are you aware of how that $17 billion number came into existence?

Senator LEVIN. No.

Senator COBURN. Could we have somebody address that, if anybody would care to on the panel, the $17 billion number?

Let me give you the history of how it came about. There was a survey asked by ATP about what do you think the economic benefit is of your product. There was no scientific study. There was no actual econometric measurement. That was a response to a question by ATP of what they thought it was. And it has no connection with what reality is because it is a thought. It is not a measured response, in terms of economic return.

So we really do not know whether that is a true statement or not. It may actually be much higher. But it was on the basis of a poll of the ATP awardees that asked them about the potential value of that project.

Senator LEVIN. I think it could be off but it could be accurate. It is the best evidence we have, though.

Senator COBURN. But from a scientific standpoint, Senator Levin, if we are going to make decisions based on total guesses on the

[1] The 2004 Report on Economic Progress submitted for the Record appears in the Appendix on page 125.

ATP, and that is what we are doing. There is no econometric model that is measuring that.

And maybe that is something we should do if we continue ATP.

The other thing that I was thinking as you were talking is why should the government not have some ownership associated with this investment, as we do in a lot of drugs and a lot of other money that we fund? Why should the government not get a return for that risk? Should there not be a way of sourcing the Federal Government back for the risk that it is taking, the American taxpayers, in terms of putting this money out there?

This may very well be a true number. I just would tell you, as looking at how the number came about, it is hard to know whether it is a real number or not.

Senator LEVIN. Let me just read something, and I thank you for that. I think it is the best evidence we have, even though it comes from the people who received the grants, is what you are saying, the people who actually were in the program. I will give them a presumption that they are telling the truth. I think there is the presumption that they are giving us on an honest estimate.

But in any event, let me just read this one piece and I think my time is up. ATP's Economic Assessment Office, according to this piece of paper I am reading, and maybe we can ask the witnesses if they know if this is accurate. But ATP's Economic Assessment Office uses statistical analyses, case studies, economic and econometric analyses, surveys and other methodological approaches to measure program effectiveness and return to taxpayers.

I do not know where this came from so I cannot tell you that this is accurate but I have to assume it is, since my staff gave it to me. They always give me accurate information.

But according to this, the Economic Assessment Office at ATP does use econometric analyses. So we ought to find out just what is the basis from them, since they are not witnesses here today—I wish they were. But in any event, perhaps we could ask them what is the basis for that $17 billion.

Senator COBURN. Absolutely. That is a fair question. And actually, without objection, we will ask that question of ATP.

Senator LEVIN. That would be great. Thank you, Mr. Chairman, my time is up.

Senator COBURN. You are welcome to continue if you would like.

Dr. WESSNER. Senator, may I make a small comment?

Senator COBURN. Absolutely. Please do.

Dr. WESSNER. Let we say that I admire your skepticism about numbers in the evaluation process. I think that is often most warranted, and I mean that very sincerely.

What I can affirm is that our multi-hundred page study here looked very carefully at their assessment program. And our view, a view of independent economists not attached to the program, is that it had the greatest rigor of any comparable program.

Senator COBURN. In the Federal Government?

Dr. WESSNER. Yes, in the Federal Government. Now that may not be a high standard.

Senator COBURN. That is a low standard. I want you to know, that is a very low standard.

Dr. WESSNER. Given, Senator, that I said compared to what? They do way better than most.

Second, could I draw to your attention, and I do not want to read it at any length, but on page 208 we have a paper by two independent economists. They concluded—and I will be very brief here, Senator—that ATP is selecting projects and firms that have greater potential for increasing the circulation of new knowledge and for having the business connection necessary to realize economic benefits from its activities.

I am jumping ahead. We provide evidence that the investment community values the ATP award. Among firms that seek additional funding, we find that ATP award winners are more successful than non-winners.

Now I am very attached to the private markets, and what I find validating for ATP is that after they have made those awards the companies get this halo effect, this certification effect, where the private investors are attracted to them.

Senator COBURN. So what you are saying, there is value to recognition by ATP through a grant that allows them better access to more marketable money?

Dr. WESSNER. It generates better recognition—because the investment community recognizes that the selection criteria are tough. Remember only 12 percent of the firms are selected. In that regard, that is why I reject this idea that ATP is corporate welfare. Corporate welfare, as you know, is an entitlement for a class of people or firms—but only 12 percent of the ATP applicants receive an award. Thus an ATP award is much more akin to getting a scholarship. It is very competitive and you have to be good to get it.

Senator COBURN. Thank you. Ms. Nazzaro.

Ms. NAZZARO. If I may comment, one comment that Dr. Wessner made was that the individuals that were doing these reviews were not affiliated with the Department of Commerce. You may want to include that as a question for the agency because we have found in the past that these reviewers are, in fact, paid by the Department of Commerce to do these studies. While we did not review the 2004 study, we have reviewed earlier studies and have found that some of the economic assumptions that are made have been flawed.

For example, in one case they had cited an example with the printed wiring board effort that they had funded. And they had extrapolated that that influence went to the entire industry. Well, the industry at the time had 800 members. So there was no way that one project had that kind of an impact across the whole industry, if you will.

Granted, what they had done was good research. However, you could not make that kind of an extrapolation.

Senator COBURN. I think it is also fair to note, if you are a stockholder in a major corporation, you are thrilled to get an ATP grant. That is return on your money. There is no investment, there is no risk on this money.

I want to ask a question if I might. One of my concerns with ATP is this is supposedly grant money from people who cannot get money somewhere else. Is that true? Is that the way the project is supposed to be set up? In other words, the design behind the ATP

program was that this was going to supply a need where capital was not available for research in the private sector?

Ms. NAZZARO. Just one caveat to that is that it would not be funding existing or planned research that would be conducted in the same time period, in the absence of ATP.

Senator COBURN. So there is two points. First, the GAO study found that 63 percent of the people who actually got grants never asked for money and never applied for any money in the private sector? Is that a true statement?

Ms. NAZZARO. Correct. That was in our 1995 study.

Senator COBURN. And second, there was no knowledge on the part of ATP in granting that whether or not there was any other research being done in any of the private sector. Is that a true statement, as well?

Ms. NAZZARO. At that time, yes.

Senator COBURN. Is that not true now? Has ATP responded to that criticism? Do we see something different now?

Ms. NAZZARO. Yes, in response to that report that we did in 1995, when we did bring them to task, if you will, on the fact that they were not aware of whether these individuals had applied for funding other places, they do now ask that question of whether they have. As to what weight that bears in their final determination, I am not aware of.

Senator COBURN. My staff tells me having not sought private funding today is still not a disqualifying factor.

Ms. NAZZARO. As I said, I do not know what the implication is but they do ask the question.

Senator COBURN. Mr. Riedl, did you want to say something?

Mr. RIEDL. On that, that is exactly the same research that we have seen, that 63 percent never sought private funding that apply, 65 percent of the winners never sought private funding, and 56 percent of the near-winners never sought private funding.

Again, of those who said it was the financier of last resort who just came up short, half of them miraculously found funding after they were rejected. Most of the other half who did not never looked. These are people who never looked before and never looked after. They decided that we are only going to keep playing the ATP lottery year after year.

So for the most part, the argument that we need these grants because we need this technology to keep up with other countries is tough to sustain when data shows that those who do not get the grants or who look are able to get funding elsewhere. What that shows is that we are subsidizing existing research. Despite the best of intentions to create new research, it does not do that.

The point also that I want to make on that is, in terms of the broad argument about how we need to fund technology and how important it is, total Federal R&D spending, according to OMB, has jumped 53 percent since 2001 to $122 billion. ATP represents 0.1 percent of the Federal R&D budget.

So we are not talking about totally taking five steps back, in terms of Federal R&D spending. We are talking about the small sliver, 0.1 percent, that really has an abysmal track record. And that could be shifted into, say, the NSF or the NIH or something

else where you do not see evidence that you merely be subsidizing existing research.

The final quick point that I wanted to make was regarding the argument that ATP creates $17 billion in new value, again that $17 billion number is only relevant if you assume that none of those ATP grants would have been funded by the private sector. If ATP projects create $17 billion but you assume that most of those projects would have been funded anyway and then you would say the private sector would have created $17 billion in new growth for the economy other than the ATP.

And if it is important to have the ATP's endorsement in order to attract more seed funding, I would be happy to have ATP slap a sticker on certain projects, saying the Department of Commerce thinks this is a really good project so other investors go for it, without necessarily giving them the grant. If the grant is not the best thing, just the endorsement, give them the endorsement.

Senator COBURN. Let us go back to those people who do not get grants from ATP. What percentage of the people who do not get grants, who apply for grants but do not get grants from ATP, get funded in the private sector?

Mr. RIEDL. The only surveys that I have seen only look at the near-winners, the people who came up really close. Half of them find private funding after, is the number that I have seen. And again, of the half that do not, that overwhelmingly correlates with those who do not look for private sector funding afterwards. So among those who look, the vast majority find private sector funding.

Ms. NAZZARO. Our numbers support that statement, that half of the near-winners continued their projects without relying on ATP funding.

Another important note is that seven applicants in our study turned down offers from the private sector because they could not reach an acceptable funding arrangement.

Senator COBURN. In other words, they went ahead anyhow but they did want the private sector because they did want to give as much of a percentage of ownership should they have been successful? Was that the implication?

Ms. NAZZARO. That was why they came to ATP, because they had actually sought funding but turned down offers from the private sector.

Senator COBURN. Dr. Wessner if, in fact, the Federal Government continues ATP and does it in a way to where the Federal Government gets a revenue stream off of it, and if your numbers are correct, in 2 or 3 years we can fund more than $125 million just off the earnings potential of the research that you are doing. Why would we not want to make this an investment, rather than a grant, and saying that we are a participant, just like our universities are on drugs and other patents and other patents. Why would we not want to turn ATP into that type of a vehicle?

And if it is really getting a $17.2 billion return on $125 million, why would we not want to grow that in a private investment mechanism and endow it?

On the things we fail to do in Washington is to endow things. That is why we are struggling with Social Security. We are strug-

gling with Medicare. We are struggling with them because we do not save in advance. We do not prepare for the future.

I would just love your thoughts. What about sharing—what is wrong with the American taxpayer, who has now put over $2 billion into this program and gotten what looks like a 900 percent return to the economy over the life of the program, what would be wrong with the American taxpayer sharing enough to continue the program?

Dr. WESSNER. Thank you, sir. We have analyzed a number of other programs and are in regular dialogue and consultation with countries around the world who have similar programs. The European Union, because of their suspicion of the private sector, is always trying to have recoupment mechanisms. And Senator, there is strong support from lawyers and accountants to do recoupment programs from which they would profit.

The difficulty is that it is very hard to calculate the exact benefit that results from any particular grant or any particular project. CEOs generally think it is thanks to their leadership and vision that the company goes on to have major sales. The technical staff generally think it is because of their competence and skill. The government likes to claim——

Senator COBURN. But that is an intermediary problem. That is negotiated every day in the private sector. I am going to give you $50,000, here is what I am going to expect if we are successful and we have a patentable and marketable product. Here is the share of the return and here is the share of the gross sales.

Dr. WESSNER. We think the government already is a partner. The government is a partner because if the company is in existence and paying salaries, we tax them. If the company is making any money, we tax that revenue, as we should. It is a much cleaner, simpler system.

Senator COBURN. Except for everybody that is not getting an ATP grant, they are not getting the money and they are getting taxed as well.

Dr. WESSNER. It is a competitive program, sir. Not everybody gets a scholarship

Second, if I could go on, we are drawing our figures from this analysis, which is publicly available both on the Web and we have them here. Some of these claims, leaving aside my GAO colleague, I do not recognize where they come from. I would like to say, in a friendly but very sincere fashion, that this is a serious topic. And making unsubstantiated claims that the private sector would have done it anyhow, as one of my colleagues here has done, is simply not acceptable analysis. There is no documentation for that. Our figures do not support that assertion of the same high number of companies being funded anyhow.

Senator COBURN. What do your numbers show, in terms of——

Dr. WESSNER. Seventy percent do not go on at all or at the same level.

Senator COBURN. How many go on, at any level, that are turned down by ATP?

Dr. WESSNER. Thirty percent, if my memory serves me.

Senator COBURN. At any level?

Dr. WESSNER. At any level. But I would be happy to get back to you for that and we can actually document this for the record in a serious fashion.

Senator COBURN. So 70 percent of the people who do not get an ATP scholarship do not continue their research?

Dr. WESSNER. In that area, of course.

Senator COBURN. In that area. Nobody picks it up, it does not continue. And you all have looked at the studies to see whether that has been picked up by the private sector?

Dr. WESSNER. My understanding is that the figure is 70 percent either not at all or not at the same level. These things are measured in some nuance, Senator. It is difficult to ascertain if it is a major program or does the company just have one engineer working on it?

One of the points I raised earlier, and as Senator Lieberman suggested, is that it is important to dialogue about this because the hurdle rates and the development process within a firm are hard to understand. Asking a CEO what he is going to do in a particular area, how many resources he is going to put in, what is the potential, can management justify the investment compared to alternatives, is difficult. In the best of circumstances, this is all very tough to learn even without any Federal award at all.

What we have seen is that the Federal awards have a catalytic effect that tend to provide internal justification for investment and also attract external investment. The awards help get something done.

Occasionally, a researcher can come in from the R&D unit and say "look, we just got this ATP award and we want to go forward with this." And the CEO who had turned down the project earlier will say "OK, let's go for it. There may be a market there, and this will provide me with some reputational benefits which will enable us to go ahead."

And again may I put a nuance here? We are not saying that the early-stage financing system in the United States would not work in the absence of ATP. That would be absurd. But to say that this program adds value is true. Also, what I liked was your opening remark, "Is it a quality program?" Yes, it is both internationally and nationally, a quality program. In fact, it is one of the best we have.

Is there an impact? Yes, and they have made a real determined—not perfect but determined—effort to measure it much better than others.

Is there a significant benefit? Yes. Have I associated the Academies' work with that $17 billion return number? No, sir, I have not.

Senator COBURN. The problem is, and maybe it is our measurement. But if you use the PART program that we are trying to use in the Federal Government to assess whether programs are successful, whether they have a measurable end point, can you mention the benefit, do you have defined objectives, it does not meet it. And that is why it was on the President's list.

And the whole purpose of this hearing is to see is if that is legitimate?

Let me just stop for a minute and I want to raise the level. Every man, woman, and child in this country right now owes $36,000 on the Federal Government's debt. The interest on that is $1,800 this year. Plus we are going to add another $2,200 associated with the budget deficit, the real budget deficit, this year. Plus we are going to add another $1,100 in Social Security increased liability and we are going to add another $2,600 this year to everybody in this country in terms of Medicare unfunded liability.

So we are either going to start making the tough decisions about what is good for us and what is not and it may be that ATP is a great program. But should we be spending the money on that great program when there are other great programs that we could? And can we continue to spend $125 million or $135 million on ATP program when what it is doing is actually cutting the legs out from underneath the children of the next two generations because they are going to have a reduced standard of living?

So it is not about priorities. That is where we have to get to. And I recognize and I will tell you, and I think your performance and your demonstration and defense—I read your testimony, it is an excellent defense of this program. And I think it is done very well. But I also think that there are still questions that need to be answered with this program.

One of them is on this slide. The fact that there is no status on programs from 1992, 1994, 1997. The fact that we do not know the status? That is a problem in itself.

But again, let us look at it macro. What should we do as a country, now that we are almost $8 trillion in debt on the regular budget, that we have $43 trillion in unfunded liabilities for the baby boomers, that is my generation and maybe a few of you sitting out there. And we are going to ask our children to pay for it. So it becomes a matter of priority.

Which is the best programs that we should fund? What should we fund first, second, third, fourth, and fifth.

If we were in surplus, I probably would not even be having this hearing because there has been marked improvement in the ATP program since 1996. They have markedly changed. They have changed the amount of money that goes to small businesses and taken a lot more away from it.

But that is not what the issue is. The issue is: Can we afford to have a program when we are having the kind of deficit and problems that we are having today? And is it, looking at the next two generations, in the priorities of where we should be spending our time today?

I believe that we can justify most of the Federal Government programs that we have. I think most of them are well-intentioned, well-meaning, the thought behind them, the people that created them, the people that work in them are well-intentioned. But when we put all that together and then we say our grandkids are not going to be able to afford a college education—it is not going to matter whether we send technology oversees. We are not even going to be able to afford a college education for them as we struggle with this unfunded liability that is in front of us.

So we need to have a critical look, not emotional but a critical look, at everything this government is doing and say which is the

most important priorities. And if you look at the numbers that are happening to us and what the projections are, we cannot grow our way out of it.

So the answer then has to come back as where do we squeeze? Now we could do what I have offered several times. Let us cut everything 5 percent. We could make it. If we cut ATP 5 percent and everybody else 5 percent, we could make it. We know we could do that. But we do not have the political will to do that. We do not have the political will to send that signal to the international financial markets, which is our biggest problem today.

So I do not want you to take this personally, I do not want the people at ATP to take this personally. This is about a good, open, honest evaluation, not is it good. But is it good enough to continue spending the money on that is going to undercut the future of this country? Because this money is borrowed. On 30-year notes we are paying 4 percent on it and it is going to be compounded every year. So by the time you really start compounding, you get a lot of money.

What is our obligation? Is it to make the easy choices now and fund ATP so that everybody at home is happy and the people who run ATP are happy? Or is it to make the hard long-term choices that are best for this country? How do we best secure the future?

And that is my consideration. Ms. Nazzaro.

Ms. NAZZARO. Dr. Wessner points to some of the studies that we have done. In our most recent study, where we looked at three projects, our concern was to look at whether this is research that the private sector would have funded. In those three projects we identified that they were funding projects that were similar to the same goals that the private sector would have funded.

In their agency comments, the Department of Commerce came back and said if we had looked at all 199 projects that were funded at that time, we would have reached the same conclusion. So they concurred that we were not trying to pick examples hopefully to make a best case.

Senator COBURN. So Department of Commerce readily admits that they are funding things that would have been funded in the private sector?

Ms. NAZZARO. In the comments to our report, first they said, we presumably picked these three projects with the intent to make a particular point. We said we did not. We picked three technology areas. Those technology areas represented almost 70 percent of the projects that had been funded by the program.

Initially, we intended to look at nine case studies. But when we realized how labor-intensive it was to do an adequate and thorough job, we cut that back to three to make sure that we were really researching to make sure that these projects were, in fact, similar research goals.

And when they came back and commented on our report, they said if we had looked at all 199 projects that they had funded to date, we would have reached that same conclusion.

Senator COBURN. Thank you. Mr. Riedl, I think it is really fair for you to be able to reference your numbers. I think Dr. Wessner makes a great point. And I think if you do not have those numbers, you need to——

Mr. RIEDL. I do.

Senator COBURN. I will give you an opportunity to do that.

Mr. RIEDL. The numbers that I had mentioned, specifically that the idea that ATP individuals who are near-winners could find funding in the private sector, is not just an economic theory that Heritage has pulled out of a hat. This is based off a survey through a GAO report that was reported in January 1996, which I believe you have with you today.

Senator COBURN. It is a part of the record.

Mr. RIEDL. That shows specifically that half of those near-winners reported finding private sector funding later. And the vast majority of those who did not find private sector funding later reported in a survey to GAO that they did not seek private sector funding.

And furthermore, there is actually a report that was written by the National Institute of Science and Technology within the Department of Commerce in December 1996 that admitted that ATP funds projects which are the most profitable, the most ready for commercial success, and therefore the ones that the private sector would have most incentive to fund anyway. This is the Department of Commerce, itself, saying this.

So I think there is some degree of universal agreement in most areas that there is a real economic issue regarding whether or not we are subsidizing existing research that would have happened anyway, or new research. The evidence seems to show whether it is a PART, GAO, or a Heritage's analysis, that we are probably subsidizing existing research.

And while I do not want to quibble with the studies that are being quoted by Mr. Wessner, he did mention that one of the studies was led by Intel, a gentleman from Intel. And it is not uncommon for studies headed by the industry receiving government studies to show that the subsidies lead to the public good. That is not uncommon to see those conclusions.

Senator COBURN. My observation is that there has been some pretty good improvement through what Dr. Wessner has given forward in his testimony versus 1996. And so I think our dependence is on that.

But I think there is a valid point in what you say, Mr. Riedl because if, in fact, they want us to believe the $17 billion survey but do not want us to believe the survey that says the opposite of that, you cannot use those same methods and come down.

I think it is important for us to have a healthy look at it.

Dr. Wessner, I am going to give you an opportunity to comment again because I want to make sure you get into the record what you want and rebut what you heard from Mr. Riedl if you want to.

Dr. WESSNER. Thank you. There are two things.

One is there are perhaps three brief elements. The first I would like to express quietly a level of outrage about the most recent comment about Gordon Moore. As I am sure you know, sir, Gordon Moore was a founder of Intel. At the time of this study I think he was worth many billions of dollars. He is retired after a long, arducous, and successful career. Many of the medical instruments that you use are as a result of the advances that have gone on through Moore's Law. He is a distinguished person and has chaired

the CalTech Board. The idea that we need to raise an ad hominem comment about a man who gave freely of his time in his retirement years to lead the study is repugnant in the extreme.

I would point out that Gordon Moore was initially skeptical about ATP. He was skeptical that we should intervene in the market at all, although he recognized that the semiconductor consortium Sematech was not a bad idea, (and a successful one I would note). Indeed, Gordon Moore likes to point out that in the case of Sematech, the entire Federal contribution over the 9 years is paid back quarterly by Intel in its taxes.

His observation illustrates the point that as these partnerships to go forward, the gains that you are looking for are realized. Let me also stress that I am very sensitive to the deficit. My son is 19. He is taking economics, bless him. And he came down and said "dad, how are we going to pay back this deficit?" And I said "who is we, paleface? This problem is yours."

Senator COBURN. But that is a very important point and let me make it just for a second. Never in the history of our country have we had one generation of Americans about to leave the next generation in such sad shape. Our heritage defies that we would do that.

And so when we come to a $125 million program that may have some good, is there another $125 million program that has more good?

In other words, it is not about everything is bad. It is not. Unfortunately, my frustration is we cannot get enough people up here thinking that way because we are not going to trip the deficit until we have a financial disaster in the international financial community. I am pretty well down to that. But that does not mean we should not try.

And so the improvements that have been made in the ATP program are great, and it is not that we should not do research, and it is not that there are not good outcomes from some of that research. And it is not that everything that ATP does is wrong or less than perfect. It may be that 80 percent of it is right.

The question is can we afford to continue to spend $125 million in this area, versus should we cut $125 million out of Medicaid? Or should we reverse the Stark Law so that we allow medical technology to flow from hospitals to doctors so we decrease medical error?

The point is that we have to make those decisions and it is incumbent upon us to start doing it pretty quickly or we are all going to be in a pretty good sized jam.

I think your testimony, and your defense of where they are, demonstrates very well that there has been major improvements since 1996. Your testimony said that.

Some of the anecdotal—and I have trouble with anecdotal stories because they do not mean anything scientifically, they do not mean anything mathematically, and they do not mean anything economically because they are an observation of what happened but do not compare what happened to what might have happened by chance or in the private sector.

So when we try to make decisions for investment of Federal taxpayer money based on anecdotal observation, it is not good science.

And we have enough junk science up here, and we certainly should not be using it with economics. We cannot make that decision.

An example being digitalization of mammography. I will guarantee you as much as I take my next breath that that would have happened in the private sector without the first penny from ATP because it was happening everywhere and it had to happen if GE wanted to sell mammography units. They would have funded it had you not funded it.

Dr. WESSNER. Senator, first off, we at the Academies do not fund it. And I would be the last——

Senator COBURN. I mean ATP.

Dr. WESSNER. I will be the first person to defer to your expertise in medical technologies. But I can give you, at the close of this session, the page number where Dr. Griffiths from GE made that argument.

Senator COBURN. If you are from the private sector, you would make the argument every time. You do not have to spend the money. You did not have to spend the money, the Federal Government spent the money for you.

Dr. WESSNER. Actually, they had to spend a lot more money.

Senator COBURN. But they got Federal Government money. If I got a grant and I said hey, I am successful with it, you guys did it.

Dr. WESSNER. I can only tell you what the interview found. We did not conduct the interview—it was done by a group of Harvard researchers—who found that GE basically did not think that there was any money in this technology, in this mammography system. And they were not willing to do it. The ATP award let the advocates of this new technology win the day inside.

While recognizing the reality of a $2.7 trillion budget I would suggest that the real challenge, if I may venture, Senator, is that the difficult choice is to keep ATP.

Senator COBURN. Maybe.

Dr. WESSNER. Because the tides are against it politically. The difficult choice is to say that the ATP program is actually seed corn. And the seed corn is what we need to plant.

Senator COBURN. That is a great point.

Dr. WESSNER. Will every one sprout? No. But the chance that only a third of them do is, in fact, a very positive statement. And they can pay back—that is my point about Intel. They can pay back over time to help reduce this deficit.

Senator COBURN. But we have to qualify. A third do but many of those would have anyway, according to the research that has been done about ATP. Because the private sector would have funded about half of them. And half of those who did not get funded would have gone on anyway.

Dr. WESSNER. I am running a team right now of about 16 economists for an evaluation that the Congress mandated of the SBIR program. The hardest thing in the world, Senator, is to figure out what would have happened anyhow. The question is analogous to "If you had not married your wife, who would you have married?" "If you had not gotten the scholarship, would you have gone to college?" "Where would you have gone to college?" "What would have happened?" Those are darn difficult questions.

Senator COBURN. Those are great points. But we do have testimony and there is a GAO report that says here is the facts.

There has been improvement and I think you make a great point. The hard thing maybe to continue to fund ATP in those choices. You may be right. But what we have to do is really know what the return on it is.

The other thing that I am a little bit disappointed in is everybody pays taxes that does research in this country that makes any income. They pay it on their employees and everything else. And I believe I see a way to fund ATP in the future. And it ought to be endowed by the money, the seed money it puts in. And it ought to get a return for the taxpayers.

And if we continue ATP, then we ought to be figuring out a way for ATP to become self-funded. And if ATP is great, then let us self-fund it and let us let it grow. And let us let it get bigger.

Dr. WESSNER. We would be happy to study that for you, sir.

Senator COBURN. I do not want to study it. I understand one thing. Greed conquers all technological difficulties. It does. The desire to advance, to advance oneself, will cause people to take risks that they would not have otherwise if they perceive that risk benefit reward. That is true in government. That is true in the private sector. That is true of senators and congressmen.

And so my hope is that bringing this information forward today—actually, I have gotten a good viewpoint. I am enlightened somewhat. And I am much more positive about what the changes from ATP than what we saw in 1996. But that does not mean it should not change some more.

The question is if it stays around, how should we modify it? How should we make it more effective? How should we make sure that the American taxpayers, if they are going to fund $125 million a year, of which half of it is probably going to have been funded anyway, how do they get a return on that? And how do we build an endowment so that endowment pays for that? Ms. Nazzaro.

Ms. NAZZARO. Just in summary, we would like to also reiterate your opening remarks, that ATP has certainly been associated with a number of successes. And we have given them credit for encouraging joint ventures and economic growth.

However, the discussion cannot be just about benefits. It has to be about costs.

And you talked about whether there are other ways to do it? If half the projects now are going to small businesses, there is the $1 billion Small Business Innovation Research Program, as well as the Small Business Technology Transfer Program. We have seen that some of the applicants not only receive ATP funding but then go and get SBIR awards, as well.

Senator COBURN. They know where the money is.

Ms. NAZZARO. They know where the money is, that is right.

Also, your discussion of payback. It is our understanding that the Act originally had a payback provision. And each year GAO does a report called the Budget Options Report. We have continuously made that recommendation, that for research, there should be a payback, particularly if it is large companies that are getting the money. There has to be a way that you can assess what the impact has been, whether you have been allowed to commercialize a prod-

uct and you are now having sales or revenues, you should be able to pay back some of that money and make it a self-sustaining program.

Senator COBURN. Dr. Wessner.

Dr. WESSNER. Just a quick observation. We are looking at the SBIR Program, as I mentioned.

One of the things that is important to keep in mind—we refer to the active venture capital community, but the fall from $100 billion available in the year 2000 to just over $20 billion now illustrates some of the unpredictability of venture markets. Both SBIR and ATP saw very rapid rise in applicants as the private sector—if you take a glance at this—as they moved farther upstream and away from this valley of death area.

The last point, if I may, simply, for the record, sir, because it is an important one, regarding the statement by my colleague, whom I respect immensely, that NIST agreed with them on their 2000 report is not accurate. I would simply like to enter into the record the director at that time writing that he "disagreed with both the methodology and the conclusions reached in this report." He writes that the implied argument in the GAO study is that the Federal Government should not fund research that shares the same overall goal as research funded outside the government. By that criterion, he notes, we would shut down Federal research on cures for cancer and AIDS and a host of other diseases, wireless communications, computing technologies and manufacturing. The fundamental error in this report is its failure to understand and address the central aspect——

Senator COBURN. You can submit that for the record and we will include it in the record.[1]

Dr. WESSNER. My point is that they took strong issue.

Senator COBURN. We will also include the letter from Appendix V, comments from the Department of Commerce, page 35, which states the opposite of that or a different opinion than that.[2]

Let me also make one last note, and then we will adjourn the meeting. And I want to thank each of you for spending the time to come here. Thank you for your efforts and your service to the country and your efforts to make sure we make good decisions.

When you talked about the other countries that, in fact, fund research through their government, what is their percentage deficit to their GDP?

Dr. WESSNER. Most of them just export to us, sir. They are doing pretty well.

Senator COBURN. That is right. Most of them have surpluses. They do not have deficits. A big point.

We could be in a lot of different things if we did not have a deficit, if we were in surplus. I might even earmark something for the first time in my political career, which I have never done.

But the fact is we are not there. So in comparison, you to compare what our investment is as a percentage of our GDP and what our deficit is as a percentage of GDP as to whether or not—the fact

[1] The GAO report appears in the Appendix on page 66.
[2] The letter appears in the Appendix on page 99.

is, we cannot grow out of it. It would be wonderful if we could, but we cannot.

I would still make one point, we still have the highest growth in productivity of anybody in the world. We have the highest growth in productivity. And that is because we are working hard at doing it. And most of that is coming out of the private sector. It is not coming out of government-funded research. It is coming out of innovation and that concept I talked about before, greed conquers technologic difficulties. And we need to recognize that.

I want to thank each of you for being here. A copy of the record will be made available to you. A copy of the record will stay open for any additional comments from any other Members of the Committee.

Thank you very much and the hearing is adjourned.

[Whereupon, at 4:09 p.m., the Subcommittee was adjourned.]

APPENDIX

AN ASSESSMENT OF FEDERAL FUNDING
FOR PRIVATE RESEARCH AND DEVELOPMENT

Statement of

Charles W. Wessner, Ph.D.
National Research Council
The National Academies

before the

Subcommittee on Federal Financial Management, Government Information,
and International Security
Committee on Homeland Security and Governmental Affairs
U.S. Senate

May 26, 2005

Mr. Chairman,

I am Charles Wessner, and I direct the program on technology, innovation and entrepreneurship at The National Academies. While the views I offer the Committee today are my own, my testimony also incorporates the specific recommendations contained in the consensus report of the National Academies that reviewed the ATP program.

Today, I would like to talk briefly about what ATP is and what it is not and why it is important to continue supporting this innovative and effective program. In the course of our discussion, we can also explore some myths and realities about innovation in the United States.

ATP's mission is to accelerate the development of innovative technologies for broad national benefit through partnerships with the private sector. A recent National Academies assessment of ATP, under the leadership of Gordon Moore of Intel, found that ATP is meeting its mission goals.[1] In short, the program contributes to our nation's innovation, economic growth, and national security.

Why is the program needed? Very simply because even though we recognize that innovative technologies have the potential to bring enormous benefits to society as a whole, private investors often can not adequately support their development because profits are often too uncertain or too distant.

How does ATP work? The program seeks promising new projects that 1) must be proposed by industry; 2) must be directed and carried out by industry; and 3) must be funded by industry on a cost-shared basis. The awards often serve a catalytic function, often creating new partnerships between large and small companies and universities. The bulk of ATP awards, nearly 70 percent, go to small businesses that drive innovation, employment, and growth in the U.S. economy.

How well does it work? An impartial Academy assessment found ATP to be a proven program, with a positive track record. In fact, ATP has demonstrated over 15 years that is works well. It achieves its goals of stimulating risky, new, high-payoff technology development, by funding small companies and bringing together universities, small firms, and large companies. We can say that with confidence because the ATP program is quite likely the most intensively studied, rigorously scrutinized and carefully assessed U.S. technology program of the past 50 years. By itself, the National Academies review of ATP consumed two years, three major meetings, two major reports and numerous detailed studies. The process involved a 15-person steering committee, including leading economists and wide consultations with the venture community, major corporations, small companies, and government officials. And as with all Academy studies, the findings were then subject to a second independent review as per standard Academy procedure. This rigorous, impartial analysis is the basis for our positive view of the program.

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[1] National Research Council, *The Advanced Technology Program, Assessing Outcomes*, C. Wessner, ed. Washington, D.C.: National Academy Press, 2001.

Our work on innovation also brought to light a set of common myths about markets and the innovation process that must be overcome if we are to successfully meet intense global competition, especially in high-tech manufacturing, and, by doing so, maintain the economic strength that sustains our national security.

The National Academies finds that ATP Works

Based on this thorough National Academies' assessment, we can report to you that the ATP is definitively meeting its Congressional mandate to provide cost-shared funding to industry to accelerate the development and broad dissemination of challenging, high-risk technologies that promise broad-based economic benefits for the nation.

The Academies complimented ATP for the rigor and quality of the assessment program, suggesting that other programs might see it as a best practice model. The ATP assessment program includes

- A rigorous selection process, where companies must prove a need for government support, as well as demonstrate the technical and commercial merit of their project;
- Real time project monitoring, with a demonstrated willingness to stop funding for projects that are not performing; and
- Follow-up evaluations to ensure that funded projects are achieving technical, commercial, and social goals called for by ATP.

The good news is that ATP investments are already yielding high returns. Innovative technologies for knee repair and early breast cancer detection, for example, not only return our citizens to happier, more productive lives but lower medical costs for all as well. ATP has also helped to fund work to support U.S. manufacturing, such as on printed wiring boards, and supported promising technologies such as fuel cells and DNA diagnostics that will contribute to our nation's growth and security.

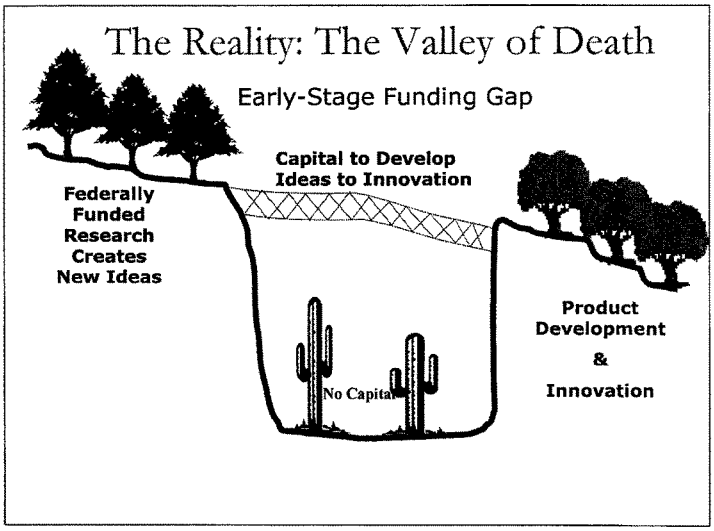
In short, ATP is a specific example of what works well in the general area of government-industry-university technology partnerships. The ATP program is a rather unique part of the overall complex of technology programs that the U.S. Government supports. It is exceptional in several ways, including its intelligent design and its remarkably thorough assessment program. But keep in mind that ATP is part of a family of long-standing U.S. programs, whether it is military research at ONR, new concepts funded by DARPA, or the two-phase SBIR program that helps bring new technologies to the war-fighter. In all these cases, the government is really helping to plant long-term technology seeds where private markets hesitate to go or to address acute public needs. Some of those technology seeds will sprout, others will not. But the planting, as an activity on the whole, must go forward if long-term economic gains are to be effectively harvested.

Let me talk for a moment about a few myths about the U.S. innovation system.

The Myth of Perfect Markets

The first major myth is that "if it is a good idea, the market will fund it." In reality, market participants nearly always have less than perfect knowledge, especially about innovative new

ideas. This "asymmetric information," as economists call it, makes it difficult for small firms to obtain funding to develop new ideas for the market. The reality facing firms in the early stages of their development is what Congressman Vernon Ehlers referred to as "the Valley of Death" between federal funding for basic research that creates new ideas and closer-to-market product development that can be attractive to venture capitalists and other private investors.

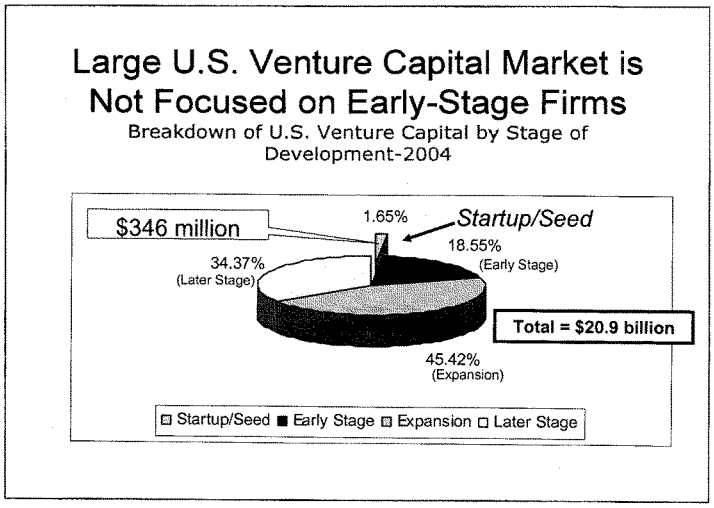


The Valley of Death results from the different levels of information that exists between an entrepreneur and potential investors and partners. Lacking full appreciation of the technology, investors hesitate to provide the funds that would permit the entrepreneur to demonstrate the concept. These funding gaps matter because equity-financed small businesses are one of the most effective mechanisms for capitalizing on new ideas and brining them to market. Small businesses are also a leading source of growth and employment in the United States

The Myth of the Venture Capital Solution

While almost every small businessperson who has brought an innovative product to market can tell you about his or her experience with the Valley of Death, many in the policy world still believe that because we have a robust venture capital market, VC finance alone is the solution to the many challenges of early-stage finance. This is not the case. For a variety of reasons, private capital markets tend to both over- and under-invest in new technologies. Venture funding can also be quite unpredictable. You recall that venture funding soared to some $100 billion in 2000 and then, after a dramatic fall, stabilized just over $20 billion last year.

Why does this happen? Because early-stage technology capital markets are prone to numerous imperfections including herd behavior among investors, information asymmetries, institutional imperatives focused on the later stages of technology development, and early exit--all of which were amply on display during the collapse of the dot-com technology bubble. As a result, some new technology domains may get too much attention from private investors while other promising areas may get comparatively little. After all, the goal of venture capitalists is not to develop the U.S. economy with long-term investments but to obtain a timely and significant return for the funds' investors. The key point is that the large U.S. venture capital market is not focused on early-stage firms with promising but unproven technologies. Reflecting this reality, the amount of early-stage financing available from venture capitalists is quite small, around $346 million of the $20.9 billion noted earlier.



These problems are especially severe for promising but risky new technical approaches. These approaches often require intensive collaboration across multiple technical disciplines, requiring the coordination among companies and, increasingly, universities. Even with promising technologies, it is sometimes hard for company managers to see a clear, reasonably short-term path to the necessary return on their investment. In those cases, public-private partnerships like ATP can play an essential, catalytic role in helping to foster technical innovation to the point where private capital markets can sustain further development.

Reflecting these realities, influential venture capitalists have spoken positively about the program. For example, as you can see, David Morgenthaler, a past President of the National Venture Capital Association, has affirmed the value of the program. He emphasizes that its focus is not on the same financial space as venture funds and welcomes these types of leveraged public-private investments in potential platform technologies of the future.

"[The ATP] is an excellent program for developing enabling, or platform, technologies, which can have broad applications but are long-term, risky investments. Venture capitalists are not going to fund these opportunities, because they will feel that they are at too early a stage of maturity. Government can and should fund these technologies. In fact, it should do more than it is doing."

David Morgenthaler
Morgenthaler Ventures[2]

The Myth of Crowding Out

Still, some ask, "Wouldn't private capital support an ATP project anyhow?" The short answer is "usually not." Why? Because it is too risky, the technology requires competencies not controlled by one firm, and/or the cost is simply too high. ATP addresses these factors. Our research supports this view. Looking at the 1998 ATP applicants one year after the funding decisions, NRC researchers found that most of the non-winners (70%) had not proceeded with their proposed R&D project.[3] Of those that did, most were working at a smaller scale than initially proposed. This result suggests that firms are not seeking ATP funding for projects they would conduct anyway—ATP is not "crowding out" the market. Crowding out is theoretically possible but our research from some of the country's leading economists, Stanford's Paul David and Berkeley's Bronwyn Hall, found that evidence for crowding out was problematic at best. The NRC research actually shows that[4] ATP award winners were more likely to actually receive additional funding from private sources. This suggests that the ATP award creates a "halo effect" for recipients.

The Myth about Awards for Large Companies

A persistent myth is that ATP pays businesses to perform activities they would naturally do anyway. The reality is that new ideas, by definition, lack champions. This means that researchers within larger corporate organizations often have difficulty getting funding within their company to develop innovative but risky new products. An ATP award can help validate and provide seed funding for these ideas, when they promise widespread societal benefits. While over sixty-eight percent of ATP awards go to small businesses that are seeking to commercialize innovative ideas, government awards are also sometimes necessary to attract internal funding within larger firms.

For example, between 1995 and 2000, ATP co-funded a joint venture project with General Electric Corporate R&D and EG&G Reticon on a cost share basis to develop a low-cost manufacturing process for digital mammography and radiography systems.[5] The project lowered the cost of mammograms and, because they were digitized, permitted easier second opinions and reduced false positives with the expensive and nerve-racking biopsies. As costs

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[2] See National Research Council, *The Advanced Technology Program: Assessing Outcomes*, *op.cit*, p. 66.
[3] Maryann P. Feldman and Maryellen R. Kelley, "Leveraging Research and Development: The Impact of the Advanced Technology Program," in National Research Council, *The Advanced Technology Program, Assessing Outcomes*, *op. cit.*
[4] Ibid.
[5] See National Research Council, *The Advanced Technology Program: Assessing Outcomes*, *op.cit*, pp. 90 and 96.

for equipment fell, distribution to rural areas rose, with the attendant benefits. ATP's investment in this technology resulted in a productive alliance between large and small firms. This successful joint venture illustrates both the positive synergies resulting from small and large firm cooperation and the reality that there is a valley of death for new technologies, even in the largest companies.[6]

The Myth about Picking Winners and Losers

As we have seen, public-private partnerships like ATP—involving cooperative research and development activities among industry, government laboratories, and universities—can play an instrumental role in accelerating the development of new technologies from idea to market.[7] Yet many believe that the government should not be in the business of supporting new technologies, claiming that the government should not be picking winners and losers. This easy statement is also a myth, one that ignores U.S. history and current practice. This myth appears in several different forms, often mixed together. The claim is that--

- The government cannot successfully make judgments about new firms or technologies, or
- The government should not substitute its judgment for that of the market, or
- Government intervention in the market is unwarranted and therefore constitutes corporate welfare.

The historical reality is that the government often has to make technology choices through its research allocations, regulatory decisions, and procurement choices. The reality, as noted by Vernon Ruttan, Emeritus Professor of Applied Economics at the University of Minnesota and one of the world's leading development economists, is that "government has played an important role in the technology development and transfer in almost every U.S. industry that has become competitive on a global scale."[8] The table below highlights some of key game changing technologies that came about through government sponsorship.

Precedents for Public Role in Commercialization of Science in the U.S.

- 1798 - Grant to Eli Whitney to produce muskets with interchangeable parts, founds first machine tool industry
- 1842 - Samuel Morse receives award to demonstrate feasibility of telegraph
- 1903 – Wright Brothers fly, fulfilling the terms of an Army contract.
- 1915 – National Advisory Committee for Aeronautics plays an instrumental role in the rapid advance in commercial and military aircraft technology
- 1919 – Radio manufacturing (RCA) founded on the initiative (Equity and Board Membership) of the U.S. Navy with commercial and military rationales.
- 1940s, '50s, '60s – Government investments in Jet Aircraft, Semiconductors, Computers, Satellites, Nuclear Energy lay the "Foundations of the Modern Economy," (Cohen & Noll, 1992)

[6] See remarks of Dr. Bruce Griffing, "Between Invention and Innovation: Mapping the Funding for Early Stage Technologies," Carnegie Conference Center, Washington, D.C., 25 January 2001.
[7] See National Research Council, *Government-Industry Partnerships for the Development of New Technologies: Summary Report*, C. Wessner, ed. Washington, D.C.: National Academies Press, 2003, page 23.
[8] Vernon Ruttan, *Technology, Growth, and Development: An Induced Innovation Perspective*, Oxford: Oxford University Press, 2000.

- 1969-1990s - Government investments create the forerunners of the Internet (Arpanet) and build the Global Positioning System
- **Today: Current investments in promising research and technologies are found in genomic and biomedical research, as well as advanced computing and new materials, (e.g., the government's nanotechnology initiatives).**

The Global Competition in Innovation

The technologies enabled by ATP investments are particularly relevant in the new international competitive environment that the United States faces today. The increasing offshore movement of R&D, software development, and manufacturing poses a profound challenge to U.S. technical preeminence, and therefore on military preeminence. Private R&D by U.S. firms is increasingly spent in countries like China and India, where they are conducted increasingly by non-captive, independent organizations. Outsourced R&D is also moving up from lower-end research to the operation of major branch offices integrated into the worldwide operations of U.S. multinationals.[9] This represents a new competitive paradigm for the United States and one for which we need an effective policy response.

The challenges do not stop with R&D. Most other nations have created new, well funded programs to develop new technologies and new industries for their national economies. This is a global phenomenon. China is the most striking example. It has a broad array of programs designed to develop new technologies and to attract and grow leading industries such as semiconductors. While Chinese efforts are massive, they are by no means unique. For example, Finland, a country of five million, has a program similar to ATP, called Tekes; it is funded at $540 million. Belgium, a nation of ten million, has a consortium for microelectronics research called IMEC that is budgeted at $157 million. The EU is spending $22 billion in its Framework Programme of applied research, and there are proposals to double it. Taiwan has a superb series of programs at ITRI, funded at over $500 million. Other nations in Europe and Asia similarly have well-funded technology programs.[10] Cooperative technology programs, like ATP and SBIR, have emerged as key elements in national competition for the high-technology industries of the future.

Many corporate leaders are concerned about these trends. Dr. Mark Myers, the former head of R&D for Xerox, was quoted in the *Wall Street Journal* recently that "this is an increasingly global game, and how the U.S. fares in that [game] is uncertain."[11] A well-funded ATP would help the United States better capitalize on its investments in basic science and R&D, help develop technologies with high economic and social pay-offs, and bring small businesses and large businesses together to collaborate on the competitive technologies of the future. We need to work harder and better to compete, and ATP is and should be an integral part of that competitive strategy.

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[9] See *The Economist*, "Innovative India," August 1, 2004.

[10] For a review of regional and national programs in semiconductors, see National Research Council, *Securing the Future, Regional and National Programs to Support the Semiconductor Industry*, C. Wessner, ed., Washington, D.C.: National Academies Press, 2003.

[11] *Wall Street Journal*, 7 January 2005.

Conclusion

To better understand ATP and its contributions, it is important that we recognize certain realities, namely:

- We need to capitalize on our research investments. We need to convert research dollars into products and processes that enhance the health, welfare, economic growth, and security of U.S. citizens.
- We need to understand the inherent challenges of early-stage finance, and the concomitant limitations of venture capital, both in terms of when it invests and what it will invest in.
- In a global economy, we need to remember that we are not alone. The rest of the world has many large, well funded programs focused on capturing new technologies for their national economies. These programs, especially when combined with a vibrant and efficient private sector, can be remarkably effective.
- We should keep in mind that the U.S. government has long played a major role in developing the U.S. economy, whether it's aircraft frames, turbines, nuclear power, semiconductors, computers, or the Internet. Not a bad track record.
- Perhaps most important, we should recall that these contributions to our economy are in turn central elements of our national security. ATP can and does make contributions to Homeland Security through, for example, container inspection technology, DNA diagnostics, and new fuel cell technologies. Appropriately funded, ATP can make major contributions both for homeland security and for the industrial base on which U.S. military strength ultimately relies.

In sum, the National Academies "...finds that the Advanced Technology Program is an effective federal partnership program. The selection criteria applied by the program enable it to meet broad national needs and help ensure that the benefits of successful awards extend across firms and industries. Its cost-shared, industry-driven approach to funding promising new technological opportunities has shown considerable success in advancing technologies that can contribute to important societal goals...."[12]

With your help and support, the ATP program will continue to contribute to the nation's growth and security.

Mr. Chairman, thank you for this opportunity to address your Committee.

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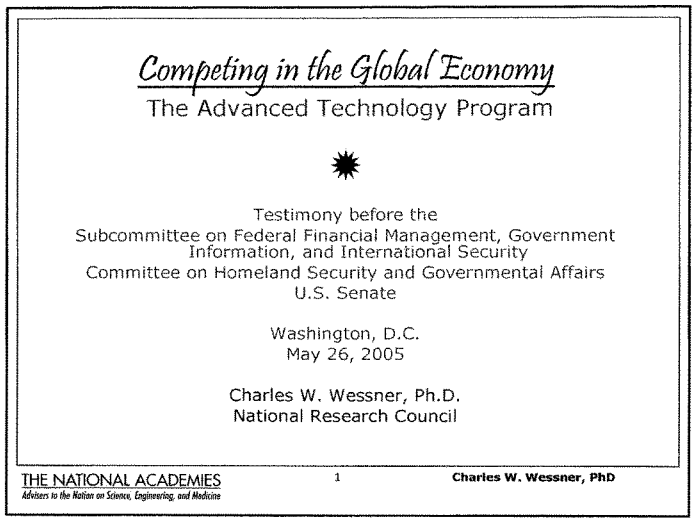
[12] See National Research Council, *The Advanced Technology Program: Assessing Outcomes*, *op.cit*, p. 87.


Competing in the Global Economy
The Advanced Technology Program
Testimony before the
Subcommittee on Federal Financial Management, Government Information, and International Security
Committee on Homeland Security and Governmental Affairs
U.S. Senate
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Charles W. Wessner, Ph.D.
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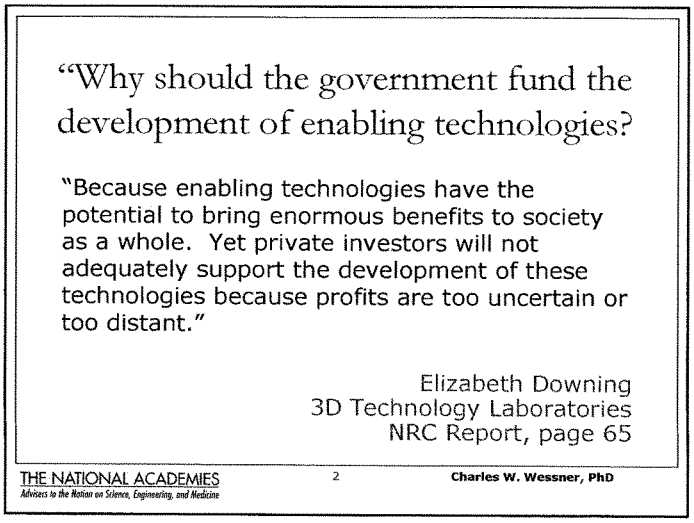
Charles W. Wessner, PhD


"Why should the government fund the development of enabling technologies?
"Because enabling technologies have the potential to bring enormous benefits to society as a whole. Yet private investors will not adequately support the development of these technologies because profits are too uncertain or too distant."
Elizabeth Downing
3D Technology Laboratories
NRC Report, page 65
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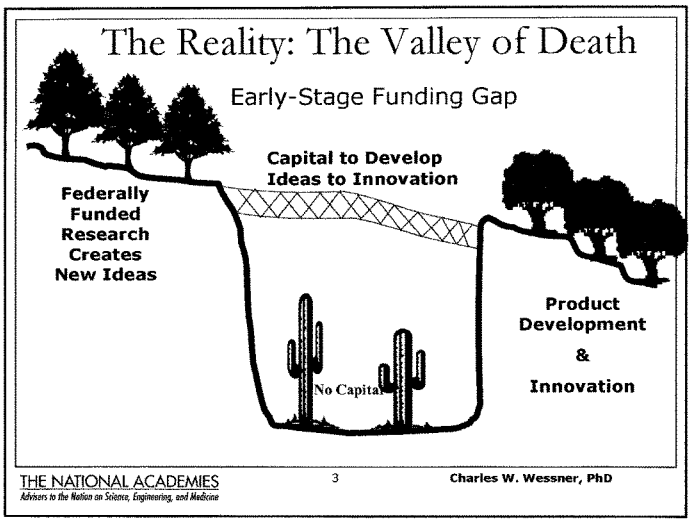
The Reality: The Valley of Death
Early-Stage Funding Gap
Capital to Develop Ideas to Innovation
Federally Funded Research Creates New Ideas
No Capital
Product Development & Innovation
THE NATIONAL ACADEMIES
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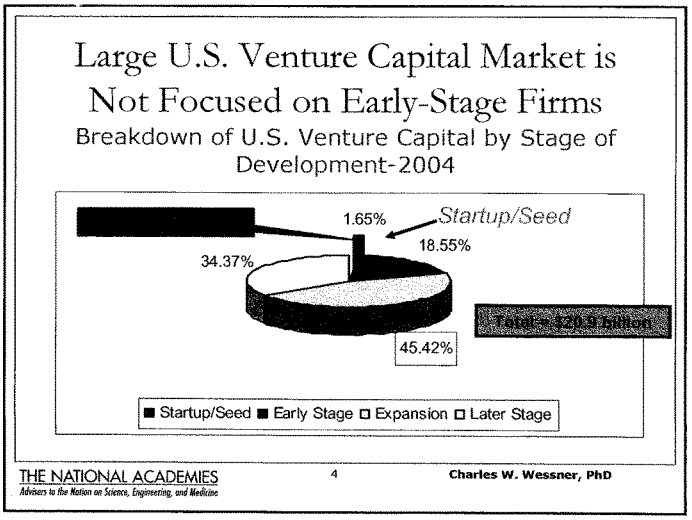
Large U.S. Venture Capital Market is Not Focused on Early-Stage Firms
Breakdown of U.S. Venture Capital by Stage of Development-2004
1.65%
Startup/Seed
18.55%
34.37%
45.42%
Total = $20.9 billion
Startup/Seed
Early Stage
Expansion
Later Stage
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Charles W. Wessner, PhD

A Venture Capitalist's Perspective on the ATP

- "[The ATP] is an excellent program for developing enabling, or platform, technologies, which can have broad applications but are long-term, risky investments."
- "Venture capitalists are not going to fund these opportunities, because they will feel that they are at too early a stage of maturity. Government can and should fund these technologies. In fact, it should do more than it is doing."

David Morgenthaler
Morgenthaler Ventures
NRC Report, page 66

Realities of Foreign Competition

We are not alone

China's Integrated Policy Measures to Support High-Technology Industries:
Semiconductor Manufacture & Research

- Supportive Tax Policies
- WTO Illegal VAT Rebates
- Incentive for Repatriation of Top Level Researchers and Industry Managers
- First Class Research Facilities
- Heavy Subsidies for Infrastructure
- Major Tax Benefits for Individuals working in key Technology Industries
- Taken together, these measures have powerful synergistic effects

ATP in International Context:
Other Countries' Support for New Technologies

- TEKES in Finland
  - similar to ATP - $540 million annually
- Semiconductor Partnerships in Japan
  - ASET Program (1995-2000) - $473 million
- ITRI in Taiwan – over $500 annually
- Medea II in Europe - $632 million annually
- German Federal & State Programs
  - Pro Inno - $794 million & Inno Regio - $320 million
- Belgium's IMEC - $157 million annually
- European Framework Program : $22 billion annually
  - Proposal to Double it

In sum, the National Academies "...finds that the Advanced Technology Program is an effective federal partnership program. The selection criteria applied by the program enable it to meet broad national needs and help ensure that the benefits of successful awards extend across firms and industries.

Its cost-shared, industry-driven approach to funding promising new technological opportunities has shown considerable success in advancing technologies that can contribute to important societal goals...."

NRC Report, page 87

THANK YOU

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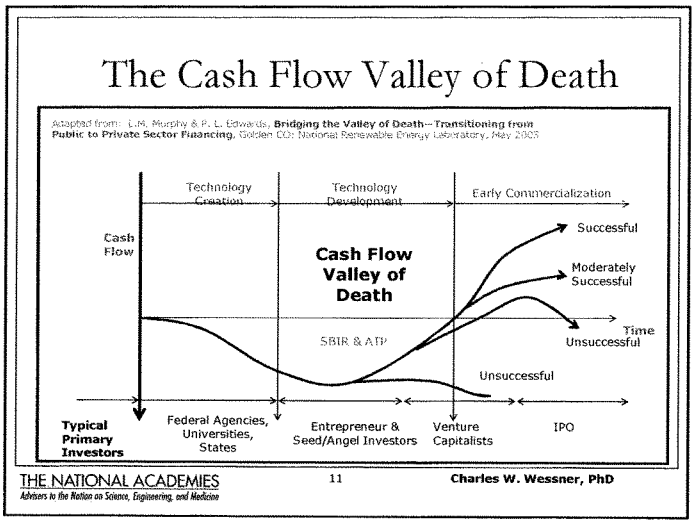
The Cash Flow Valley of Death
Adapted from: L.M. Murphy & P. L. Edwards, Bridging the Valley of Death--Transitioning from Public to Private Sector Financing, Golden CO: National Renewable Energy Laboratory, May 2003
Technology Creation
Technology Development
Early Commercialization
Cash Flow
Cash Flow Valley of Death
Successful
Moderately Successful
Time
Unsuccessful
SBIR & ATP
Unsuccessful
Typical Primary Investors
Federal Agencies, Universities, States
Entrepreneur & Seed/Angel Investors
Venture Capitalists
IPO
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Advisers to the Nation on Science, Engineering, and Medicine
11
Charles W. Wessner, PhD

United States Government Accountability Office

GAO

Testimony

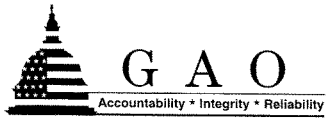
Before the Subcommittee on Federal Financial Management, Government Information, and International Security, Committee on Homeland Security and Governmental Affairs, U.S. Senate

For Release on Delivery
Expected at 2:30 p.m. EDT
Thursday, May 26, 2005

ADVANCED TECHNOLOGY PROGRAM

Inherent Factors in Selection Process Are Likely to Limit Identification of Similar Research

Statement of Robin M. Nazzaro, Director
Natural Resources and Environment



GAO-05-759T

May 2005

ADVANCED TECHNOLOGY PROGRAM

Inherent Factors in Selection Process Are Likely to Limit Identification of Similar Research

GAO Accountability · Integrity · Reliability

Highlights

Highlights of GAO-05-759T, a report to the Chairman, Subcommittee on Federal Financial Management, Government Information, and International Security, Committee on Homeland Security and Governmental Affairs, U.S. Senate

Why GAO Did This Study

The Advanced Technology Program (ATP) supports research that accelerates the development of high-risk technologies with the potential for broad-based economic benefits for the nation. Under the program, administrators at the National Institute of Standards and Technology are to ensure that they do not fund research that would be conducted in the same period without ATP funding. Between 1990 and September 2004, ATP funded 768 projects at a cost of about $2.3 billion. There is a continuing debate over whether the private sector has sufficient incentives to undertake research on high-risk, high-payoff emerging technologies without government support, such as ATP.

This testimony discusses the results of GAO's April 2000 report, *Advanced Technology Program: Inherent Factors in the Selection Process Could Limit Identification of Similar Research (GAO/RCED-00-114)* and provides updated information. GAO determined (1) whether ATP had funded projects with research goals that were similar to projects funded by the private sector and (2) if ATP did, whether its award selection process ensures that such research would not be funded in the future.

What GAO Found

The three completed ATP-funded projects GAO reviewed, which were approved for funding in 1990 and 1992, addressed research goals that were similar to those already funded by the private sector. GAO chose these 3 projects from among the first 38 completed projects, each representing a different technology sector: computers, electronics, and biotechnology. These three technology sectors represent 26 of the 38 completed ATP projects, or 68 percent. The projects included an on-line handwriting recognition system, a system to increase the capacity of existing fiber optic cables for the telecommunications industry, and a process for turning collagen into fibers for human prostheses use. In the case of the handwriting recognition project, ATP provided $1.2 million to develop a system to recognize cursive handwriting for pen-based (i.e., without a keyboard) computer input. GAO identified several private firms that were conducting similar research on handwriting recognition at approximately the same time the ATP project was funded. In fact, this line of research began in the late 1950s. In addition, GAO identified multiple patents, as early as 5 years prior to the start of the ATP project, in the field of handwriting recognition. GAO found similar results in the other two projects.

Two inherent factors in ATP's award selection process—the need to guard against conflicts of interest and the need to protect proprietary information—make it unlikely that ATP can avoid funding research already being pursued by the private sector in the same time period. These factors, which have not changed since 1990, make it difficult for ATP project reviewers to identify similar efforts in the private sector. For example, to guard against conflicts of interest, the program uses technical experts who are not directly involved with the proposed research. Their acquaintance with ongoing research is further limited by the private sector's practice of not disclosing its research efforts or results so as to guard proprietary information. As a result, it may be impossible for the program to ensure that it is consistently not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance.

GAO made no recommendations in its April 2000 report.

www.gao.gov/cgi-bin/getrpt?GAO-05-759T.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Robin M. Nazzaro at (202) 512-3841or nazzaror@gao.gov.

Dear Mr. Chairman and Members of the Subcommittee:

We are pleased to be here today to discuss our past work,[1] as well as to provide some updated information, on the funding that the Advanced Technology Program (ATP) provides for private research. As you know, ATP was established in 1988 to support research that accelerates the development of high-risk technologies with the potential for broad-based economic benefits for the nation.[2] Under the provisions establishing ATP, program administrators at the National Institute of Standards and Technology (NIST) are to ensure that they are not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance. Between 1990 and September 2004, ATP funded 768 projects at a cost of about $2.3 billion in federal matching funds.

Research can provide both private benefits, which accrue to the owners of the research results, and societal benefits, which accrue to society as a whole. In some instances, the private sector does not fund research that would be beneficial to society because doing so might not provide an adequate return on a firm's investment. To address this situation, the federal government, through tax credits or direct public funding, supports research that has very broad societal benefits, such as basic research and research focused on developing technologies in areas such as public health and nutrition, energy conservation, and environmental protection. However, there is a continuing debate over whether the private sector has sufficient incentives to undertake research on high-risk, high-payoff emerging and enabling technologies without government support, such as ATP.

In this context, in our prior work, we determined (1) whether, in the past, ATP had funded projects with research goals that were similar to projects funded by the private sector and (2) if we identified such cases, whether ATP's award selection process ensures that such research would not be funded in the future. To determine whether ATP has funded projects similar to private sector projects, we chose 3 of the first 38 completed projects, each representing a different technology sector: biotechnology; electronics; and information, computers, and communications. These three technology sectors represent 26 of the 38, or 68 percent, of the ATP projects completed by 1999. We reviewed the ATP project files and held discussions with industry and academic experts, technical reviewers, and award recipients to assist in our examination of these projects. We also conducted patent searches on the technical areas associated with each of the three projects. Our objective was not to provide an evaluation of the quality of the research funded by ATP or the private sector, nor the impact these projects may or may not have had on their respective industries. To address the second objective, we

[1] GAO, *Advanced Technology Program: Inherent Factors in Selection Process Could Limit Identification of Similar Research,* GAO/RCED-00-114 (Washington, D.C.: April 24, 2000).

[2] The Omnibus Trade and Competitiveness Act of 1988 (Pub. L. No. 100-418).

reviewed ATP's award selection process. We did not review the overall management of the program. We performed our initial work from October 1999 through April 2000, and developed updated information in May 2005, in accordance with generally accepted government auditing standards.

Results in Brief

The three completed ATP-funded projects, which were approved for funding in 1990 and 1992, addressed research goals that were similar to those already funded by the private sector. The projects included an on-line handwriting recognition system, a system to increase the capacity of existing fiber optic cables for the telecommunications industry, and a process for turning collagen into fibers for human prostheses use. In the case of the handwriting recognition project, ATP provided $1.2 million to develop a system to recognize cursive handwriting for pen-based (i.e., without a keyboard) computer input. We identified several private firms that were conducting similar research on handwriting recognition at approximately the same time the ATP project was funded. In fact, this line of research began in the late 1950s. In addition, we identified multiple patents, as early as 5 years prior to the start of the ATP project, in the field of handwriting recognition. We found similar results in the other two projects.

Two inherent factors in ATP's award selection process—the need to guard against conflicts of interest and the need to protect proprietary information—make it unlikely that ATP can avoid funding research already being pursued by the private sector in the same time period. These factors, which have not changed since 1990, make it difficult for ATP project reviewers to identify similar efforts in the private sector. For example, to guard against conflicts of interest, the program uses technical experts who are not directly involved with the proposed research. Their acquaintance with on-going research is further limited by the private sector's practice of not disclosing its research efforts or results so as to guard proprietary information. As a result, it may be impossible for the program to ensure that it is consistently not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance.

Background

ATP, which began funding projects in fiscal year 1990, was intended to fund high-risk research and development (R&D) projects with broad commercial and societal benefits that would not be undertaken by a single company or group of companies, either because the risk was too high or because the economic benefits of success would not accrue to the investors. ATP is viewed as a mechanism for fostering investment in areas in which societal returns would exceed private returns. ATP has addressed other opportunities to achieve broader societal goals, such as small business participation, as well as the establishment of joint ventures for high-risk technologies that would be difficult for any one company to justify because, for example, the benefits spread across the industry as a whole. Thus, ATP is seen by some as a means of addressing market

failure in research areas that would otherwise not be funded, thereby facilitating the economic growth that comes from the commercialization and use of new technologies in the private sector. Advocates of the program believe that the government should serve as a catalyst for companies to cooperate and undertake important new work that would not have been possible in the same time period without federal participation. Critics of the program view ATP as industrial policy, or the means by which government rather than the marketplace picks winners and losers.

ATP provides funding through cooperative agreements—a type of financial assistance in which the federal government is substantially involved in project management. ATP offers these agreements through announced annual competitions. It provides multiyear funding to single companies and to industry-led joint ventures. The proposal review and selection process is a multistep process based on NIST regulations. In general, these steps include a preliminary screening, technical and business reviews, semifinalist identification, oral reviews, ranking, and final selection. At the beginning of each round of ATP competitions, NIST establishes Source Evaluation Boards (SEBs) to ensure that all proposals receive careful consideration. Each SEB is comprised of NIST technical experts as well as outside specialists with backgrounds in business and economics. ATP supplements the SEBs with outside technical reviewers, generally federal government experts in the specific industry of the proposal. Independent business experts are also hired on a consulting basis, including high-tech venture capitalists, people who teach strategic business planning, retired corporate executives from large and small high-tech businesses, as well as economists and business development specialists. All SEB members and outside reviewers must sign nondisclosure statements, agree to protect proprietary information, and certify that they have no conflicts of interest.

As part of the proposal evaluation process, ATP uses the external reviewers to assess the technical and business merit of the proposed research. Each proposal is sponsored by both technical and business SEB members, whose roles include identifying reviewers, summarizing evaluative comments, and making recommendations to the SEB. The SEB evaluates the proposals, selects the semifinalists, conducts oral interviews with semifinalists, and ranks the semifinalists. A source selecting official makes the final award decisions based on the ranked list of proposals from the SEB.

The three projects that we reviewed received funding through the ATP competitions announced in 1990 and 1992. In those years, the selection criteria included scientific and technical merit, potential broad-based benefits, technology transfer benefits, the proposing organization's commitment level and organizational structure, and the qualifications and experience of the proposing organization's staff. Each of the five selection criteria was weighted at 20 percent. Today, these same selection criteria are used but are grouped into two categories, each weighted at 50 percent. The "Scientific and Technical Merit" category addresses a variety of issues related to the technical plan and the relevant experience of the proposing organization. The second category, "Potential for Broad-Based Economic Benefits," addresses the means to achieving an

economic benefit and commercialization plans, as well as issues related to the proposer's level of commitment, organizational structure, and management plan. Technical and business reviewers complete documentation, referred to as technical and business evaluation worksheets, that address various aspects of these criteria.

Three ATP Projects Addressed Similar Research Goals to Projects in the Private Sector

The three completed projects that we reviewed addressed research goals that were similar to goals the private sector was addressing at about the same time. Each of the three projects was from a different sector of technology—computers, electronics, and biotechnology. The projects include (1) an on-line handwriting recognition system for computer input, (2) a system to increase the capacity of existing fiber optic cables for the telecommunications industry, and (3) a process for turning collagen into fibers for human prostheses use.

ATP Project on Handwriting Recognition

Both the ATP project and several private sector projects had a similar research goal of developing an on-line system to recognize natural or cursive handwritten data without the use of a keyboard. This technology would make computers more useful where keyboard use is limited by physical problems or in situations where using a keyboard is not practical. On-line handwriting recognition means that the system recognizes handwritten data while the user writes. The primary technical problem in handwriting recognition is that writing styles vary greatly from person to person, depending upon whether the user is in a hurry, fatigued, or subject to a variety of other factors. While the technology for obtaining recognition of constrained careful writing or block print writing was commercially available, systems for cursive writing recognition were not commercially available because of the greater handwriting variability that was encountered.

The ATP project we reviewed sought to develop an on-line natural handwriting recognition system that was user-independent and able to translate natural or cursive handwriting. Communication Intelligence Corporation (CIC) was the award recipient. CIC used its ATP funding of $1.2 million from 1991 to 1993 to build its own algorithms and models for developing its handwriting recognition system.[3] During the project, CIC created a database that includes thousands of cursive handwriting samples and developed new recognition algorithms. Some of this technology has been incorporated into a registered software product that has the ability to recognize cursive writing in limited circumstances.

[3] Algorithm here refers to the mathematical procedures involved in recognizing writing as it is being written on a computer device.

According to the experts we interviewed, as well as literature and patent searches, several companies were attempting to achieve a similar goal of handwriting recognition through their research around the same time that the ATP project received funding. Some of the key players in the private sector conducting research on cursive handwriting recognition included Paragraph International (in collaboration with Apple Computer) and Lexicus (which later became a division of Motorola). For example, Apple licensed a cursive handwriting recognition system from a Soviet company, Paragraph International, according to articles published in computer magazines in October 1991. According to these sources, this technology provided Apple with a foundation for recognizing printed, cursive, or block handwritten text.

Another indication of research with a similar goal appeared in the October 1990 edition of *PC Week*, which reported that "handwriting recognition is an emerging technology that promises increased productivity both for current microcomputer owners and for a new breed of users armed with hand-held 'pen-based' computers." Similarly a technical journal article indicated that there was renewed interest in the 1980s in this field of on-line handwriting recognition, from its advent in the 1960s, because of more accurate electronic tablets, more compact and powerful computers, and better recognition algorithms.[4]

Moreover, according to the U.S. Patent and Trademark Office's (PTO) database, over 450 patents were issued on handwriting recognition software, concepts, and related products from 1985 through 1999,[5] indicating that research of a similar goal was being conducted around the time of the ATP project. Given the fact that it can take many years between the time a research project takes place and the time that an outcome is realized, this time period for a patent search allowed us to determine whether there was research ongoing during the time of the ATP project. The dates of the patents actually occurred sometime after the research was conducted. And, as we reported in a prior report,[6] the time between the point when a patent application is filed until the date when a patent is issued, or the application is abandoned, ranged from 19.8 months to 21 months, adding additional time to when the research was done.

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[4] IEEE Transactions on Pattern Analysis and Machine Intelligence, "The State of the Art in On-Line Handwriting Recognition" (Aug. 1990), vol. 12, no. 8

[5] A patent is a grant given by a government to an inventor of the right to exclude others for a limited time (usually 20 years) from making, using, or selling his or her invention.

[6] GAO, *Intellectual Property: Comparison of Patent Examination Statistics for Fiscal Years* 1994-1995, GAO/RCED-97-58 (Washington, D.C., Mar. 13, 1997).

ATP Project on Capacity Expansion of Fiber Optic Cables

Another ATP project we reviewed, which proposed to develop a system to increase the capacity of existing fiber optic cables for the telecommunications industry, also had a similar goal to that of research in the private sector. At the same time, firms in the private sector were attempting to increase the number of light signals that can be transmitted through a single strand of fiber optic cable using a technology called wavelength division multiplexing (WDM).[7] In the 1980s, telephone companies laid fiber optic cables across the United States and other countries to create an information system that could carry significantly more data than the copper wires they replaced. Tremendous increases in cable traffic, primarily from the Internet, have crowded these cables. WDM technology was aimed at providing a cost-effective alternative to the expensive option of installing additional fiber optic cables.

Accuwave Corporation (Accuwave) was the ATP award recipient. Accuwave used its ATP funding of approximately $2 million from March 1993 through March 1995 to develop a wavelength division multiplexing system that would substantially increase the number of signals that could be transmitted through a single optical fiber strand, using the concept of volume holography. Volume holography uses holograms to direct multiple light signals simultaneously through a single fiber strand. Accuwave was able to make improvements on these issues but not enough to fully develop and market a successful WDM system for the telecommunications market. In 1996, a competitor beat Accuwave to the market. After the completion of the ATP project, Accuwave filed for bankruptcy protection due to its inability to successfully commercialize a wavelength division multiplexing system.

Other private firms were involved in research with a similar goal of increasing the capacity of fiber optic cable at about the same time as Accuwave was conducting its research. Conceptual research on such systems dates back to the early 1980s, but development and commercialization did not flourish until the mid- to late-1990s. Bell Labs (now Lucent Technologies), Nortel Networks, and Ciena Corporation, among others, were considered some of the major competitors in the industry. In the early 1990s, these firms were attempting to develop WDM technology using different methods and materials. For example, Ciena Corporation developed a system that incorporated fiber-Bragg gratings, which are filters embedded directly onto fiber optic cable that help to separate multiple light signals through a single fiber strand.

[7] A fiber optic cable consists of many extremely thin strands of glass or plastic, each capable of transmitting light signals. Wavelength division multiplexing transmits separate light signals through a single optical fiber strand at different wavelengths.

We also found an indication of WDM-related research through a review of issued patents. According to PTO's database, over 2,000 patents were issued related to wavelength division multiplexing components, systems, and concepts from 1985 through 1999. The patents issued ranged from 10 patents in 1985 to 493 in 1999.

ATP Project on Regenerating Tissues and Organs

Both the ATP project and private sector projects we identified in the tissue engineering field had similar broad research goals of developing biological equivalents for defective tissues and organs utilizing diverse technical approaches. ATP's project proposed procedures for extracting, storing, spinning, and weaving collagen (the main constituent of connective tissue and bones) into fibers suitable for human prostheses that could induce the body's cells to regenerate lost tissue. Tissue Engineering, Inc., received ATP's award of about $2 million for use over the years 1993 through 1996. The company's long-term and yet unrealized goal is to transplant these prostheses into humans, after which the collagen framework, or scaffold, would induce the growth and function of normal body cells within it, eventually remodeling lost human tissue and replacing the scaffold.

Within the very innovative field of tissue engineering, however, many competitors were attempting to achieve similar broad research goals. Organogenesis, the Collagen Corporation, Integra LifeSciences, Advanced Tissue Sciences, Genzyme Tissue, Osiris Therapeutics, Matrix Pharmaceuticals, and ReGen Biologics are key players in the market to develop structures that could replace or regenerate cells, tissues, and organs such as skin, teeth, orthopedic structures, cartilage, and valves. A number of these companies have subsequently received ATP awards. In addition, universities and medical schools have researchers investigating the many possibilities to engineer human tissues, and eventually complex organs, such as the liver, pancreas, and heart. According to one expert, there is a great deal of competition within the field of tissue engineering.

Although the Tissue Engineering, Inc. research focused on the use of collagen as the basis for these structures, other companies were pursuing a variety of technical approaches for addressing the goal of developing biological equivalents for defective tissues and organs. In addition to research in collagen, other companies and researchers have also been attempting to create human tissues and organs from other biological materials, synthetics, and hybrid products, which are both biologic and synthetic. For example, researchers from the Massachusetts Institute of Technology (MIT) developed an artificial skin product using collagen and a natural polymer. Several companies have since developed comparable products. In 1986, researchers from MIT and a hospital in Massachusetts began inserting cells into scaffolds created of biodegradable polymer. As the cells multiply, tissues form. The magazine *BusinessWeek* reported this concept as "an elegantly simple concept that underlies most engineered tissue."[8] Two competitors, Integra LifeSciences and Organogenesis, reported that they were also doing work on the

[8] "Biotech Bodies," BusinessWeek, July 27, 1998.

use of collagen in various applications. Although their technical approaches were different than the ATP project, the broad research goals were similar.

In addition to our discussions with experts and literature searches, patent research shows that there was activity related to the field of tissue engineering prior to and during the ATP project. According to a search done on the PTO website, at least 370 patents were issued related to cell culturing, scaffolding or matrix development, and tissue engineering from 1985 through 1999. Experts have also indicated that there are several patents related to the field, with a considerable amount of overlap in the technologies described in those patents.

ATP's Award Selection Process Is Unlikely to Avoid Funding Similar Research

Two factors in ATP's award selection process could result in ATP's funding research similar to research that the private sector would fund in the same time period. These two factors are inherent in the review process and limit the information the reviewers have on similar private sector research efforts. Due to conflict-of-interest concerns, technical reviewers are precluded from being directly involved with the proposed research, making them less likely to know about all the research in an area. Also, the information available about private sector research is limited because of the private sector practice of not disclosing research results. Until a patent is issued, a private sector firm generally publishes very few details about the research to protect proprietary information. Therefore, it is difficult for the reviewers to identify other cutting-edge research.

ATP's Conflict-of-Interest Provision Limits Its Ability to Identify Similar Research

ATP selection officials rely on outside technical reviewers to evaluate a proposal's scientific and technical merit. All reviewers must certify that they have no conflicts of interest. To minimize possible conflicts of interest, the technical reviewers are generally federal government employees who are experts in the specific technology of the research proposal but are not directly involved with the proposed research area. Although this approach helps to guard against conflict of interest, it has inherent limitations on the program's ability to identify similar research efforts. The technical reviewers rely on their own knowledge of research underway in the private sector. One of the technical reviewers we interviewed said that he did not personally know of other companies that were doing similar work. However, he believed that it was unlikely that there were not dozens of others working on the same issue.

Proprietary Information Limits ATP's Ability to Identify Similar Research

ATP reviewers are significantly limited in their ability to identify similar research efforts by an inherent lack of information on private sector research. Although ATP officials use several sources, such as colleagues, conferences and symposia, and current technical literature, to try to identify research efforts conducted by the private sector and the

federal government, this information is often proprietary. Most of the private sector and university experts we consulted agreed that it can be very difficult to identify the specific research that private sector firms are conducting, especially considering the competitive nature of most industries. The early release of information on a company's research could be costly to the firm. If a competing firm could determine the nature and progress of another company's research, it could help the competitor to develop and commercialize an identical or higher-quality product before the other firm. At the very least, the early release of research information by a firm can give competitors an idea as to the focus of the firm's strategic plan. Thus, many firms are very careful about releasing detailed information related to research and development activities they are conducting.

In conclusion, Mr. Chairman, the process ATP follows to select projects for funding is limited in its ability to identify similar research efforts in the private sector. Our retrospective look at the three ATP research projects showed that their goals were similar to research goals already being funded by the private sector. Examining the process that ATP uses to select projects, we found two inherent factors—the need to guard against conflicts of interest and the need to protect proprietary information—that limit ATP's ability to identify similar research efforts in the private sector. These two factors have not changed since the beginning of the program. We recognize the valid need to guard against conflicts of interest and to protect proprietary information; thus, we did not recommend any changes to the award selection process. However, we believe that it may be impossible for the program to ensure that it is consistently not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance.

Mr. Chairman, this concludes my prepared statement. I would be happy to respond to any questions that you or Members of the Subcommittee may have.

Contacts and Acknowledgements

For further information about this testimony, please contact Robin M. Nazzaro at 202-512-6246. Diane Raynes, Carol Herrnstadt Shulman, and Jessica Evans made key contributions to this statement.

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GAO Responses to Follow-up Questions from May 26, 2005 Hearing
"An Assessment of Federal Funding for Private Research and Development"
U.S. Senate Committee on Homeland Security and Governmental Affairs,
Subcommittee on Federal Financial Management, Government Information, and International Security

Questions from Senator Coburn

The questions from Senator Coburn concerned actions by the Advanced Technology Program at the National Institute of Standards and Technology since 1990, which GAO has not examined. As a result, our responses will require extensive follow-up audit work with the agency.

Questions from Senator Lieberman

- *The GAO 2000 report was the basis for Ms. Nazzaro's testimony. Although NIST was not a witness at this hearing, it is critical to understand their evaluation of this report. Please comment and provide any documentation addressing NIST's evaluation of the GAO study.*

The Department of Commerce's National Institute of Standards and Technology (NIST), which administers the Advanced Technology Program, provided GAO with agency comments on the report that served as the basis for Ms. Nazzaro's testimony. The report was entitled, Advanced Technology Program: Inherent Factors in Selection Process Could Limit Identification of Similar Research, GAO/RCED-00-114, from April 2000. A copy of the letter GAO received from NIST can be found on pages 35-38 of that report. GAO responded to these comments in the Agency Comments section of the report on pages 15-18. In summary, NIST disagreed with both the methodology that we used and the conclusions that we reached in the draft report. NIST's disagreement focused on six areas, each of which we addressed in our agency comments. A copy of the report is attached to this document.

Questions from Senator Laughtenberg

- *Since a sample of three is not statistically significant, would it be a mistake to generalize from the study that GAO has done? Has GAO done a complete assessment of the Advanced Technology Program (ATP)?*

As indicated in the Scope and Methodology section of the report (pages 20-22) we did not attempt to generalize to the entire program. The three projects were chosen from three technology sectors: information, computers and communication; electronics; and biotechnology. We consulted with ATP officials at the beginning of our review regarding which technology sectors would provide a useful framework for our review. These officials supported our selection of the three industrial sectors and gave us information showing that they had each received increasing number of awards, since the start of the ATP. However, in its agency comments to GAO, ATP Director Raymond Kammer said "if it were to review all 199 projects completed to

date, the GAO might still have come to the same conclusion, i.e. that the research goal may have been similar to those funded by the private sector."

Over the years of the ATP, GAO has conducted a number of studies assessing various aspects of the ATP program. These reports address topics such as: the award selection process, carryover balances, implementation, research results and implementation, and indirect cost rates. A listing of these reports and information on obtaining copies is attached.

- *Has ATP made changes to address the issues identified in GAO's 1996 report? Are there more recent examples of supposedly problematic projects than those identified by GAO and Heritage? Why haven't they been cited?*

In GAO's 1996 report, Measuring Performance: The Advanced Technology Program and Private-Sector Funding, GAO/RCED-96-47 GAO reported that ATP has funded research projects that would have been funded by the private sector as well as those that would not. In addition, GAO stated that ATP achieves other goals, such as aiding the formation of joint ventures and helping companies achieve research milestones faster. We did not recommend actions to be taken by ATP in the report, and therefore cannot report changes to address issues identified in the report. Nonetheless, the most recent ATP application kit (FY 2004) requires applicants to explain in the Project Narrative section why the project needs taxpayer funds and why full private funding is not available; applicants are also asked to include any letters corroborating their efforts to secure other funding.

As noted previously, since1996 GAO has reviewed various aspects of the ATP. For the hearing, we were asked to discuss the report issued in 2000 which addressed (1) whether, in the past, ATP had funded projects with research goals that were similar to projects funded by the private sector, and (2) if such cases were identified, whether ATP's current award selection process ensures that such research would not be funded in the future. As we stated in our conclusions, "we found two inherent factors—the need to guard against conflicts of interest and the need to protect proprietary information—that limit ATP's ability to identify similar research efforts in the private sector. These two factors have not changed since the beginning of the program. We recognize the valid need to guard against conflicts of interest and to protect proprietary information; thus we are not recommending any changes to the award selection process. However, we believe that it may not be possible for the program to ensure that it is consistently not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance."

GAO has not investigated whether there have been more recent examples of problematic projects.

- *Although some ATP projects may aim toward similar goals as private sector research, they may take alternative approaches with greater risk and a greater reward. Would you still view this as duplicative?*

GAO focused its analysis on whether the three completed projects reviewed addressed research goals that were **similar** to goals that the private sector was addressing at about the same time.

We did not analyze whether ATP projects were duplicative. As we stated in our agency comments section, if the private sector is funding any of the technical approaches toward the broad research goal, the benefits resulting from these efforts may be realized without federal funding.

- *Does GAO believe that the federal government should not fund research just because the private sector may be funding research with the same overall goal?*

GAO's role in the hearing was to discuss our findings regarding the ATP program and whether its projects addressed research goals that were similar to goals undertaken in the private sector. Our testimony did not address the goal of federal research. As we state in the agency comments section of the report, we recognize that there could be value to funding a number of technical approaches or to accelerating critical technologies. However, while ATP is to ensure that it is not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance, the fact remains that we found that the three ATP-funded projects that we reviewed addressed similar research goals to those already funded by the private sector, which is counter to P.L. 100-418, that established ATP.

- *Should GAO's report be viewed as an evaluation of ATP?*

GAO's report should be viewed as an evaluation of whether ATP has funded research that would be conducted in the same time period in the absence of ATP funding.

Attachments:

- Advanced Technology Program: Inherent Factors in Selection Process Could Limit Identification of Similar Research (GAO/RCED-00-114)
- Summary information about past GAO work addressing ATP

United States General Accounting Office
GAO
Report to Congressional Requesters

April 2000

ADVANCED TECHNOLOGY PROGRAM

Inherent Factors in Selection Process Could Limit Identification of Similar Research

GAO/RCED-00-114

Contents

Abbreviations

ATP	Advanced Technology Program
CIC	Communication Intelligence Corporation
GAO	General Accounting Office
MIT	Massachusetts Institute of Technology
NIST	National Institute of Standards and Technology
PTO	U.S. Patent and Trademark Office
SEB	Source Evaluation Board
TE	Tissue Engineering
WDM	wavelength division multiplexing

United States General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-283784

April 24, 2000

The Honorable F. James Sensenbrenner
Chairman
Committee on Science
The Honorable John R. Kasich
Chairman
Committee on the Budget
House of Representatives

The Advanced Technology Program (ATP), administered by the National Institute of Standards and Technology (NIST), was established to support research that accelerates the development of high-risk technologies, with the potential for broad-based economic benefits for the nation. The Omnibus Trade and Competitiveness Act of 1988 (P.L.100-418), which established ATP, states that ATP program administrators should ensure that they are not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance. ATP is a competitive cost-sharing program that since 1990 has funded 468 projects at a cost of about $1.5 billion in federal matching funds. As of December 1999, 236 projects had been completed.

Research can provide both private benefits, which accrue to the owners of the research results, and social benefits, which accrue to society as a whole. In some instances, the private sector does not fund research that would be beneficial to society because doing so might not provide an adequate return on firms' investments. In other words, the market is unable to fund certain types of research either at all or at the most desirable or optimal level, resulting in what is commonly referred to as "market failure." To address this situation, the federal government, through tax credits or direct public funding, supports research that has very broad social benefits, such as basic research and research focused on developing technologies in areas such as public health and nutrition, energy conservation, and environmental protection. However, there is a continuing debate over whether the private sector has sufficient incentives to undertake research on high-risk, high-payoff emerging and enabling technologies without government support, such as ATP.

Because of your concern that ATP may have funded research that was similar to research already being funded by the private sector, you asked us

to review the NIST ATP document entitled Performance of Completed Projects, Status Report Number 1, dated March 1999, which provided the status of the first 38 completed projects. As agreed with your offices, we determined (1) whether, in the past, ATP had funded projects with research goals that were similar to projects funded by the private sector and (2) if such cases were identified, whether ATP's current award selection process ensures that such research would not be funded in the future. To determine whether ATP has funded projects similar to private sector projects, we chose 3 of the 38 completed projects, each representing a different technology sector—biotechnology; electronics; and information, computers, and communications. These three technology sectors represent 26 of the 38 completed ATP projects, or 68 percent. We analyzed the ATP project files and held discussions with industry and academic experts, technical reviewers, and award recipients to assist in our examination of these projects. We also conducted patent searches on the technical areas associated with each of the three projects. Our objective was not to provide an evaluation of the quality of the research funded by ATP or the private sector nor the impact these projects may or may not have had on their respective industries. To address the second objective, we reviewed ATP's current award selection process. We did not review the overall management of the program. (See app. I for a detailed discussion of our scope and methodology.) We performed our work from October 1999 through April 2000 in accordance with generally accepted government auditing standards.

Results in Brief

The three completed ATP-funded projects, which were approved for funding in 1990 and 1992, addressed similar research goals to those already funded by the private sector. The projects included an on-line handwriting recognition system, a system to increase the capacity of existing fiber optic cables for the telecommunications industry, and a process for turning collagen into fibers for human prostheses use. In the case of the handwriting recognition project, ATP provided $1.2 million to develop a system to recognize cursive handwriting for pen-based (i.e., without a keyboard) computer input. We identified several private firms that were conducting similar research on handwriting recognition at approximately the same time the ATP project was funded. In fact, this line of research began in the late 1950s. In addition, we identified multiple patents, as early as 5 years prior to the start of the ATP project, in the field of handwriting recognition. We found similar results in the other two projects.

Two inherent factors in ATP's current award selection process—the need to guard against conflicts of interest and the need to protect proprietary information—make it unlikely that ATP can avoid funding research already being pursued by the private sector in the same time period. These factors, which have not changed since 1990, make it difficult for ATP project reviewers to identify similar efforts in the private sector. For example, to guard against conflicts of interest, the program uses technical experts who are not directly involved with the proposed research. Their acquaintance with on-going research is further limited by the private sector's practice of not disclosing its research efforts or results so as to guard proprietary information. As a result, it may not be possible for the program to ensure that it is consistently not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance.

Background

ATP, which began in fiscal year 1990, was initiated to fund high-risk research and development (R&D) projects with broad commercial and societal benefits that would not be undertaken by a single company or group of companies, either because the risk was too high or because the economic benefits of success would not accrue to the investors. ATP is viewed as a mechanism for fostering investment in areas in which social returns would exceed private returns. ATP has addressed other opportunities to achieve broader social goals such as small business participation, as well as the establishment of joint ventures—for high-risk technologies that would be difficult for any one company to justify, because, for example, the benefits spread across the industry as a whole. Thus, ATP is seen by some as a means of addressing market failure in research areas that would otherwise not be funded, thereby facilitating the economic growth that comes from the commercialization and use of new technologies in the private sector. Advocates of the program believe that the government should serve as a catalyst for companies to cooperate and undertake important new work that would not have been possible in the same time period without federal participation. Critics of the program view ATP as industrial policy, or the means by which government rather than the marketplace picks winners and losers.

ATP's cooperative agreements are made through announced annual competitions. The ATP provides multiyear funding to single companies and to industry-led joint ventures. The proposal review and selection process is a multistep process based on NIST regulations. In general, these steps include: a preliminary screening, technical and business reviews,

semifinalist identification, oral reviews, ranking, and final selection. At the beginning of each round of ATP competitions, NIST establishes Source Evaluation Boards (SEBs) to ensure that all proposals receive careful consideration. Each SEB is comprised of NIST technical experts as well as outside specialists with backgrounds in business and economics. ATP supplements the SEBs with outside technical reviewers, generally federal government experts in the specific industry of the proposal. Independent business experts are also hired on a consulting basis, including high-tech venture capitalists, people who teach strategic business planning, retired corporate executives from large and small high-tech businesses, as well as economists and business development specialists. All SEB members and outside reviewers must sign nondisclosure statements, agree to protect proprietary information, and certify that they have no conflicts of interest.

As part of the proposal evaluation process, ATP uses the external reviewers to assess the technical and business merit of the proposed research. Each proposal is sponsored by both technical and business SEB members, whose roles include identifying reviewers, summarizing evaluative comments, and making recommendations to the SEB. The SEB evaluates the proposals, selects the semifinalists, conducts oral interviews with semifinalists, and ranks the semifinalists. A source selecting official makes the final award decisions based on the ranked list of proposals from the SEB.

The three projects that we reviewed received funding through the ATP competitions announced in 1990 and 1992. In those years, the selection criteria included: scientific and technical merit, potential broad-based benefits, technology transfer benefits, the proposing organization's commitment level and organizational structure, and the qualifications and experience of the proposing organization's staff. Each of the five selection criteria was weighted at 20 percent. Today, these same selection criteria are used but are grouped into two categories, each weighted 50 percent. The "Scientific and Technical Merit," category addresses a variety of issues related to the technical plan and the relevant experience of the proposing organization. The second category, "Potential for Broad-Based Economic Benefits," addresses the means to achieving an economic benefit, commercialization plans, as well as issues related to the proposer's level of commitment, organizational structure, and management plan. Technical and business reviewers complete documentation called technical and business evaluation worksheets addressing various aspects of these criteria.

Three ATP Projects Addressed Similar Research Goals to Projects in the Private Sector

The three completed projects that we reviewed addressed research goals that were similar to goals that the private sector was addressing at about the same time. The three projects were funded in the early 1990s, and our efforts to locate similar research involved identifying, retrospectively, research that we now know was going on at that time. Each of the three projects was from a different sector of technology—computers, electronics, and biotechnology. The projects include (1) an on-line handwriting recognition system for computer input, (2) a system to increase the capacity of existing fiber optic cables for the telecommunications industry, and (3) a process for turning collagen into fibers for human prostheses use. (Apps. II through IV describe each of the ATP projects and the private sector research projects whose goals were similar to the ATP-funded projects.)

ATP Project on Handwriting Recognition

Both the ATP project and several private sector projects had a similar research goal of developing an on-line system to recognize natural or cursive handwritten data without the use of a keyboard. This technology would make computers more useful where keyboard use is limited by physical problems or in situations where using a keyboard is not practical. On-line handwriting recognition means that the system recognizes handwritten data while the user writes. The primary technical problem in handwriting recognition is that writing styles vary greatly from person to person depending upon whether the user is in a hurry, fatigued, or a variety of other factors. While the technology for obtaining recognition of constrained careful writing or block print writing was commercially available, systems for cursive writing recognition were not commercially available because of the greater handwriting variability that was encountered.

The ATP project we reviewed sought to develop an on-line natural handwriting recognition system that was user-independent and able to translate natural or cursive handwriting. Communication Intelligence Corporation (CIC) was the award recipient. CIC used its ATP funding of $1.2 million from 1991 to 1993 to build its own algorithms [1] and models for developing its handwriting recognition system. During the project, CIC created a database that includes thousands of cursive handwriting samples

[1]Algorithm here refers to the mathematical procedures involved in recognizing writing as it is being written on a computer device.

and developed new recognition algorithms. Some of this technology has been incorporated into a registered software product that has the ability to recognize cursive writing in limited circumstances.

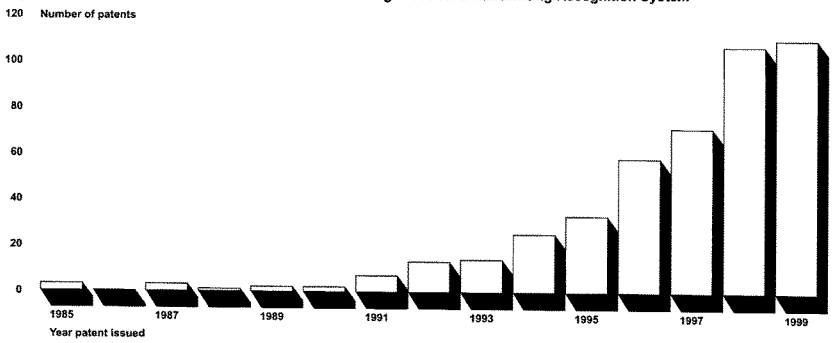
According to the experts we interviewed, as well as literature and patent searches, several companies were attempting to achieve a similar goal of handwriting recognition through their research around the same time that the ATP project received funding. Some of the key players in the private sector conducting research on cursive handwriting recognition included Paragraph International (in collaboration with Apple Computer) and Lexicus (which later became a division of Motorola). For example, Apple licensed a cursive handwriting recognition system from a Soviet company, Paragraph International, according to articles published in computer magazines in October 1991. According to these sources, this technology provided Apple with a foundation for recognizing printed, cursive, or block handwritten text.

Another indication of research of a similar goal appeared in the October 1990 edition of *PC Week*, which reported that "handwriting recognition is an emerging technology that promises increased productivity both for current microcomputer owners and for a new breed of users armed with hand-held 'pen-based' computers." Similarly a technical journal article indicated that there was renewed interest in the 1980s in this field of on-line handwriting recognition, from its advent in the 1960s, because of more accurate electronic tablets, more compact and powerful computers, and better recognition algorithms.[2]

[2]IEEE Transactions on Pattern Analysis and Machine Intelligence, "The State of the Art in On-Line Handwritting Recognition." (Aug. 1990), vol. 12, no. 8.

Moreover, as shown in figure 1, according to the U.S. Patent and Trademark Office's (PTO) database, over 450 patents[3] were issued on handwriting recognition software, concepts, and related products from 1985 through 1999, indicating that research of a similar goal was being conducted around the time of the ATP project. Given the fact that it can take many years between the time a research project takes place and the time that an outcome is realized, this time period for a patent search allowed us to determine whether there was research ongoing during the time of the ATP project. The dates of the patents actually occurred sometime after the research was conducted. And, as we reported in a prior report,[4] the time between the point when a patent application is filed until the date when a patent is issued, or the application is abandoned, ranged from 19.8 months to 21 months, adding additional time to when the research was done.

Figure 1: The Number of Patents Issued from 1985 Through 1999 for a Handwriting Recognition System



Source: Prepared by GAO using PTO's data.

[3] A patent is a grant given by a government to an inventor of the right to exclude others for a limited time (usually 20 years) from making, using, or selling his or her invention.

[4] Intellectual Property: Comparison of Patent Examination Statistics for Fiscal Years 1994-1995 (GAO/RCED-97-58, Mar. 13, 1997).

ATP Project on Capacity Expansion of Fiber Optic Cables

Another ATP project we reviewed, which proposed to develop a system to increase the capacity of existing fiber optic cables for the telecommunications industry, also had a similar goal to that of research in the private sector. At the same time, firms in the private sector were attempting to increase the number of light signals that can be transmitted through a single strand of fiber optic cable using a technology called wavelength division multiplexing (WDM).[5] In the 1980s, telephone companies laid fiber optic cables across the United States and other countries to create an information system that could carry significantly more data than the copper wires they replaced. Tremendous increases in cable traffic, primarily from the Internet, have crowded these cables. WDM technology was aimed at providing a cost-effective alternative to the expensive option of installing additional fiber optic cables.

Accuwave Corporation (Accuwave) was the ATP award recipient. Accuwave used its ATP funding of approximately $2 million from March 1993 through March 1995 to develop a wavelength division multiplexing system that would substantially increase the number of signals that could be transmitted through a single optical fiber strand, using the concept of volume holography. Volume holography uses holograms to direct multiple light signals simultaneously through a single fiber strand. Accuwave was able to make improvements on these issues but not enough to fully develop and market a successful WDM system for the telecommunications market. In 1996, a competitor beat Accuwave to the market. After the completion of the ATP project, Accuwave filed for bankruptcy protection due to its inability to successfully commercialize a wavelength division multiplexing system.

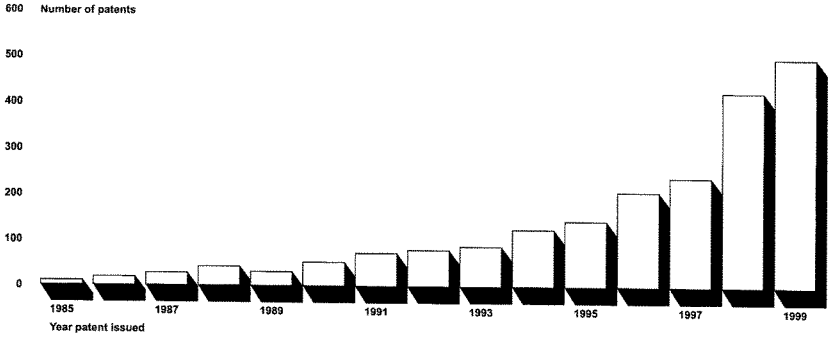
Other private firms were involved in research with a similar goal of increasing the capacity of fiber optic cable at about the same time as Accuwave was conducting its research. Conceptual research on such systems dates back to the early 1980s, but development and commercialization did not flourish until the mid- to late 1990s. Bell Labs (now Lucent Technologies), Nortel Networks, and Ciena Corporation, among others, were considered some of the major competitors in the industry. In the early 1990s, these firms were attempting to develop WDM technology using different methods and materials. For example, Ciena

[5]A fiber optic cable consists of many extremely thin strands of glass or plastic, each capable of transmitting light signals. Wavelength division multiplexing transmits separate light signals through a single optical fiber strand at different wavelengths.

Corporation developed a system that incorporated fiber-Bragg gratings, which are filters embedded directly onto fiber optic cable that help to separate multiple light signals through a single fiber strand.

We also found an indication of WDM-related research through a review of issued patents. According to PTO's database, over 2,000 patents were issued related to wavelength division multiplexing components, systems, and concepts from 1985 through 1999. As shown in figure 2, the patents issued ranged from 10 patents in 1985 to 493 in 1999.

Figure 2: The Number of Patents Issued from 1985 Through 1999 for Wavelength Division Multiplexing Systems and Components



Source: Prepared by GAO using PTO's data.

ATP Project on Regenerating Tissues and Organs

Both the ATP project and private sector projects we identified in the tissue engineering field had similar broad research goals of developing biological equivalents for defective tissues and organs utilizing diverse technical approaches. ATP's project proposed procedures for extracting, storing, spinning, and weaving collagen (the main constituent of connective tissue and bones) into fibers suitable for human prostheses that could induce the body's cells to regenerate lost tissue. Tissue Engineering, Inc., received

ATP's award of about $2 million for use over the years 1993 through 1996. The company's long-term and yet unrealized goal is to transplant these prostheses into humans, after which the collagen framework, or scaffold, would induce the growth and function of normal body cells within it, eventually remodeling lost human tissue and replacing the scaffold.

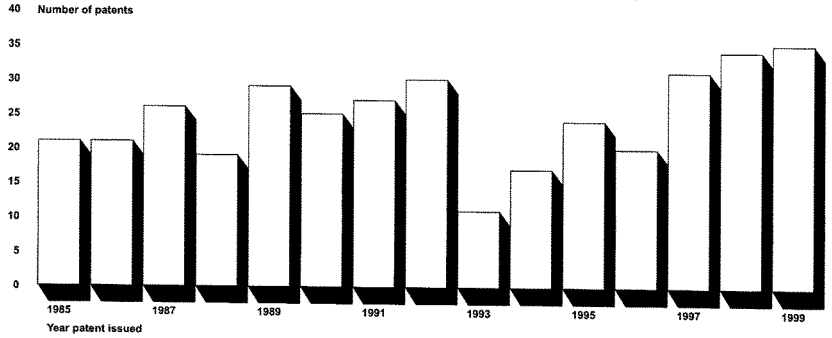
Within the very innovative field of tissue engineering, however, many competitors were attempting to achieve similar broad research goals. Organogenesis, the Collagen Corporation, Integra LifeSciences, Advanced Tissue Sciences, Genzyme Tissue, Osiris Therapeutics, Matrix Pharmaceuticals, and ReGen Biologics are key players in the market to develop structures that could replace or regenerate cells, tissues, and organs such as skin, teeth, orthopedic structures, cartilage, and valves. A number of these companies have subsequently received ATP awards. In addition, universities and medical schools have researchers investigating the many possibilities to engineer human tissues, and eventually complex organs, such as the liver, pancreas, and heart. According to one expert, there is a great deal of competition within the field of tissue engineering.

Although the Tissue Engineering, Inc., research focused on the use of collagen as the basis for these structures, other companies were pursuing a variety of technical approaches for addressing the goal of developing biological equivalents for defective tissues and organs. In addition to research in collagen, other companies and researchers have also been attempting to create human tissues and organs from other biological materials, synthetics, and hybrid products, which are both biologic and synthetic. For example, researchers from the Massachusetts Institute of Technology (MIT) developed an artificial skin product using collagen and a natural polymer. Several companies have since developed comparable products. In 1986, researchers from MIT and a hospital in Massachusetts began inserting cells into scaffolds created of biodegradable polymer. As the cells multiply, tissues form. The magazine *BusinessWeek* reported this concept as "an elegantly simple concept that underlies most engineered tissue."[6] Two competitors, Integra LifeSciences and Organogenesis, reported that they were also doing work on the use of collagen in various applications. Although their technical approaches were different than the ATP project, the broad research goals were similar.

[6]"Biotech Bodies," *BusinessWeek*, July 27, 1998.

In addition to our discussions with experts and literature searches, patent research shows that there was activity related to the field of tissue engineering prior to and during the ATP project. According to a search done on the PTO website, at least 370 patents were issued related to cell culturing, scaffolding or matrix development, and tissue engineering from 1985 through 1999. Experts have also indicated that there are several patents related to the field, with a considerable amount of overlap in the technologies described in those patents. Figure 3 depicts patents issued for research related to tissue engineering from 1985 through 1999.

Figure 3: The Number of Patents Issued from 1985 Through 1999 Related to Tissue Engineering



Source: Prepared by GAO using PTO's data.

ATP's Current Award Selection Process Is Unlikely to Avoid Funding Similar Research

Two factors in ATP's current award selection process could result in ATP's funding research similar to research that the private sector would fund in the same time period. These two factors are inherent in the review process and limit the information the reviewers have on similar private sector research efforts. Due to conflict-of-interest concerns, technical reviewers are precluded from being directly involved with the proposed research, making them less likely to know about all the research in an area. Also, the information available about private sector research is limited because of the private sector practice of not disclosing research results. Until a patent is issued, a private sector firm generally publishes very few details about the research to protect proprietary information. Therefore, it is difficult for the reviewers to identify other cutting edge research.

ATP's Conflict-of-Interest Provision Limits Its Ability to Identify Similar Research

ATP selection officials rely on outside technical reviewers to evaluate a proposal's scientific and technical merit. All reviewers must certify that they have no conflicts of interest. To minimize possible conflicts of interest, the technical reviewers are generally federal government employees who are experts in the specific technology of the research proposal but are not directly involved with the proposed research area. Although this approach helps to guard against conflict of interest, it has inherent limitations on the program's ability to identify similar research efforts. The technical reviewers rely on their own knowledge of research underway in the private sector. One of the technical reviewers we interviewed said that he did not personally know of other companies that were doing similar work. However, he believed that it was unlikely that there were not dozens of others working on the same issue.

Proprietary Information Limits ATP's Ability to Identify Similar Research

ATP reviewers are significantly limited in their ability to identify similar research efforts by an inherent lack of information on private sector research. Although ATP officials use several sources such as colleagues, conferences and symposia, and current technical literature, to try to identify research efforts conducted by the private sector and the federal government, this information is often proprietary. Most of the private sector and university experts we consulted agreed that it can be very difficult to identify the specific research that private sector firms are conducting, especially considering the competitive nature of most industries. The early release of information on a company's research could be costly to the firm. If a competing firm could determine the nature and progress of another company's research, it could help the competitor to

develop and commercialize an identical or higher-quality product before the other firm. At the very least, the early release of research information by a firm can give competitors an idea as to the focus of the firm's strategic plan. Thus, many firms are very careful about releasing detailed information related to research and development activities they are conducting.

Conclusions

Our retrospective look at the three ATP research projects showed that their goals were similar to research goals already being funded by the private sector. Looking at the process that ATP currently uses to select projects, we found two inherent factors—the need to guard against conflicts of interest and the need to protect proprietary information—that limit ATP's ability to identify similar research efforts in the private sector. These two factors have not changed since the beginning of the program. We recognize the valid need to guard against conflicts of interest and to protect proprietary information; thus, we are not recommending any changes to the award selection process. However, we believe that it may not be possible for the program to ensure that it is consistently not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance.

Agency Comments

We provided a draft of this report to the Department of Commerce for its review and comment. The Department's National Institute of Standards and Technology (NIST), which administers the Advanced Technology Program, disagreed with both the methodology that we used and the conclusions that we reached in the draft report. NIST's disagreement focused on six areas, which are discussed in the following sections. NIST's comments and an enclosure describing the technical approaches of the three ATP projects that we reviewed are in appendix V.

First, NIST states that the report implies that the federal government should not fund research that shares the same overall goal as research funded outside of the government. We disagree. NIST believes that it is appropriate for the federal government to fund research projects that have similar research goals to research funded by the private sector as long as that research has an innovative technical approach and has the potential for broad-based economic benefits. However, the Omnibus Trade and Competitiveness Act, which established the ATP, states that ATP program administrators should ensure that they are not funding existing or planned

research that would be conducted in the same time period in the absence of ATP financial assistance.

Second, NIST believes that our report failed to understand and address a central aspect of the ATP: that it selects projects for innovative, high-risk technical approaches for break-through solutions to challenging problems and that these technical innovations offer broad potential national benefits. To the contrary, throughout the report we state that the goal of the program and the criteria for project selection support innovative research that accelerates the development of high-risk technologies with the potential for broad-based economic benefits for the nation. Furthermore, our report states that advocates of the program believe that the government should serve as a catalyst for companies to cooperate and undertake important new work that would not have been possible in the same time period without federal participation.

Third, NIST states that our report fails to define or address the distinction between funding projects with similar "research goals" versus funding projects with "unique project-specific objectives and technical approaches." We disagree. Throughout our report we distinguish between broad research goals and specific technical approaches. In determining whether, in the past, ATP had funded projects with research goals that were similar to projects funded by the private sector, our report identifies many competitors who were attempting to achieve similar broad research goals to those of the three ATP-funded research projects, albeit using different technical approaches. Our report includes descriptions of the unique technical approaches of the ATP-funded projects and states that the other firms were attempting to develop these technologies using different methods and materials. NIST included, as an enclosure to its comments, a description of the technical approaches of each of the projects, which we believe generally mirrors much of our descriptions of the projects, included in appendixes II through IV. While the ATP-funded projects had unique technical approaches, nevertheless, the broad research goals were similar to research goals of projects being funded by the private sector.

Fourth, NIST states that our report does not discuss the competitive value of having differences in the technical approaches of the research within the broad research fields being addressed. NIST further noted that the report does not mention the national benefits, which would result from accelerating the high-risk, yet critical technology resulting from specific projects. We agree that there could be value to funding a number of technical approaches or to accelerating critical technologies. However, if

ATP is to ensure that it is not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance, the fact remains that we found that the three ATP-funded projects that we reviewed addressed similar research goals to those already funded by the private sector. If the private sector is funding any of the technical approaches toward the broad research goal, the benefits resulting from these efforts may be realized without federal funding.

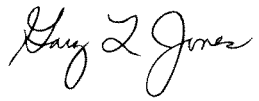
Fifth, NIST states that in conducting our review we "hand-picked" 3 of 38 completed projects, "presumably with the intent of making the strongest possible argument," and that we used these projects to draw conclusions that are unreasonably far reaching. This assertion is not correct. We selected these projects without prior knowledge of the industries or the technological approaches of the research projects. We chose three projects each representing a different technology sector. These three technology sectors represent 26 of the 38 completed ATP projects, or 68 percent. We have added additional information to explain the scope and methodology used in our case study approach. Our conclusion based on the review of the three projects is that the research goals of these three projects were similar to research goals already being funded by the private sector. To assist in our examination of these projects, we held discussions with outside experts, as well as with ATP technical reviewers and Source Evaluation Board members. These outside experts helped us to understand the industries within which each of the projects selected as case studies were operating and provided their professional assessment of whether similar research to that undertaken by the ATP award recipient was ongoing. We identified two inherent factors in ATP's current award selection process—the need to guard against conflicts of interest and the need to protect proprietary information—that led us to the conclusion that it may not be possible for the program to ensure that it is consistently not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance. This conclusion was based principally on our analysis of the current award selection process supplemented by our analysis of the three ATP-completed projects.

Sixth, NIST stated that if we "were to review all 199 ATP completed projects to date, the GAO might still have come to the same conclusions, i.e. that the research goals may have been similar to those funded by the private sector." However, NIST states that even a review of all of the completed projects "would utterly fail to capture the impact of the ATP." Our objective was not to provide an evaluation of the quality of the research funded by ATP or the private sector nor the impact these projects

may or may not have had on their respective industries. We have added this clarification to the report. Our review of completed projects was limited to identifying whether, in the past, ATP had funded projects with research goals that were similar to projects funded by the private sector.

As arranged with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after its issuance date. At that time, we will send copies of this report to the appropriate House and Senate committees; interested Members of Congress; the Honorable William M. Daley, Secretary of Commerce; Raymond G. Kammer, Director, National Institute of Standards and Technology; and Alan Balutis, Director, Advanced Technology Program.

If you have any questions regarding this report, please contact me at (202) 512-3841. Key contributors to this report are listed in appendix VI.



(Ms.) Gary L. Jones
Associate Director, Energy, Resources,
and Science Issues

Appendix I

Scope and Methodology

To determine whether the Advanced Technology Program (ATP) had funded projects with research goals similar to projects being funded by the private sector, we examined 3 of 38 completed ATP projects from ATP's status report entitled Performance of Completed Projects, dated March 1999. These projects were chosen from the following technology sectors: information, computers, and communication; electronics; and biotechnology. These three technology sectors represent 26 of the 38 completed ATP projects, or 68 percent. We consulted with ATP officials at the beginning of our review regarding which technology sectors would provide a useful framework for our review. These officials supported our selection of the three industrial sectors and gave us information showing that they had each received increasing numbers of awards, since the start of the ATP program. ATP funded the selected projects as a result of two different competitions held in 1990 and 1992. We rank-ordered all of the projects within the three technology sectors by dollar value. All three selected projects had received a medium to high dollar award from ATP. As with all case studies, we did not attempt to generalize to the entire program.

It can be very difficult to identify the specific research that private sector firms are conducting. Firms are very careful about releasing detailed information related to research and development activities they are conducting given the competitive nature of most industries. Also, it can take many years between the time a research project takes place and the time that an outcome is realized. Thus, we chose projects that ATP awarded as a result of competitions held in the early 1990s to retrospectively identify similar research projects.

To fully understand the technologies under review, we studied the official ATP project files, located at the National Institute of Standards and Technology (NIST) headquarters in Gaithersburg, Maryland, for the three projects we selected. According to NIST officials, all documents maintained in these files are considered proprietary information. Within the project files, we reviewed the original project proposals, technical and business reviewer comment sheets, sponsor summaries and recommendations, and the project manager's quarterly status reports and final report. To ensure the confidentiality of the proprietary information, none of this information was shared with the experts that we consulted. These experts were provided project information drawn from ATP's March 1999 Status Report.

We interviewed ATP staff, outside experts, and award recipients to gain an understanding of each of the technology sectors and related research and to obtain their professional assessment of whether similar research to that undertaken by the ATP award recipient was being funded by the private sector during the same time period. To identify the ATP staff, we used NIST's list of the technical and business reviewers and members of the Source Evaluation Board (SEB), who had reviewed the project proposals. We asked these reviewers to identify additional knowledgeable contacts to interview and applicable reports and articles that would supplement our knowledge of the technologies under review. For the handwriting recognition project, we interviewed five NIST scientists who were either technical reviewers or members of the SEB related to the project and 11 experts from industry and academia. For the electronics project, we interviewed four NIST scientists who were either technical reviewers or members of the SEB related to the project and 13 experts from industry, academia, or other government agencies. For the biotechnology project, we interviewed two NIST scientists who were technical reviewers related to the project and 18 experts from industry, academia, or other government agencies. These outside experts represented Fortune 500 companies, such as Lucent, Microsoft, and IBM; major universities such as MIT and the University of Maryland; and government agencies, such as the National Aeronautics and Space Administration and the National Science Foundation.

We developed a structured interview to facilitate our conversations with the ATP staff, outside experts, and award recipients. The interview document provided questions that addressed issues such as the level of similar research at the time of the ATP funding, the identification of private sector firms that conducted similar research, and the innovativeness of the ATP proposals, among others.

To gather published and other information about each industry, we conducted a literature search, as well as an Internet search. The literature search used technical library sources to identify both academic journal and industry-specific publications with articles addressing the research goals relevant to each project. In addition, many of the technical experts identified articles for us that we reviewed. The Internet searches provided further information about the technologies under review and the private sector companies involved in similar research at the time that the ATP projects received funding. For example, we conducted a search on "wavelength division multiplexing" on the Internet, and we identified several articles related to this technology that provided background

information for our work. In addition, these articles provided contact names at some of the private firms conducting similar research and academic and/or consultant contacts who have expertise in the technologies under review. The project files at NIST provided contact information for the ATP award recipients.

To show the level of related research that firms were conducting during and around the time ATP funded the projects we reviewed, we also conducted patent searches on the technical areas associated with each project. To conduct our patent search, we accessed the U.S. Patent and Trademark Office's (PTO) website (www.uspto.gov), which contains PTO's patent data base. For each of the three technologies we reviewed, we conducted a full-text keyword search of the PTO's patent data base, using key words that describe each technology as the criteria. For example, for our search for patents on related research to the ATP project on handwriting recognition software, we executed a search using "Handwriting Recognition" as the criterion. We repeated this search for individual years of patent issuance, beginning with 1985 and ending with December 1999. The patent information demonstrates that the private sector was working on research topics that related to the ATP projects we reviewed because the patents were issued after the research was conducted.

We also reviewed ATP's current award selection process to determine whether it could ensure that ATP would not fund research similar to that undertaken by the private sector. This process applies to all project proposals submitted to the ATP program. In conducting this review, we examined published reports on the ATP program, legislation that created and shaped the ATP program, and internal NIST documentation that describes the rules and processes of the ATP program. We also discussed ATP's award selection process with various NIST officials, including ATP management, project managers, and SEB members. We did not independently verify the data we obtained from NIST or the other entities we contacted. We conducted our review from October 1999 through April 2000 in accordance with generally accepted government auditing standards.

Appendix II

Communication Intelligence Corporation Project Summary

This ATP project received funding from the 1990 competition, the first solicitation for the program. The project was completed in 1993. The ATP-funded software technology is widely licensed, and a new product fully incorporating the software is due on the market soon. The company also has several new products related to multilingual handwriting recognition systems and other software technologies that have been successful in the marketplace.

Project Title
Computer Recognition of Natural Handwriting (Communication Intelligence Corporation (CIC))

Amount of Funding Granted
$1,264,000 (58%), with CIC contributing $912,000 (42%) toward the project.

Summary of Project Purpose
To develop a natural handwriting data-entry system for computers for applications where pen-based entry works best and for use by people who do not or cannot use a keyboard.

Market Data
Dataquest, Inc., predicted the market for pen-based computers would increase, potentially to $13.1 billion by 1995.

Description of Industry/Technology
Handwriting recognition was an emerging technology promising increased productivity both for microcomputer owners and for users utilizing new hand-held "pen-based" computers. Starting in the late 1950s, character recognition developed into two areas—whether the characters to be recognized were machine-printed or handwritten. Thus, a separate body of technology research grew out of the areas of machine print and handwritten text. For handwritten text, further research efforts were focused on two additional areas—printed and cursive writing. To facilitate handwritten text recognition, a pen-based, or stylus-based computer, (essentially a tablet computer) that uses an electronic pen, or stylus, in conjunction with a digitizing screen for data input is employed. These systems were expected to supplement, rather than replace, traditional desktop systems. There was concern, however, that high introductory prices and lack of consistent handwriting recognition capabilities would impede the growth of pen-based systems.

Limitations in the technology's accuracy rate made it unsuitable for every user. While the technology had the potential for expanding the use of computers to people who find conventional keyboards unnatural or intimidating, for such tasks as text editing, dictation, or taking notes in a meeting, its accuracy rate and speed were inconsistent. In October 1990, handwriting recognition systems could only interpret unconnected block writing, and no system offered 100 percent accuracy. Complaints about hardware, software, and related components were common. For example, processing power was often inadequate, leading to inconsistencies in the machine's ability to capture data and analyze it. In addition, digitizers were often slow at recording the flow of the pen on the screen. This situation was expected to remain for the foreseeable future, until a new generation of hardware and software could be developed.

CIC proposed to conduct research and development in natural or cursive handwriting recognition to try to provide the means by which ordinary handwriting skill could be used to communicate with computers for a wide variety of applications.

Private Sector Research Activities

Handwriting recognition research has focused on print recognizers and cursive recognizers. Unlike printed character recognition, cursive recognizers must determine distinct characters in a continuous string of writing. In addition, the natural handwriting of most people consists of a mix of printed and cursive; therefore, the recognizer must be able to determine when a break means a new word and when it does not. Cursive recognizers can also exhibit some uncertainty in the identification of words. Since most cursive recognizers are dictionary-based, the system will attempt to approximate the word that a sequence of characters represents and then cross-reference a dictionary or glossary to see if such a character string exists. If the recognizer is uncertain, the system will select alternative word possibilities.

In October 1991, Paragraph International announced a licensing and development agreement with Apple Computer for Paragraph's cursive handwriting recognition technology. Paragraph's technology provided Apple with a foundation for recognizing printed, written, or block handwritten text.

In 1989, Paragraph JV, the Soviet half of the joint venture, started developing a cursive handwriting recognition technology, in affiliation with two Soviet agencies: the Council for Economics and Mathematics, and the

Academy of National Economics. Paragraph developed two main recognition technologies. The first, Calligrapher, is software that can decipher written text as it is written; in addition, it is the basis for the pen-based recognition system. The second technology, Parascript, is a static recognition system for use with an optical character reader. Lexicus, a division of Motorola, concentrated research on cursive recognition as well, as did Go Corporation, Palm Computing, and others.

ATP Review Process

For its technical evaluation, CIC was assessed on the quality and innovativeness of the proposal, coherency of the technical plan, overall scientific and technical merit, and staff quality, among others. The three technical reviewers were government scientists from NIST and DOD. For the technical categories, the evaluations consistently supported CIC.

Regarding its business evaluation, CIC was assessed on several issues, such as potential to improve U.S. economic growth, staffing and facilities, evidence of commitment to complete project beyond federal grant, and overall business merit, among others. For business and economic related criteria, CIC received scores that recommended funding.

Results/Status of Project

CIC researchers sought to perfect software that could effectively recognize cursive handwriting and now has products that provide handwriting recognition for printed English and some foreign languages. Currently, the company's core software technologies include multilingual handwriting recognition systems, dynamic signature verification, natural messaging, and operating system extensions that enable pen input. CIC describes its products as technologies designed to increase the ease of use, functionality, and security of wireless electronic devices ranging from handheld companions to cellular telephones. Key licensees of the company's technologies include companies such as Ericsson, Fujitsu, Hitachi, Microsoft, Mitsubishi, and National Semiconductor.

During the project, CIC researchers created a data base with thousands of cursive handwriting samples and developed new recognition algorithms. After analyzing the handwriting sample data base and developing the recognition methods, the researchers developed procedures that permit fast computation with modest computer memory requirements. The company has achieved other goals as well. For example, CIC has:

- incorporated some of the ATP-funded technology into a registered software product, Handwriter, which recognizes cursive writing in limited circumstances (previously it recognized only printing);
- licensed the Handwriter software to more than a dozen computer manufacturers worldwide, generating $360,000 in revenue from sales of 30,000 units in 1997;
- launched a new product in 1996 called Handwriter MX, a stylus and tablet data entry device using upgraded Handwriter software;
- sold 11,000 copies of handwriter MX in 1997, with sales totaling more than $2.2 million; and
- received the "Ease of Use Seal of Commendation" from the Commendation Program of the Arthritis Foundation for the company's handwriter products—indicating their value to disabled people who have trouble with keyboard entry.

Appendix III

Accuwave Corporation Project Summary

This ATP project was awarded funding from the 1992 competition. Although Accuwave eventually filed for bankruptcy protection and was unable to commercialize a wavelength division multiplexing system, it did complete the terms of its ATP cooperative agreement by the end of the project in 1995.

Project Title
Expanding the Number of Light Signals in an Optical Fiber (Accuwave Corporation).

Amount of Funding Granted
$1,987,000 (69%), with Accuwave Corporation contributing $898,000 (31%) toward the project.

Summary of Project Purpose
To develop holographic-optics technology[1] that will increase (by more than 10 times) the number of signals that can be transmitted through a single optical fiber strand. [2] This technology is based on the concept of wavelength division multiplexing (WDM), which transmits separate light signals through a single optical fiber strand at different wavelengths.

Market Data
According to consultants hired by Accuwave at the time of the ATP proposal, the total market for Accuwave's technology was expected to reach $40 million. Another consulting firm estimates that by 2003, sales of WDM systems will reach $40 billion worldwide.

[1]Holography is a technique that allows the recording and playback of true, three-dimensional images, called holograms.

[2]A fiber optic cable consists of many extremely thin strands of glass or plastic, each capable of transmitting light signals.

Description of Industry/Technology

Due to the increased use of telephones, fax machines, mobile telephones, and particularly, the Internet, U.S. telecommunication firms have experienced an increased demand for capacity of their transmission networks, which primarily consist of fiber optic cables. The installation of additional fiber optic cables to deal with the increase in demand for capacity can be very costly. WDM provides a cost-effective alternative to installing additional fiber optic cables. WDM allows for the simultaneous transmission of multiple light signals through the same fiber at different wavelengths. Conceptual research on WDM systems dates back to the early 1980s, but the development and commercialization of WDM systems did not begin to flourish until the mid-1990s. One of the primary reasons why WDM had not become practical until recently was the lack of suitable amplifiers for signals traveling long distances.[3] According to experts we interviewed, serious research in WDM began in the early 1990s as amplifier technology evolved.

This ATP project focused on using a holography-based approach to aid in the development of a WDM system to increase the capacity of existing fiber optic cables. Accuwave's approach employed volume holography, which uses a series of holograms as filters, stored in a volume of photorefractive (light-bending) material, to direct different light signals to separate wavelengths on a single fiber strand. The concept of volume holography dates back to the 1970s and was applied primarily to research on optical signal processing and memory storage. However, volume holography fell into disfavor during the 1980s, primarily because of two problems: efficiency (amount of signal loss) and reliability (deterioration of filters due to changes in temperature). According to the experts we consulted, no one else in the industry seriously considered volume holography as a method to direct multiple signals onto different wavelengths of an optical fiber strand for telecommunications.

[3]Light signals traveling through fibers fade to undetectable levels after a couple hundred kilometers, therefore requiring amplification to increase the strength of the signal.

Private Sector Research Activities

Several private firms were involved in research activities related to WDM in the late 1980s and early 1990s. One of the early participants in this industry was AT&T and its research arm, Bell Labs. Lucent Technologies, which used to be part of Bell Labs, developed an 8-wavelength WDM system in 1995. Ciena Corporation, a company formed in 1992, received a total of $40 million in venture capital funding and developed a 16-wavelength WDM system,[4] which was commercially unveiled in March 1996. Several other companies were researching and developing WDM systems in the 1990s, including Nortel, Pirelli, Alcatel, and others. The other companies competing in this industry used different methods and materials, other than holographic filters, to develop their WDM systems. For example, Ciena Corporation used fiber-Bragg gratings, which are filters that are written onto the fiber optic cable itself, to help separate multiple signals onto different wavelengths within a single optical fiber strand. Much of the research in this industry was kept proprietary and was not released to the public.

ATP Review Process

Technical reviewers from NIST, the U.S. Air Force, and the National Security Agency evaluated Accuwave's proposal on issues such as quality and innovativeness of the proposal, coherency of the technical plan, overall scientific and technical merit, as well as staff quality, and others. For these categories, three of the four technical evaluations were consistent, stating that Accuwave's proposal was innovative. The fourth technical evaluator, however, was more critical of the proposal, stating that Accuwave's method was "another in a long line of techniques under consideration for high density WDM systems."

Business reviewers assessed Accuwave's proposal on issues such as the potential to improve U.S. economic growth, staffing and facilities, evidence of commitment to continue project beyond federal grant, and overall business merit, among other items. For these categories, the business reviewers were critical of the proposal, citing poor commercialization planning, lack of manufacturing capability, etc. ATP officials, however, listened to the company's oral presentation. As a result of the presentation and despite both technical and business reviewer concerns, ATP decided to fund the project.

[4]WDM systems with more than 8 wavelengths are called dense wavelength division multiplexing (DWDM) systems.

Results/Status of Project

According to a former Accuwave official, problems of efficiency and reliability arose during Accuwave's research to develop a WDM system. Accuwave was able to make improvements on these issues but not enough to fully develop and market a successful WDM system for the telecommunications market. In addition, Ciena Corporation, a competitor, beat Accuwave to the market in 1996 with a 16-wavelength WDM system. Accuwave did not learn about Ciena until 1995, and Ciena's research was kept proprietary. Accuwave did commercialize a few WDM components; the most successful of which was called the wavelength locker, a device that controls the frequency of the laser. Accuwave's wavelength locker was a limited commercial success, according to a former Accuwave official. Sales of Accuwave's components reached about $3 million. According to a former Accuwave official, this was not enough to appease the Board members and the venture capitalists, and the decision was made to file for bankruptcy protection in October 1998.

Appendix IV

Tissue Engineering, Inc., Project Summary

This ATP project was awarded funding from the 1992 competition. Tissue Engineering (TE) was able to successfully complete their ATP project goals by the end of the project in 1996. However, the company has not yet developed a prostheses product that can be transplanted into humans and eventually be reabsorbed by the body.

Project Title
Prostheses Made of Biomaterials that Regenerate Body Parts [Tissue Engineering, Inc. (TE)]

Amount of Funding Granted
$1,999,000 (48%), with TE contributing $2,128,000 (52%) toward the project.

Summary of Project Purpose
To develop techniques for extracting and storing collagen and spinning and weaving collagen fibers into fabrics and other forms suitable for human prostheses that could induce the body's own cells to rebuild lost tissue while gradually replacing the prosthesis.

Market Data
According to *BusinessWeek* magazine, the president of the Pittsburgh Tissue Engineering Initiative research consortium has estimated that the potential overall market for engineered and regenerated tissues to be $80 billion.

Description of Industry/Technology
One industry expert said that the premise of the tissue engineering field is to create devices that are bio-regenerative, so that the body can eventually mimic and remodel what is damaged; potentially, experts believed that the result could be more natural than other transplants. In addition, engineered tissues could possibly replace donated organ transplants, which are very limited in supply. According to industry experts, by the early 1990s, the new multidisciplinary field of "tissue engineering" was drawing scientific interest.[1] For over a decade before,

[1]In 1987, the National Science Foundation sponsored a conference where the term "tissue engineering" was first defined.

however, related basic research was being conducted. Industry experts explained that research using synthetics as well as the protein collagen[2] led to discoveries; scientists were looking for a way to package cells in a three-dimensional format, like tissues and organs. According to industry experts, there are remaining challenges; particularly, the challenge to develop products that can be reliably transplanted into and interact with the body without creating a negative reaction by the host.

According to industry experts that we interviewed, tissue engineering research in the early 1990s focused upon synthetics and collagen technology for the development of products, as well as research attempting to understand extracellular matrix from a biological and cell biology perspective. [3] Some of these experts identified academic and private labs that were conducting research on collagen structures by 1993.

Private Sector Research Activities

Prior to 1992, a number of other private sector and university groups were also working on a variety of technical approaches to develop biological equivalents for defective tissues and organs for use in the human body. Among the groups involved in tissue engineering, the experts that we interviewed named the following: Organogenesis; Integra LifeSciences; Advanced Tissue Sciences; Collagen Corporation; Genzyme; Osiris Therapeutics; Matrix Pharmaceuticals; and, researchers at MIT and other universities, hospitals, and laboratories. A study published in the journal *Tissue Engineering* estimated that the government has provided less than 10 percent of tissue engineering funding.[4] According to one industry expert, this may have been an advantage as it forced researchers to start companies and move forward, rather than spend many years in academic settings. Projects by other companies included attempts to bioengineer bone, skin, teeth, cartilage, valves, or other cells, tissues and organs. For example, Integra LifeSciences, Organogenesis, and Advanced Tissue Sciences have all been involved in research leading to bioengineered skin. In addition, Genzyme Tissue, Integra LifeSciences, Advanced Tissue

[2]Collagen is a structural protein that occurs in vertebrates as the main constituent of connective tissue fibrils and in bones. It is the most widely distributed protein in the human body.

[3]Extracellular matrix is described as molecular networks that are crosslinked and are swollen in fluids surrounding the cells.

[4] "An Economic Survey of the Emerging Tissue Engineering Industry," Tissue Engineering, Fall 1998.

Sciences, ReGen Biologics, and Osiris Therapeutics are companies in competition to develop engineered cartilage products using different technical approaches.

According to some of the industry experts that we interviewed, some of what TE proposed and did during the ATP project did not advance the core of the technology of regeneration. However, in 1992, the industry had not defined an industry-wide critical or core technology goal. The TE project was intended to provide a unique structural support for defective tissue to be gradually replaced by healthy tissue. No other therapy was available at the time of the award. Nonetheless, one expert described TE's technology as a derivative technology, rather than a high-risk and innovative technology.

ATP Review Process
During the ATP selection process, technical reviewers assessed the TE project on scientific and technical merit, feasibility, coherency, and appropriateness of staff and equipment. The three reviewers, all federal employees, evaluated the project as innovative. Based on these reviews, evaluations by three business reviewers, and a Source Evaluation Board decision, ATP funded the project.

Results/Status of Project
According to TE, the company had a profitable and rewarding start with the ATP award. According to the company's founder, the ATP project was highly innovative because it would use naturally occurring collagen to re-grow tissue. The company developed a collagen spinning technique, which allows them to imitate the scaffolding of tissues in the body. A TE official claims this can be done on a commercial scale. In addition, the company has also been able to insert cells into the collagen to re-grow tissue in the laboratory. Some of the company's accomplishments include:

- Two patents were awarded to the company for its work under the ATP award: "Apparatus and Method for Spinning and Processing Collagen Fiber"[5] and "Bipolymer Foams Having Extracellular Matrix Particulates."[6]

[5]"Apparatus and Method for Spinning and Processing Collagen Fiber" U.S. Patent Number 5,562,946, granted on 10/8/1996.

[6]"Bipolymer Foams Having Extracellular Matrix Particulates" U.S. Patent Number 5,709,934, granted on 1/20/1998.

- TE indicated that it would soon begin animal trials for its orthopedic products and eventually progress into human trials. TE also mentioned that it has initiated collaborative efforts with larger biotechnology companies.

Appendix V

Comments From the Department of Commerce

NIST

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899
OFFICE OF THE DIRECTOR

APR 14 2000

Ms. Gary Jones
Associate Director, Energy, Resources, and
Science Issues
United States General Accounting Office
Washington, D.C. 20548

Dear Ms. Jones:

Thank you for the opportunity to review and provide comments on the draft General Accounting Office (GAO) report entitled "Advanced Technology Program: Inherent Factors in Selection Process Could Limit Identification of Similar Research (GAO/RCED-00-114, code 141384)."

I disagree with both the methodology used and the conclusions reached in this report. The implied argument is that the Federal government should not fund research that shares the same overall goal as research funded outside of the government. By that doubtful criterion we would shut down Federal research on cures for cancer, AIDS, and a host of other diseases; wireless communications; computing technologies; manufacturing; etc.

The fundamental error in this report is its failure to understand and address a central aspect of the Advanced Technology Program (ATP): that it selects projects for innovative, high-risk technical approaches for break-through solutions to challenging problems, and that these technical innovations offer broad potential national benefits. This does not necessarily mean they are the only possible solutions. Numerous organizations, both government and private, fund research with similar goals. This does not mean they are funding the identical technical approach to attain the research goal. What makes each research project unique are the pathways or technical approaches to solving the problem. This report fails to define or address the distinction between funding projects with similar "research goals" versus funding projects with "unique project-specific objectives and technical approaches." This is a serious error. Lumping projects together under "research goals" is perhaps useful as a taxonomy to identify broad areas of interest, but it is not useful in judging the similarity of specific technical approaches.

Consistent with the ATP statute, ATP assists "United States businesses in creating and applying the generic technology and research results necessary to (1) commercialize significant new scientific discoveries and technologies **rapidly**." The ATP accelerates high risk technologies that are unlikely to be developed in time to compete in rapidly changing global markets, or to be developed at all without Federal support. ATP funded projects are technically challenging and innovative, with objectives that are often well beyond state-of-the-art in their research field. They are technically so challenging that the probability of failure is high and the technical objectives may be only partially met. The GAO report contains no reference to the high technical risks associated with the specific projects funded by ATP, nor the competitive value of having differences in the technical approaches of the research within the broad research fields being addressed. Neither does the GAO report mention the national benefits which would result from accelerating the high-risk, yet critical technology resulting from specific projects.

The GAO's review hand picked 3 of 38 completed projects, presumably with the intent of making the strongest possible argument, and draws conclusions which are unreasonably far reaching. Even in the case of these three projects, however, the report fails to adequately assess the unique technical approaches taken in these projects, factors which played an important role in their selection. I append a short outline of these unique technical approaches taken by each of these projects.

If it were to review all 199 ATP projects completed to date, the GAO might still have come to the same conclusion, i.e., that the research goals may have been similar to those funded by the private sector. However, it would utterly fail to capture the impact of the ATP. On April 4, GE Medical Systems recognized the ATP as a "Partner in Vision" for its support in the development of an innovative manufacturing technology to produce large-area, flat-panel amorphous silicon detectors for X rays. These panels are the heart of a unique new digital mammography system hailed as "the biggest breakthrough in mammography in more than 20 years," according to Senator Connie Mack. The ATP-funded research significantly reduced the number of processing steps required to manufacture these panels and increased the yield. In the sense that it was previously possible to make the panels, the ATP goal was not "unique", but the processing innovations can significantly reduce the cost of these panels, making the new mammography more affordable and more widely available to women. That is a clear benefit to rapidly bringing high-risk technologies to improve the quality of life for Americans.

In the 10 years that ATP has been in operation, if there was concern that ATP was funding research which duplicated that performed by other organizations, ATP would have received numerous complaints from those organizations. This is not the case. ATP's record speaks for itself in complying with the spirit of the law of funding high risk, high pay-off, emerging and

Appendix V
Comments From the Department of Commerce

ENCLOSURE

ATP PROJECTS REFLECT UNIQUE TECHNICAL APPROACHES

I. Communication Intelligence Corporation (CIC) - Handwriting Recognition

The goal of the Communication Intelligence Corporation (CIC) project was to develop user-independent, cursive handwriting recognition software. This project was innovative in that the algorithms to be used would require the system to be "trained" to recognize a specific user's handwriting, and would recognize contiguous characters not separated by discrete spaces. The project was unique in its combination of specific algorithms and programming methodologies which, together, would lead to better speed and accuracy than theretofore attained. (The project had a target of 10 characters per second with 99% accuracy.) Also, differentiating this project from other ongoing efforts, the CIC software was intended to be unconstrained and adaptable to European languages.

II. Accuwave Corporation - Capacity Expansion of Fiber Optic Cables

At the time the award was made, only a few WDM wavelengths had been multiplexed successfully in commercial systems. Accuwave's approach was both high-risk and unique. They proposed wavelength multiplexing using volume holography -- holograms "written" in the interior of thick crystals of photorefractive materials. In the demultiplexer crystal, for example, the multi-wavelength light enters one end of the crystal and encounters a series of holographic gratings, each tuned to reflect a separate and specific wavelength of light while passing all other wavelengths with minimal loss. When the award was made, Accuwave had already demonstrated the individual elements of a system that could multiplex wavelengths more than 10 times better than the current art at visible wavelengths. Under the ATP, Accuwave attempted to extend this technology to the infrared wavelengths used for long-distance telecommunications. If completely successful with this high-risk innovation, Accuwave's technology would have had the potential to increase the number of WDM wavelengths by almost three times the number commercialized by the companies mentioned in the report, which would have greatly accelerated the adoption of very high-capacity telecommunications systems.

III. Tissue Engineering, Inc. (TE) - Regenerating Tissues and Organs

Tissue Engineering was funded by ATP to investigate the combination of the technologies of traditional weaving via fabric weaving machinery and the use of animal-derived extracellular matrix (ADMAT). The resultant matrix is to be used for a scaffold for a variety of tissue engineering applications. The use of extracellular matrix from particular animals thought to be very close to that of human beings are less likely to be rejected when used in a scaffold created from tissue woven on traditional weaving machines. The scaffold can be seeded in a variety of ways to encourage cell growth. It will also resorb into the body as cellular growth takes place, thereby replacing the matrix with a body equivalent. The matrix would be a generic solution for many applications varying from relatively simple to complex including skin, ligaments, tendons, and vascular systems. At the time of the funding of this project, early 1993, this was a unique technical approach toward achieving the broad research goal of replacing human tissue in the body. Based on our information it is still a unique methodology that is not being pursued by others. This was a very high risk technology and offered a unique approach which, if successful, held the promise of widespread applicability. A variety of pilot studies have indicated that the basic hypotheses of this research have proven to be correct.

enabling technologies. To do this, ATP runs a competitive peer review process which has been applauded by the Department's Office of Inspector General as a program which "constitutes a best practice that should be used in other funding programs" (Audit Report No. DEN-10960-9-0001, ATP Award Process Promotes Merit-Based Decisions). It is a merit based program which uses technical and business experts to review proposals to ensure that ATP does not fund existing or planned research that would be conducted in the same time period.

Thank you for the opportunity to provide comments.

Sincerely,

R.G.K.

Raymond Kammer
Director

Enclosure

July 2005
DM 1371905

List of GAO Products on the Advanced Technology Program

The following list of GAO products identifies the report number and date of issuance for each of GAO's products addressing the Advanced Technology Program. Abstracts and the reports in their entirety are available on the GAO website at www.gao.gov under Reports and Testimony by entering a keyword or report number.

- Advanced Technology Program: Inherent Factors in Selection Process Are Likely to Limit Identification of Similar Research, GAO-05-759T, May 26, 2005
- Advanced Technology Program: Inherent Factors in Selection Process Could Limit Identification of Similar Research, GAO/RCED-00-114, April 24, 2000.
- National Institute of Standards and Technology: Carryover Balances for the Advanced Technology Program, RCED-00-71R, March 2, 2000
- Federal Research: Information on the Advanced Technology Program's Award Selection, RCED-99-258R, August 3, 1999
- Federal Research: Challenges to Implementing the Advanced Technology Program, RCED/OCE-98-83R, March 2, 1998
- Measuring Performance: The Advanced Technology Program and Private-Sector Funding, RCED-96-47, January 11, 1996
- R&D Funding Sources for ATP Applicants, RCED/OCE-96-258R, September 20, 1996
- Technology Program's Eligibility Determination, RCED-95-210R, June 1, 1995
- Advanced Technology: Proposal Review Process and Treatment of Foreign-Owned Businesses, RCED-94-81, January 18, 1994
- Federal Research: Advanced Technology Program's Indirect Cost Rates and Program Evaluation Status, RCED-93-221, September 10, 1993

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CONGRESSIONAL TESTIMONY

The Advanced Technology Program

Testimony before the Homeland Security and Government Affairs Committee, United States Senate

May 26, 2005

Brian Riedl
Grover M. Hermann Fellow in Federal Budgetary Affairs
Domestic Policy Studies
The Heritage Foundation

My name is Brian Riedl. I am the Grover M. Hermann Fellow in Federal Budgetary Affairs at The Heritage Foundation. The views I express in this testimony are my own, and should not be construed as representing any official position of The Heritage Foundation.

Federal spending now tops $22,000 per household, the highest inflation-adjusted total since World War II, and $5,000 per household more than in 2001. Budget deficits topping $400 billion are forecast as far as the eye can see. Given the nation's budgetary challenges, the Advanced Technology Program (ATP) remains one of the least justifiable programs. The President and the House of Representatives both support ATP's abolition. The Senate should join them.

ATP was created in 1988, supposedly to provide research and development grants to help small businesses develop profitable technologies. In reality, ATP funnels taxpayer dollars to Fortune 500 companies. Between 1990 and 2004, 35 percent of all ATP funding was granted to Fortune 500 companies. Among the recipients:

- IBM has received $127 million;
- General Electric has received $91 million;
- General Motors has received $79 million; and
- Motorola and 3M have each received $44 million.

All in all, 39 Fortune 500 companies have received a total of $732 million in ATP subsidies. Mr. Chairman, this is the kind of spending that outrages taxpayers. At a time when the federal budget is deep in the red, there is no justification for taxing waitresses in Tulsa, or cashiers in Flint, in order to lavish hundreds of millions of dollars on Fortune 500 companies.

ATP's defenders claim that these subsidies create more technological innovation. They will point out all the technologies on the market that ATP funded. Of course ATP grants have funded some successful products. But the key question is whether the market would have produced those products even without ATP. Both economic theory and practice say yes.

ATP does not fund basic science research. Rather, it funds the commercialization of research so that businesses can profit from it. Basic economic theory states that profit-seeking companies have every incentive to fund profitable R&D themselves. If these projects are as promising as claimed, the companies should have no problem convincing their shareholders to fund the projects, or tapping into the $150 billion that private investors annually spend on R&D. The 39 Fortune 500 companies that have received ATP funds report a combined $1.4 trillion in annual revenues. To suggest they cannot afford their own research and development is baseless. Yes, ATP partially funded HDTV and flat-panel televisions. But if they hadn't, a line of investors and businesses surely would have.

The economic argument that ATP merely subsidizes existing R&D is also backed up by surveys of ATP participants. Although the program is supposed to be a "financier of last resort" for companies that have exhausted all other options, a survey shows that 65 percent of ATP applicants never bothered to seek any private funding before going to the government. And among the near-winners who claimed that ATP was their final hope, 50 percent suddenly found private funding soon after their ATP application was rejected.

Among the other 50 percent who did not secure private funding, many either didn't bother to look, or decided to continue playing the ATP lottery for years to come.

Not only is ATP a give-away for wealthy companies that merely subsidizes existing research, but evidence shows that Uncle Sam is a poor investor. Only 1 out of every 3 ATP projects ever brings a new product to the market. One reason for this abysmal track record is that ATP officials to try minimize conflicts of interest by seeking outside grant reviewers with little or no knowledge of the technology markets. And even if they sought market knowledge, most private companies in these markets conceal their research agendas, leaving ATP officials to guess where the market openings are. The result is grants for projects that either duplicate existing private research, or are doomed to fail. Consequently, ATP has granted money for technologies that had already been developed, patented, and marketed by other companies years earlier. It has granted money to projects that have been discredited by their entire industry. Simply put, investors have better knowledge and more skill investing than government officials.

In conclusion, technological advancement is vitally important to the nation's economy. Yet when governments try to pick the market's winners and losers by micromanaging technological innovation, the results will always disappoint. ATP subsidizes Fortune 500 companies that already have the money and incentive to fund their own profitable projects. Too many companies see ATP as an ATM machine to finance projects they would never spend their own money on. With federal spending growing uncontrollably, ATP should be the first place lawmakers seek savings.

Appendix:

Congress Should Follow the President and Eliminate the Advanced Technology Program

Brian M. Riedl, Heritage Foundation *Backgrounder* No. 1828, March 1, 2005

President George W. Bush's 2006 budget request calls on Congress to terminate or drastically reduce funding for over 150 ineffective and wasteful programs. This is a much-needed step to control spending.

If lawmakers want to demonstrate that they are serious about controlling spending, terminating these 150 low-priority programs is the right place to start. They must take these steps if they are to pave the way for reforming larger and more politically sensitive programs such as Social Security, Medicare, and Medicaid. The Advanced Technology Program (ATP), a corporate welfare boondoggle that costs taxpayers $150 million annually, should be the first program from the President's list that Congress terminates.

The ATP has long been considered corporate welfare at its worst. In 1988, America was briefly fixated on the Japanese economic "miracle." Believing that Japan's system of bypassing the free market in favor of government subsidies and protections to preferred businesses was the new path to prosperity, Congress created the ATP to "bridge the gap between the research and the market place" by providing matching grants to businesses engaged in commercial research in such areas as information technology, electronics, and biotechnology. Congress did not design the ATP to support basic scientific research; instead, taxpayers would fund projects with a "significant commercial payoff" that could make substantial profits for businesses.

The Japanese economy has since stagnated, and so has the ATP. Since its inception, the program has cost taxpayers $2 billion, with more than 35 percent going to *Fortune* 500 companies. Most ATP-funded projects could have been funded by the private sector, and only one-third of ATP projects successfully bring new products to the market. Taxpayers fund these investments, but businesses receive all the profits.

Budget reformers from both parties have made several attempts to defund the ATP. Congress passed legislation eliminating the program in 1995, but President Bill Clinton vetoed the bill. President Clinton again blocked the elimination of the ATP in the following year, inducing Congress to try to reform the troubled program. These reforms failed to fix the program, and the House of Representatives has voted in every year since 2000 to terminate the ATP, only to have the Senate restore funding each time in conference committee.

President Bush recently joined the movement to close down the ATP after his own reform attempts proved futile. Only the Senate stands in the way of saving taxpayers $150 million per year and setting an example for other corporate welfare programs.

WELFARE FOR FORTUNE *500 COMPANIES*

The Advanced Technology Program's status as a corporate welfare program is beyond dispute:

- Five companies—IBM, General Electric, General Motors, 3M, and Motorola—have received a combined total of $385 million in ATP grants, or 19 percent of total program expenditures, since 1990;
- More than 35 percent of ATP funding[1] has been distributed to a group of 39 *Fortune* 500 companies; and
- These 39 companies had combined revenues of $1.4 trillion in 2003.[2] (See Table 1.)

These corporate giveaways are unjustifiable. For example, IBM, with revenues that topped $89 billion in 2003, does not really need the $126 million in taxpayer funding that it has received since 1990. Such companies can certainly afford to finance their own profitable research projects.

[1]National Institute of Standards and Technology, Advanced Technology Program, "ATP Active and Completed Projects by State," at *www.atp.nist.gov/eao/states/statepartners.htm* (February 22, 2005), and "ATP Awards by State," at *www.atp.nist.gov/eao/02awards_state.htm* (February 22, 2005). The data are current through February 2005.

[2]Revenue figures are from "The 2004 Fortune 500," *Fortune*, at *www.fortune.com/fortune/fortune500* (February 22, 2005).

Table 1
Fortune 500 Companies Have Been Granted over $700 Million ATP Dollars

Fortune 500 Corporation	F-500 Rank	2003 Revenue	ATP Grants 1990-2004
IBM	9	$89,131,000,000	**$126,583,013**
General Electric	5	$134,187,000,000	**$91,032,423**
General Motors	3	$195,645,000,000	**$78,554,789**
Motorola	61	$27,058,000,000	**$44,270,242**
3M	105	$18,232,000,000	**$44,200,860**
Honeywell International	76	$23,103,000,000	**$31,573,685**
Ford	4	$164,496,000,000	**$30,339,175**
Oracle	208	$9,475,000,000	**$24,623,388**
Caterpillar	77	$22,763,000,000	**$24,350,768**
Xerox Corp	130	$15,701,000,000	**$23,582,852**
Dow Chemical Co.	44	$32,632,000,000	**$23,041,706**
United Technologies	51	$31,034,000,000	**$21,943,658**
NCR	322	$5,598,000,000	**$21,382,928**
Eastman Chemical Co.	317	$5,800,000,000	**$15,623,233**
Sun Microsystems	173	$11,434,000,000	**$13,843,000**
DuPont	59	$27,730,000,000	**$12,175,975**
Praxair	321	$5,613,000,000	**$11,916,803**
Science Applications Intl.	289	$6,457,000,000	**$11,453,060**
Boeing	21	$50,485,000,000	**$10,102,331**
Lucent	243	$8,470,000,000	**$9,400,000**
Hewlett-Packerd	11	$73,061,000,000	**$7,804,654**
ConocoPhillips	7	$99,468,000,000	**$7,769,860**
Lockheed Martin	48	$31,844,000,000	**$7,262,632**
Edison	163	$12,156,000,000	**$5,871,000**
Air Products & Chemicals	295	$6,297,000,000	**$4,104,914**
PPL	324	$5,587,000,000	**$3,840,023**
Cummins	296	$6,296,000,000	**$2,786,800**
ChevronTexaco	6	$112,937,000,000	**$2,695,200**
Northrop Grumman	55	$28,686,000,000	**$2,382,000**
Wyeth	125	$15,851,000,000	**$2,379,000**
Johnson & Johnson	30	$41,862,000,000	**$2,000,000**
Dana Corporation	193	$10,071,000,000	**$2,000,000**
Medtronic	263	$7,665,000,000	**$1,998,000**
Texas Instruments	197	$9,834,000,000	**$1,971,000**
Owens Corning	350	$4,996,000,000	**$1,900,000**
Armstrong Holdings	495	$3,259,000,000	**$1,870,000**
York International	424	$4,076,000,000	**$1,488,812**
Applied Materials	392	$4,477,000,000	**$1,297,677**
Baxter International	220	$9,087,000,000	**$975,000**
TOTAL		**$1,372,554,000,000**	**$732,390,461**

Sources: ATP grant data (as of February 2005) is located at http://www.atp.nist.gov/eao/states/statepartners.htm. Revenue figures from the 2004 Fortune 500 list, located at http://www.fortune.com/fortune/fortune500.

Although most Americans strongly oppose corporate welfare, programs like the ATP are kept alive by Members of Congress who seek to "bring home the bacon" by helping constituents and donors apply for grants. Yet the ATP does not bring home a significant amount of government spending for most lawmakers.

While taxpayers in every state are forced to pay for the program, more than half of all ATP funding is distributed to companies in five states: California, Michigan, Massachusetts, New York, and New Jersey. (See Table 2.) Meanwhile, 29 states average less than $1 million each in annual grants.[3]

In short, legislators wishing to bring home the bacon should not assume that their constituents receive sufficient benefits to justify the cost in taxes.

Table 2
Five States Receive Half of All ATP Dollars

State	Projects	Grants	Percent of grant dollars
California	184	$471,647,330	23%
Michigan	54	$222,130,375	11%
Massachusetts	76	$148,618,696	7%
New York	51	$125,416,779	6%
New Jersey	36	$110,397,147	5%
Total - Top five states	**401**	**$1,078,210,328**	**52%**
Total - All other states	**367**	**$994,875,878**	**48%**

For projects involving several firms, the state of the lead firm is credited with the project.
Sources: ATP grant data (through February 2004) is located at
http://www.atp.nist.gov/eao/states/statepartners.htm.
ATP's database excludes nearly $200 million of ATP's $2.3 billion in grants

SUBSIDIZING EXISTING RESEARCH

Many people confuse the ATP's mission with that of the National Science Foundation (NSF). The NSF spends over $5 billion per year supporting basic scientific research, such as astronomy and pure mathematics. It exists to fund basic research that, despite its importance, is "so far removed from commercial application that private firms have little incentive to undertake it on their own."[4]

The ATP, by contrast, does not fund basic research: It commercializes research so that businesses can profit from it. Companies should have every incentive to fund this kind of profitable research on their own. Not surprisingly, businesses and investors already spend $150 billion annually on commercial research and development. Since these businesses and stockholders profit from the research, they should be the ones to fund it.

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[3]National Institute of Standards and Technology, "ATP Active and Completed Projects by State" and "ATP Awards by State."

[4]U.S. General Accounting Office (now Government Accountability Office), *Federal Research: Challenges to Implementing the Advanced Technology Program*, GAO/RCED/OCE–98–83R, March 2, 1998, at *161.203.16.4/paprpdf2/160140.pdf* (February 22, 2005).

Instead, the ATP shifts those business expenses to the taxpayers. For example, the promise of huge profits is motivating several private companies to invest millions of dollars in high-definition television (HDTV) technology. Yet Congress used $28 million of the taxpayers' money to subsidize HDTV research by a group led by the Sarnoff Corporation and another $7.3 million for research on flat panel television by another group of manufacturers.[5]

If these technologies will be as successful as ATP advocates claim, the businesses should have no problem either in funding the research internally or in recruiting outside investors. These grants also give the recipient companies an unfair advantage over their unsubsidized competitors.

ATP officials claim that the program leads to economic growth by funding innovative and profitable projects that fail to secure private funding. This is unlikely. Investors vote with their dollars, and a business's inability to secure funding from investors signals the market's lack of confidence that the project will succeed and earn a profit.

Far from functioning as a "financier of last resort," the ATP is the first place to which many businesses apply for funding. A mid-1990s survey revealed that 65 percent of ATP recipients did not seek any private funding before applying for a federal grant.[6] Program administrators responded by tightening the requirements mandating that firms must first seek private funding.

Nevertheless, the application questions remain vague, and applicants have every incentive to overstate their efforts to obtain private funding. The Department of Commerce admits that "project proponents have better information than the ATP about the prospects for private funding, and also have an incentive to conceal this information."[7] Applicants, in fact, have little reason to be honest. Even under the tightened requirements, the ATP has approved grants to firms that refused to answer whether or not they attempted to obtain outside funding.[8]

Of the rejected research projects, 50 percent of the "near winners"—which supposedly had already exhausted all options for private funding—found private funding *after* the ATP rejected their grant application. Of the other 50 percent, most of the companies had never sought private funding before applying to the ATP, and it is unlikely that they diligently sought private funding after rejection. Instead, many simply continued to reapply for ATP grants.[9]

TAXPAYER-FINANCED FAILURES

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[5]National Institute of Standards and Technology, Advanced Technology Program, "A Technology Boost for U.S. Manufacturers of Flat Panel Displays," December 2001, p. 2, at *statusreports-atp.nist.gov/reports/90-01-0060PDF.pdf* (February 24, 2005), and "Digital Video in Information Networks (September 1995), HDTV Broadcast Technology," project brief, at *jazz.nist.gov/atpcf/prjbriefs/prjbrief.cfm?ProjectNumber=95-04-0026* (February 24, 2005).

[6]U.S. General Accounting Office, *Measuring Performance: The Advanced Technology Program and Private-Sector Funding*, GAO/RCED–96–47, January 11, 1996, at *www.gao.gov/archive/1996/rc96047.pdf* (February 22, 2005).

[7]U.S. General Accounting Office, *Federal Research*.

[8]*Ibid.*

[9]Near-winners who sought private funding before applying for an ATP grant were nine times as likely to continue a project after being rejected as those who had not sought private funding. See U.S. General Accounting Office, *Measuring Performance*.

While businesses profit from the ATP's successes, taxpayers fund both its failures *and* its successes. Only one in three ATP projects successfully brings a new product to the market. The rest either fail completely or result in research that has not made it to the market.[10] It is difficult to assess whether or not ATP officials simply approve the wrong applications, because program officials do not keep records of which projects are rejected and why.

One reason that so many projects fail is that many ATP officials lack sufficient knowledge of the relevant markets. This inevitably occurs because officials seek outside reviewers who have no conflicts of interest with the project. Such conflicts are reduced by ensuring that grant reviewers have knowledge of the relevant science and technology, but not of the market. Accordingly, their lack of market knowledge frequently causes grants to be awarded to projects that the market does not demand.[11]

Another reason that projects fail is that ATP grant reviewers do not know whether a certain project would duplicate research performed by other companies. Most businesses conceal their research agendas, not wanting to tip off their competitors. Consequently, ATP officials often have to guess whether a grant application represents new or duplicative research. This duplicative research adds little value to the relevant industry and provides an unfair advantage to the government-subsidized firm.

These and other factors explain the following examples of taxpayer-financed ATP boondoggles:[12]

1. In the early 1990s, several private companies were investing tens of millions of dollars in efforts to increase the data transmission capacity of fiber optic cables. In 1993, Accuwave applied for an ATP grant so that it could also enter this market. Accuwave's approach of using "volume holography" had been so discredited by the rest of the industry that no other private company even considered it. Yet, despite an already competitive market, a discredited scientific approach, and a rejection recommendation from the ATP's own business reviewers, ATP managers still approved the $2 million grant. Predictably, the other companies' research led to more than 2,000 new patents, full market commercialization, and a $40 billion industry in 2003. Accuwave's technique failed, and the firm declared bankruptcy in 1996.
2. In 1991, ATP officials gave the Communications Intelligence Corporation (CIC) $1.2 million for initial research into computer recognition of cursive handwriting, despite the fact that similar technology had already been developed, patented, and marketed. ATP grant makers needed only to open an issue of *PC Week* to see how many other companies were concurrently improving that technology. The other companies' research resulted in 450 new patents, while the taxpayer-financed CIC project provided negligible benefits to the industry.
3. Agridyne Technologies received $1.2 million in 1992 for a project intended to reduce the human side effects of certain pesticides. Agridyne lacked the resources

[10]U.S. General Accounting Office, *Federal Research.*

[11]U.S. General Accounting Office, *Advanced Technology Program: Inherent Factors in Selection Process Could Limit Identification of Similar Research*, RCED–00–114, April 24, 2000, at *www.gao.gov/archive/2000/rc00114.pdf* (February 22, 2005).

[12]All examples are from National Institute of Standards and Technology, Advanced Technology Program, "ATP Status Report Database," at *statusreports-atp.nist.gov/basic_form.asp* (February 22, 2005), and U.S. General Accounting Office, *Advanced Technology Program.*

to commercialize the product and declared bankruptcy in 1995. Biosys then purchased Agridyne, declined to continue the project, and declared bankruptcy a year later. Finally, Thermo Trilogy acquired Biosys's assets and patents and determined that the pesticide project was both obsolete and unprofitable.

4. A group led by Boeing received $5.2 million in 1992 to develop a common framework for automating different types of circuit boards. Although much of the technology was completed, company upheavals have prevented it from being fully commercialized. A project review explained that participating companies had prioritized their own mergers and acquisitions at the expense of completing this project and that reductions in other government contracts created "turmoil" for three of the four participating corporations.
5. ETOM Technologies received $1.4 million in 1993 to increase the storage capacity of compact disks. The technology was developed, but ETOM was unable to acquire the green lasers needed for the product. Additionally, the market for video-on-demand service, which would have used this technology, never developed. ETOM declared bankruptcy in 1998.
6. Hampshire Instruments received $900,000 in 1991 to improve the miniaturization of computer chips. Within two years, Hampshire Instruments fell into financial distress, declared bankruptcy, and was liquidated. No other firms have offered to purchase this research for further development.

Conclusion

Many lawmakers agree that the Advanced Technology Program is just another shameless exercise in taxpayer-funded corporate welfare. Before every important vote, however, many lawmakers ask themselves whether a future opponent could use their vote against them. In the ATP's case, a vote to continue the status quo is always safe, while a vote to terminate could be misconstrued as a vote against business and technology.

Legislating by worst-case political scenarios is neither a formula for effective public policy nor a reliable reflection of political reality. The majority of Representatives and Senators in the current Congress have voted to defund or significantly reduce the ATP at some point between 1995 and 2004. Lawmakers could easily win public support by explaining the importance of eliminating such unnecessary and wasteful spending.

Eliminating the ATP is both smart public policy and smart politics. By eliminating the ATP, lawmakers can show taxpayers that Congress can responsibly confront unnecessary and wasteful government spending.

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Mr. Riedl ATP Hearing Questions:

- **Questions from Senator Levin:**

(Geographic Distribution)

Mr. Riedl, you seem to take issue with the ATP program because there is not an even geographic distribution of the awards. Is there geographic distribution of:

- **ethanol tax credits** (subject to a federal tax incentive of 52 cents per gallon)
- **the artificially low grazing fee for the grazing of cattle and livestock on federal lands** (fee charged to graze on federal land is $1.79 for one animal to graze for one month compared to 2003 average fee of grazing on private lands of $13.40 per head)
- **special tax deductions for oil and gas exploration and production**
- **Federal farm commodity support programs for wheat, feed grains, cotton, rice, dairy and sugar**

Yes, there is a strongly unequal geographic distribution of these federal programs, which is why many of them should be devolved to state and local governments, where program costs can be borne by the program beneficiaries. In the case of farm subsidies, just 22 of the 435 House districts collect half of all farm subsidies, according to the Environmental Working Group. There is no national interest in such corporate welfare, and if lawmakers wish to lavish special interest spending on those regions, then the locals should pay the costs.

(Communications Intelligence Corporation Failure)

- Mr. Riedl, in your article you mention the failure of the Communication Intelligence Corporation to commercialize their handwriting recognition computer technology. I understand that CIC's technology (developed partially with ATP funding) has been licensed for use in palm pilots, for use in smartphones by Sony Ericsson, and into other projects. Shouldn't this be considered a successful ATP investment?

Not at all. Calling this a "successful ATP investment" assumes that the federal government is the only entity able to provide new research and development. In other words, it is based on the misguided notion that if Washington doesn't do something, no one will. But thanks to the profit motive, the private sector has already poured billions into these technologies and produced similar research. Taxing working Americans to subsidize private research so that businesses can earn even bigger profits off that research does not serve the public interest. It is important to note that many of ATP's subsidies are distributed to Fortune 500 companies, rather than small businesses.

- **Questions from Senator Lautenberg:**

- Has ATP made changes to address the issues identified in GAO's 1996 report? Are there more recent examples of supposedly problematic projects than those identified by GAO and Heritage? Why haven't they been cited?

ATP is supposed to be a "financier of last resort" for companies that have exhausted all other options. Yet the 1996 report shows that 65 percent of ATP applicants never bothered to seek any private funding before going to the government. And among the near-winners who claimed that ATP was their final hope, 50 percent suddenly found private funding soon after their ATP application was rejected. Among the other 50 percent who did not secure private funding, many either didn't bother to look or decided to continue playing the ATP lottery for years to come. In other words, ATP functions as the financier of *first* resort for businesses who don't want to fund their own R&D.

Despite numerous GAO reviews since then, there is no persuasive evidence that these issues have been resolved.

- Does America still face competitive pressures from abroad, from countries like China and India? Would it be a mistake to say that ATP is no longer necessary because America no longer faces competitive pressures from abroad?

Of course the United States competes in a global economy and faces competitive pressures from abroad. Yet taxing working Americans in order to hand out massive subsidies to Fortune 500 companies so they can reap additional profits off research they were already undertaking does nothing to help American workers compete. Rather than serve as a "financier of last result," for risky projects, evidence clearly shows that many businesses use ATP as a piggy bank for projects they simply don't want to fund themselves. Also keep in mind that only one-third of ATP projects ever result in a product brought to the market. There are much better ways to help U.S. workers compete globally than dumping millions of dollars on Fortune 500 companies for projects that fail two-thirds of the time.

- When a grant goes to a Fortune 500 company, does that necessarily mean that it is corporate welfare? Or does the federal government have a proper role in providing matching funds to large companies under programs like ATP?

Yes. Government handouts to Fortune 500 companies are clearly corporate welfare. In terms of the taxpayers' obligations, the 39 Fortune 500 companies that have received ATP funding since 1990 reported combined revenues of $1.4 *trillion* in 2003. Surely businesses such as Ford, IBM, and General Motors can scrounge together enough money to fund their own profitable research and development projects. And if their combined $1.4 trillion in annual revenues are not sufficient, these Fortune 500 companies may be able to locate a bank or other financial institution willing to provide a loan for the type of slam dunk profitable investments that ATP claims to support. After all, it is the businesses – not the taxpayers funding ATP – that will get to keep all the profits from these investments.

➢ **Questions from Senator Lieberman:**

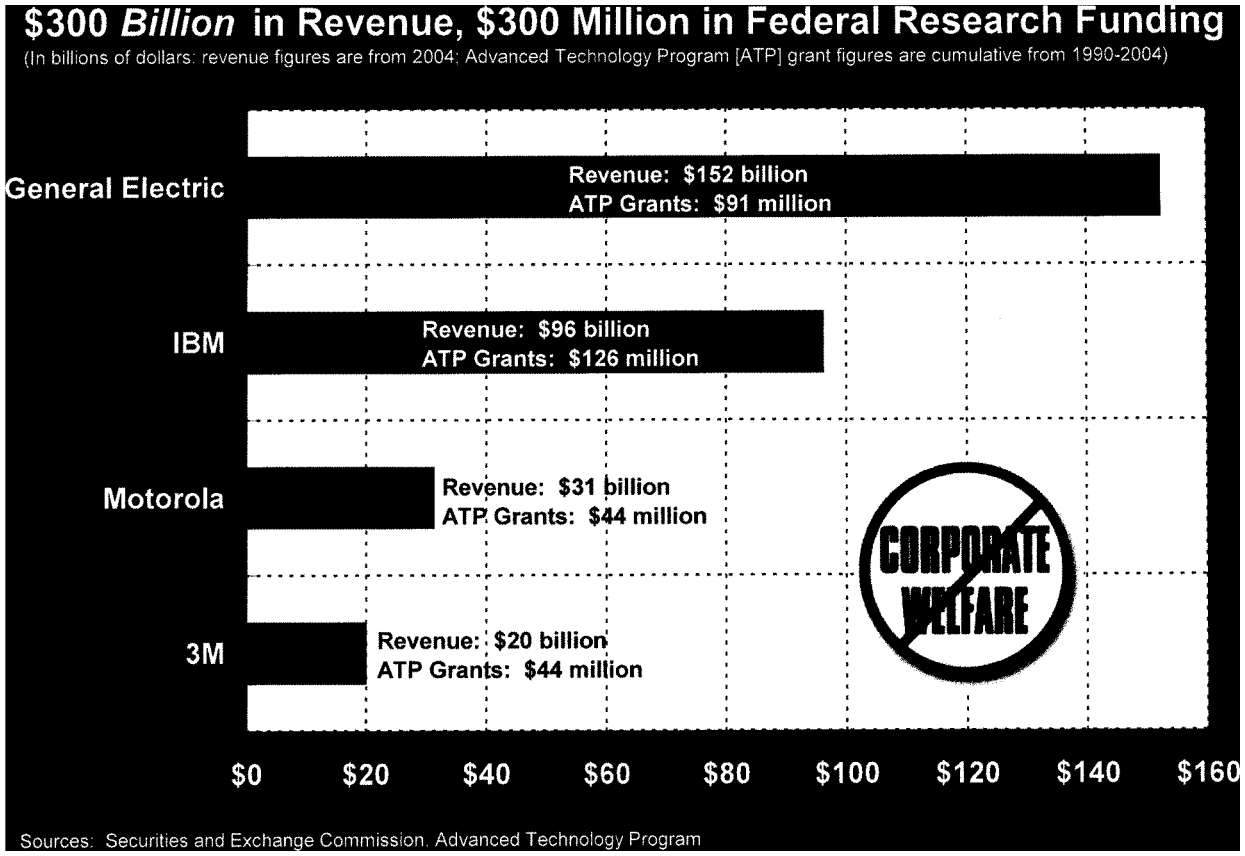
- The GAO 2000 report was the basis for Ms. Nazzaro's testimony. Although NIST was not a witness at this hearing, it is critical to understand their evaluation of this report.

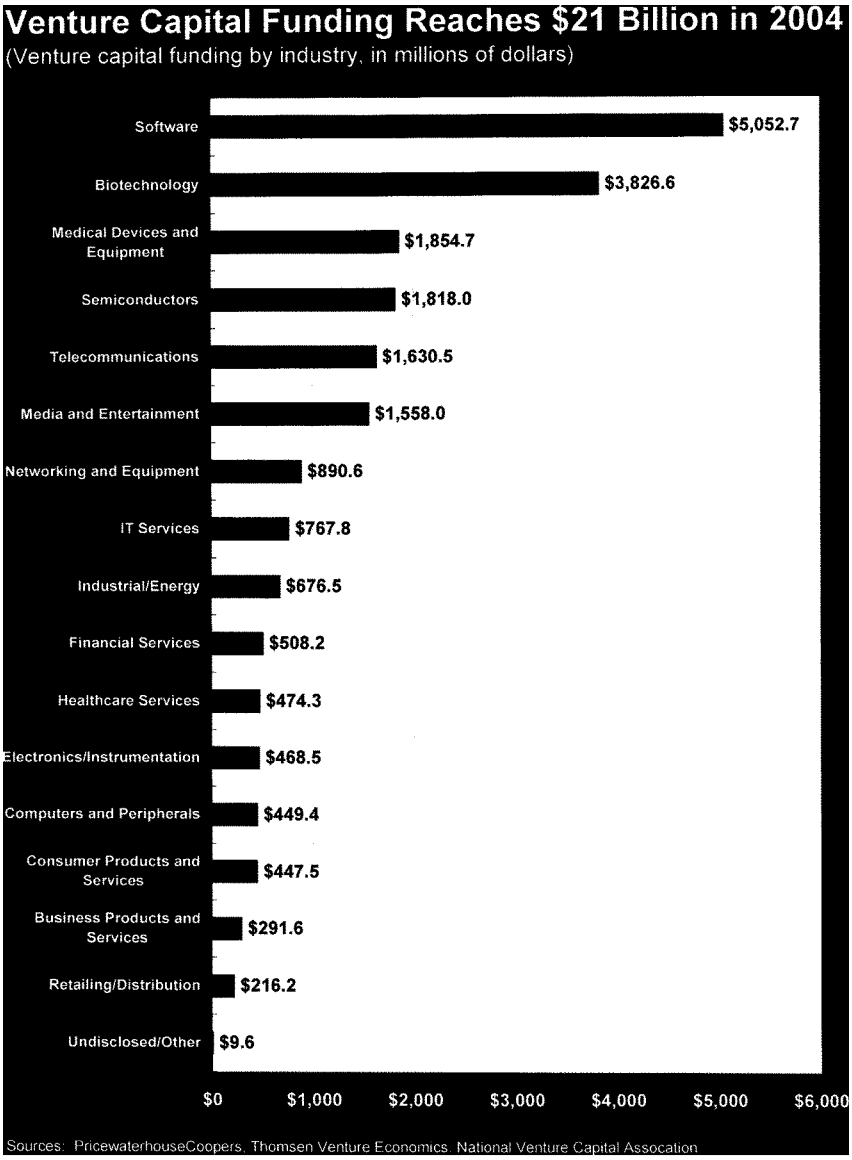
  Please comment and provide any documentation addressing NIST's evaluation of the GAO 2000 study.

NIST's response to the 2000 GAO report is flawed for several reasons. First, by comparing the case for ATP with the case for federal funding of AIDS and cancer research, NIST confuses basic high-risk science research (where a market can underfund research) with applied, profitable commercial research (where the profit motive guarantees sufficient product development).

Second, NIST argues that while ATP may fund projects similar to those of the private sector, their grantees may use different methods and approaches. This is a distinction without a difference. If the approaches embraced by ATP were better than those funded by the private sector, then surely those projects would be receiving private support in addition to (or even instead of) the current private sector approaches.

And that is the key point here – any project or method as promising as NIST suggests should have no problem securing private funding. Remember that The 39 Fortune 500 companies that have received ATP funding since 1990 reported combined revenues of $1.4 trillion in 2003. For companies short on revenues, banks should be able provide a loan for the slam dunk profitable projects that ATP claims to support. Remember, it's the businesses that will pocket the profits, so they should pay the R&D costs. Taxpayers pay for enough government, they deserve a break.


$300 *Billion* in Revenue, $300 Million in Federal Research Funding
(In billions of dollars: revenue figures are from 2004; Advanced Technology Program [ATP] grant figures are cumulative from 1990-2004)
General Electric
Revenue: $152 billion
ATP Grants: $91 million
IBM
Revenue: $96 billion
ATP Grants: $126 million
Motorola
Revenue: $31 billion
ATP Grants: $44 million
3M
Revenue: $20 billion
ATP Grants: $44 million
CORPORATE WELFARE
$0
$20
$40
$60
$80
$100
$120
$140
$160
Sources: Securities and Exchange Commission, Advanced Technology Program


Venture Capital Funding Reaches $21 Billion in 2004
(Venture capital funding by industry, in millions of dollars)
Software
$5,052.7
Biotechnology
$3,826.6
Medical Devices and Equipment
$1,854.7
Semiconductors
$1,818.0
Telecommunications
$1,630.5
Media and Entertainment
$1,558.0
Networking and Equipment
$890.6
IT Services
$767.8
Industrial/Energy
$676.5
Financial Services
$508.2
Healthcare Services
$474.3
Electronics/Instrumentation
$468.5
Computers and Peripherals
$449.4
Consumer Products and Services
$447.5
Business Products and Services
$291.6
Retailing/Distribution
$216.2
Undisclosed/Other
$9.6
$0
$1,000
$2,000
$3,000
$4,000
$5,000
$6,000
Sources: PricewaterhouseCoopers, Thomsen Venture Economics, National Venture Capital Association

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COMMITTEE ON HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS

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COMMITTEE ON THE JUDICIARY

CHAIRMAN
SUBCOMMITTEE ON INCARCERATION AND REHABILITATION

COMMITTEE ON INDIAN AFFAIRS

May 18, 2005

The Honorable Carlos Gutierrez
Secretary
U.S. Department of Commerce
1401 Constitution Ave. NW
Washington, D.C. 20230

Dear Secretary Gutierrez:

In the fiscal year 2002 appropriations bill for the Department of Commerce (P.L. 107-77), $184.5 million was appropriated to the Advanced Technology Program (ATP), of which $60.7 million was made available for new grants. On October 12, 2001, less than two weeks into fiscal year 2002, Advanced Cell Technology, Inc. (ACT) of Worcester, MA announced in a press release that it had been awarded a grant of $1.89 million from the National Institute of Standards and Technology (NIST) through ATP. According to ATP, the project associated with this grant will be active through May 2006. On November 25, 2001, ACT announced in a press release the publication of ACT's research into human cloning. According to the press release, ACT "performed somatic cell nuclear transfer (cloning) to form preimplantation embryos." ACT also promotes itself as a company that researches and applies "human embryonic stem cell technology."

As I am sure you are aware, President Bush in 2001 signed an executive order limiting the use of federal funds on destructive embryonic stem cell research. While the 2001 ATP grant to ACT states that the grant "involves no issues in the use of embryonic cells," I am concerned, given ACT's history in the fields of destructive embryonic stem cell research and human cloning, that taxpayer dollars may have been used to fund research that is restricted by federal law. In 2002 the Department of Health and Human Services (HHS) Office of the Inspector General conducted its own investigation of ACT's use of federal grants. This particular investigation resulted in the recommendation that ACT refund $149,917 charged to grants provided through the National Institutes of Health.

In addition to the 2001 executive order regarding federal funding of destructive embryonic stem cell research, there are also restrictions on the use of federal funds to create and destroy human embryos for research purposes. Since 1996, the Congress has passed into law restrictions on the use of federal funds to create or destroy human embryos for research purposes. However, these same restrictions do not apply to funds appropriated to the Department of Commerce. Since companies that are in the business of human cloning and embryonic stem cell research can receive federal funds through both HHS and the Department of Commerce, I am concerned that these companies may seek

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money through programs such as ATP that are not subject to the same conditions as programs that are funded through HHS.

In closing, I respectfully request a formal inquiry into any and all grants provided to ACT through ATP and the Department of Commerce. Citing my aforementioned concerns, I also respectfully request a full audit of all expenditures by ACT related to its 2001 grant (Project #00-00-4380) provided through ATP in order to ensure that federal funds are not being directly or indirectly used to finance restricted activities. As a physician, I believe that we need to do everything we can to find cures to diseases such as Alzheimer's and Parkinson's while at the same time preserving innocent human life in all of its stages. As a Senator, I also believe that we need to ensure that taxpayer dollars are being wisely spent. If you have any questions about these requests, please contact Sean Davis of my staff at (202) 224-5754.

Sincerely,

Tom Coburn, M.D.
Chairman
Subcommittee on Federal Financial
Management, Government Information, and
International Security

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United States Senate

WASHINGTON, DC 20510-3604

COMMITTEE ON HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS

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COMMITTEE ON THE JUDICIARY

CHAIRMAN
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COMMITTEE ON INDIAN AFFAIRS

May 24, 2005

The Honorable Carlos Gutierrez
Secretary
U.S. Department of Commerce
1401 Constitution Ave. NW
Washington, D.C. 20230

Dear Secretary Gutierrez:

In 1988, the Advanced Technology Program (ATP) was established by the Omnibus Trade and Competitiveness Act of 1988 (P.L. 100-418, 15 U.S.C. 278n) to improve the competitive position of United States industry. Upon amending this Act in 1992, the Congress noted that the U.S. was "losing badly...in many important emerging technologies and risks losing much of the...world market expected to develop by the year 2000 for products based on emerging technologies[.]" The Congress also stated that ATP was the "appropriate vehicle" through which to address issues regarding the competitiveness of American businesses.

Even as federal funding for ATP declined from $345.0 million in fiscal year 1997 to $136.5 million in fiscal year 2005, the U.S. global high-technology market share remained steady at 31 percent according to data provided by the National Science Foundation. In 1980, nearly eight years before the creation of ATP, the U.S. global high-technology market share was 31 percent. According to a U.S. Government Accountability Office (GAO) report released in 2004 (GAO-04-649), "U.S. businesses are in a markedly improved competitive position compared with Japanese and other foreign businesses competing in the global economy." In addition, the report found that the National Institute of Standards and Technology "cannot ensure that Advanced Technology Program funding is critical for the timely development of generic technologies that may be vital to the U.S. and global economies."

Many observers, including GAO, have also voiced concerns about ATP funding of research activities that either had already been undertaken or would otherwise have been undertaken by the private sector. A 2001 GAO report (GAO/RCED-00-114) identified ATP-sponsored research projects that duplicated private sector research efforts dating back to the late-1950s. GAO also found that inherent factors in ATP's award selection process "make it unlikely that ATP can avoid funding research already being pursued by the private sector[.]" The same report went on to state, "As a result, it may not be possible for the program to ensure that it is consistently not funding existing or planned research that would be conducted in the same time period in the absence of ATP financial assistance." In yet another example of ATP funding research already undertaken by the private sector, a 2002 report from the Federal Reserve Bank

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of Atlanta found that ATP "launched major efforts to fund...Internet tools companies during periods when venture funding was flowing into these sectors."

According to the Program Assessment Rating Tool used by the Office of Management and Budget to rate the effectiveness of federal programs, ATP does not address a specific interest, problem, or need; is not designed to have a significant impact; is not designed to make a unique contribution; does not demonstrate improved efficiencies and cost effectiveness in achieving program goals each year; and does not collaborate effectively with related programs that share similar goals.

While I support efforts to spur innovation and increase the global competitiveness of American businesses, I have serious concerns about the ability of ATP to accomplish these goals. From federal funding of redundant research efforts to the lack of a significant impact in addressing any specific need, it appears that throughout its history this program has demonstrated an inability to effectively or efficiently expend taxpayer dollars.

In light of the information cited above, please provide the following information:

(1) Of the organizations that received grants through the Advanced Technology Program since 1990, what percentage did not seek private funding before requesting grants from ATP? Please provide a list of those organizations as well as a list of projects, and the size of their respective federal grants, associated with each organization.

(2) Of the awards granted through ATP since 1990, what percentage focused on research not already conducted with private funds in the private sector?

(3) Please provide a list and description of every ATP-sponsored project that focused on research that was either in the process of being or already had been conducted with private funds in the private sector.

(4) How do ATP's selection criteria ensure that ATP-sponsored research is not duplicative of past or ongoing private sector efforts?

(5) Since 1990, how many grants awarded through ATP have gone to publicly-traded corporations and what is the cumulative dollar total of those grants? Please provide a specific list with each company name and individual grant amount.

(6) Since 1990, what percentage of federal funds appropriated to ATP has been spent by ATP on activities not specifically associated with research and development such as marketing or promotion?

(7) Since 1990, on average, what percentage of federal funds awarded to each project has been spent by grantees on activities not specifically associated with research and development?

(8) Since 1990, what percentage of federal funds appropriated to ATP has been spent on conferences? Please provide a list of those conferences, including the date, location, and amount of federal money spent on each conference.

(9) How many organizations that conduct research into human cloning or embryonic stem cell research have received grants from ATP? Please provide a list of each organization, associated project, and size of federal grant.

I look forward to your prompt reply so that we may work together to ensure that taxpayer dollars are being wisely spent. If you have any questions about these requests, please contact Sean Davis of my staff at (202) 224-5754.

Sincerely,

Tom Coburn, M.D.
Chairman
Subcommittee on Federal Financial Management,
Government Information, and International Security

Department of Commerce: Discretionary Proposal
Advanced Technology Program (ATP)

Funding Summary
(In millions of dollars)

	2005 Enacted	2006 Proposed	Change From 2005
Budget Authority	136	---	–136

Background

The Advanced Technology Program (ATP) supports industry-led research and development projects in areas of emerging technology. The Administration believes that grants to industry for such projects are not necessary, particularly given the growth in available sources of private funding, such as venture capital firms and corporate research labs. As an alternative to direct spending on R&D, the Administration supports permanent extension of the broadly available research and experimentation tax credit. The PART for this program noted that large shares of ATP funding have gone to major corporations, which may not be an appropriate use of Federal resources, and that past GAO studies found projects often have been similar to those conducted by firms not receiving such subsidies.

Administration Action

The Budget terminates ATP, providing no funding for new or prior year awards. The 2005 appropriated level does not provide for new awards, so the program is already effectively on a path to termination.

The Administration believes the program is no longer warranted in today's research and development environment. To address the highest priority needs of the U.S. science and technology base, the Budget provides $485 million for the National Institute of Standards and Technology.

OMB Program Assessment Rating Tool (PART)

Competitive Grant Programs

Name of Program: Advanced Technology Program

Section I: Program Purpose & Design (Yes,No, N/A)

	Questions	Ans.	Explanation	Evidence/Data	Weighting	Weighted Score
1	*Is the program purpose clear?*	Yes	ATP is designed for and focuses on promoting private investment in R&D for high-risk, broad impact technology development.	The mission and purpose of the ATP is stated in DOC Annual Performance Plans, budget justifications, and associated documents. ATP's purpose derives from its statutory authority: see 15 USC 278n.	20%	0.2
2	*Does the program address a specific interest, problem or need?*	No	ATP was initially established to address concerns about U.S. competitiveness in the late 1980s and early 1990s. However, one could argue that this concern has lessened in recent years. Studies show that there are many non-governmental entities investing in early-stage technology development, such as corporate research labs, venture capital firms, angel investors, and universities. Given the amounts available from other sources, it is not evident that there is a clear need for federal subsidies for private technology development.	Recent work by Lewis Branscomb et al. at Harvard estimates that between $5.4B (conservative estimate) to$35.5B (inclusive estimate) was invested in early stage technology development (Branscomb and Auerswald, *Between Invention and Innovation*, pre-publication copy available upon request). These estimates include $1.4B to $7.3B in investments from the federal government.	20%	0.0
3	*Is the program designed to have a significant impact in addressing the interest, problem or need?*	No	ATP is designed to have a targeted impact in an area dominated by private funding. Substantial ATP investments have been made in areas where significant external funding is available, such as biotechnology and information technology. Relative to the other funding sources available for these areas, ATP is only a modest contributor.	ATP has met its annual performance goals for new patents filed and new technologies under commercialization (see "program results" below, as well as DOC's budget justification and annual DOC performance plans and reports), but it is not evident that ATP funding was actually needed for individual projects to achieve these results.	20%	0.0

	Questions	Ans.	Explanation	Evidence/Data	Weighting	Weighted Score
4	*Is the program designed to make a unique contribution in addressing the interest, problem or need (i.e., not needlessly redundant of any other Federal, state, local or private efforts)?*	No	ATP is tiny fraction of the total amount invested in early-stage technology development. There is overlap with private venture capital and angel investors, as well as with other federal programs, such as the Defense Advanced Research Projects Agency (DARPA), Small Business Innovation Research (SBIR), and Small Business Technology Transfer (STTR).	Past GAO studies have concluded that many ATP projects would have been funded with or without ATP participation. Branscomb's study indicates significant investment by other entities, both private and federal, relative to ATP. Of ATP clients surveyed, 75% indicated that the project would have continued in some form without ATP funding.	20%	0.0
5	*Is the program optimally designed to address the interest, problem or need?*	No	ATP is intended to stimulate highly focused R&D efforts that are identified and led by the private sector but which would not take place without Federal resources. ATP selection criteria currently do not adequately ensure that projects are not duplicative of research occurring in the private sector, nor do they ensure that projects address particular public needs. Commerce continues to work with the Administration and with Congress to reform the program.	Past GAO studies have identified ATP projects that are duplicative of research efforts in the private sector. The Administration has submitted reforms, but they are unlikely to be enacted in a form that will transform the program.	20%	0.0
Total Section Score					100%	20%

	Questions	Ans.	Explanation	Evidence/Data	Weighting	Weighted Score
Section II: Strategic Planning		**(Yes,No, N/A)**				
	Questions	**Ans.**	**Explanation**	**Evidence/Data**	**Weighting**	**Weighted Score**
1	*Does the program have a limited number of specific, ambitious long-term performance goals that focus on outcomes and meaningfully reflect the purpose of the program?*	Yes	ATP has one overarching strategic goal that directly reflects the purpose of the program.	ATP's overarching goal is "to accelerate private investment in and development of high-risk, broad-impact technologies". See DOC's budget justification and annual DOC performance plans and reports.	14%	0.1
2	*Does the program have a limited number of annual performance goals that demonstrate progress toward achieving the long-term goals?*	Yes	ATP's annual performance goals--technical publications, patents, and technologies commercialized--suggest at least some progress toward the program's long-term overarching goal and purpose. However, as with most publicly funded R&D programs, it is difficult to determine whether progress would have occurred without ATP funding. Potential for cost recoupment is another indicator that could be used in assessing long-term progress.	See "Program Results" section below; see also DOC's budget justification and annual DOC performance plans and reports.	14%	0.1
3	*Do all partners (grantees, sub-grantees, contractors, etc.) support program planning efforts by committing to the annual and/or long-term goals of the program?*	Yes	At the time of the initial award, grantees begin contributing directly to the program's long-term goal and purpose. Grantee technical progress and outputs (and hence contribution to the program goal) are monitored throughout the grant period and for up to six years after ATP funding ends. Under the Terms and Conditions of ATP awards, ATP uses its Business Reporting System to systematically collect data from awardees during and after project completion; these data allow ATP to track and report on output and intermediate outcome performance. These data are supplemented by case studies and special-purpose surveys.	Data from ATP's Business Reporting System are used for reporting results on key ATP performance measures; measures and results are presented in annual DOC Performance Plans and Performance Reports. Data also are analyzed and presented in special ATP progress reports (for example, see Powell and Lellock, *Development, Commercialization, and Diffusion of Enabling Technologies*, US DOC/TA/NIST, report #6491, April 2000). Data on technical performance and technology diffusion are collected systematically in Technical Quarterly and Final Reports.	14%	0.1
4	*Does the program collaborate and coordinate effectively with related programs that share similar goals and objectives?*	No	While ATP is structurally different than other Federal technology programs such as the Small Business Innovation research program (SBIR) and the Defense Advanced Research Projects Agency (DARPA), there is opportunity for collaboration with these programs. OMB has asked Commerce to evaluate options for using ATP as a competitive source for other agencies as an alternative to SBIR.	There is no evidence of a strong track record of collaboration with these other programs.	14%	0.0

	Questions	Ans.	Explanation	Evidence/Data	Weighting	Weighted Score
5	*Are independent and quality evaluations of sufficient scope conducted on a regular basis or as needed to fill gaps in performance information to support program improvements and evaluate effectiveness?*	Yes	Regular external review and oversight are provided by the ATP Advisory Committee (which meets 2 to 3 times per year) as well as by the NIST Visiting Committee on Advanced Technology (which meets quarterly). ATP also has been the subject of many external program evaluations and reviews, including 29 GAO and OIG audits from 1993 to the present that have evaluated virtually all aspects of the program.	See annual reports of the ATP Advisory Committee and the NIST VCAT. ATP Advisory Committee reports and minutes are available at http://www.atp.nist.gov/atp/adv_com/reports.htm. See also NRC, *The Advanced Technology Program: Challenges and Opportunities*, 1999 (available at http://books.nap.edu/catalog/9699.html); NRC, *The Advanced Technology Program: Assessing Outcomes* 2001, available at http://www.nap.edu/catalog/10145.html; and numerous GAO and OIG audits (references available upon request).	14%	0.1
6	*Is the program budget aligned with the program goals in such a way that the impact of funding, policy, and legislative changes on performance is readily known?*	Yes	ATP's performance measures show the impact of changes in funding levels.	DOC budget justifications and annual performance plans and reports show the relationship between funding levels and performance measures over time.	14%	0.1
7	*Has the program taken meaningful steps to address its strategic planning deficiencies?*	Yes	NIST as a whole has developed a new Institute-wide long-term strategic planning process; the process includes new mechanisms for aligning Operating Unit plans with the NIST-wide plan. The Administration has also proposed ATP reforms.	NIST's external advisory bodies routinely observe and comment on any deficiencies associated with NIST's strategic planning processes, and NIST responds to these observations. For example, the Visiting Committee on Advanced Technology has reviewed and commented favorably on NIST-wide strategic planning efforts in recent meetings (held quarterly).	14%	0.1
Total Section Score:					100%	86%

	Questions	Ans.	Explanation	Evidence/Data	Weighting	Weighted Score
Section III: Program Management (Yes,No, N/A)						
	Questions	Ans.	Explanation	Evidence/Data	Weighting	Weighted Score
1	*Does the agency regularly collect timely and credible performance information, including information from key program partners, and use it to manage the program and improve performance?*	Yes	ATP's Business Reporting System and Technical Quarterly Reports collect data systematically; data are reported regularly in annual performance plans and reports; current projects are evaluated regularly and performance factors are used to make continuation and termination decisions and to review program design and project management processes.	Program performance data collected through the Business Reporting System are presented in DOC budget justifications and annual performance plans and reports. Data collected through Technical Quarterly Reports includes proprietary data and are not publicly available.	9%	0.1
2	*Are Federal managers and program partners (grantees, subgrantees, contractors, etc.) held accountable for cost, schedule and performance results?*	Yes	ATP program management is accountable for programmatic and administrative performance. Grantees are held accountable for--and continuation / termination decisions are made on the basis of--cost, schedule, and performance results.	See annual reports of the ATP Advisory Committee and the NIST VCAT; internal program reviews also focus on accountability for programmatic and administrative performance.	9%	0.1
3	*Are all funds (Federal and partners') obligated in a timely manner and spent for the intended purpose?*	Yes	NIST as a whole manages its resources carefully and the ATP program typically has a limited amount of unobligated funds at year end, excluding adjustments for changes in the status of grants made in prior years (which may result from program management practices). NIST's strong budget and accounting systems include rigorous internal reviews and external audits to ensure that funds are expended as intended. In addition, ATP grantees are audited on a regular basis to ensure funds are spent appropriately.	SF-132 (apportionment schedule) and SF-133 (report on budget execution). Internal processes include rigorous quarterly financial reviews. See the NIST-audited Annual Financial Statements and numerous GAO and OIG reviews. Audits of ATP grantees are conducted by external, independent auditors following Government Auditing Standards (these audits contain proprietary data and are not publicly available).	9%	0.1

	Questions	Ans.	Explanation	Evidence/Data	Weighting	Weighted Score
4	*Does the program have incentives and procedures (e.g., competitive sourcing/cost comparisons, IT improvements) to measure and achieve efficiencies and cost effectiveness in program execution?*	Yes	ATP's administrative costs have been held at the lowest possible level over the course of the program, and comply with appropriation guidance. ATP program management continuously reviews administrative procedures to identify and implement measures that will improve program efficiency and effectiveness.	Examples of recent efforts to improve administrative efficiency and effectiveness include: electronic submission of proposals; rolling submissions over the fiscal year; and a gated approach to proposal review. Administrative costs are tracked in the NIST accounting system; data can be provided, if needed, on administrative costs per FTE, per grant, etc. or a similar ratio.	9%	0.1
5	*Does the agency estimate and budget for the full annual costs of operating the program (including all administrative costs and allocated overhead) so that program performance changes are identified with changes in funding levels?*	Yes	NIST's budget request and prior year budget data reflect the full annual costs of operating ATP, including direct and indirect costs. Out-year targets for quantitative performance measures are based in part on resource inputs; variation in input levels directly affect estimated performance.	Total program costs are presented in NIST's budget justification and annual financial statements. NIST's internal accounting system reports can provide costs by object class. Overhead is applied uniformly per full-cost accounting procedures that are specified in Chapter 8.07 of the NIST Administrative Manual. DOC annual performance plans show the impact of proposed funding levels on ATP's performance measures.	9%	0.1
6	*Does the program use strong financial management practices?*	Yes	NIST maintains financial management oversight. NIST has a long history of unqualified financial audits and provides accounting services for several other DOC bureaus.	See NIST's audited Annual Financial Statements.	9%	0.1
7	*Has the program taken meaningful steps to address its management deficiencies?*	Yes	Regular program oversight is obtained through several channels: the NIST Visiting Committee on Advanced Technology; ATP's external Advisory Committee; internal NIST program reviews. Many of the 29 GAO and OIG audits have focused on program management assessment.	ATP has made numerous changes in program management in response to recommendations produced by these review mechanisms.	9%	0.1

	Questions	Ans.	Explanation	Evidence/Data	Weighting	Weighted Score
8 (Co 1.)	*Are grant applications independently reviewed based on clear criteria (rather than earmarked) and are awards made based on results of the peer review process?*	Yes	All grantees are selected through ATP's rigorous Source Evaluation Board (SEB) analysis and review process, which combines appropriate technical and economic expertise for peer review of all proposals. Reviews are based on clear and transparent criteria and debriefings are made available to all proposers.	The SEB-based selection process has been carefully designed based on extensive stakeholder input and numerous external reviews by GAO. The process also has been reviewed by the NRC; see NRC, The Advanced Technology Program: Challenges and Opportunities, 1999 (available at http://books.nap.edu/catalog/9699.html); and NRC, The Advanced Technology Program: Assessing Outcomes 2001 available at http://www.nap.edu/catalog/10145.html).	9%	0.1
9 (Co 2.)	*Does the grant competition encourage the participation of new/first-time grantees through a fair and open application process?*	Yes	ATP receives proposals through open competitions in response to broadly advertised notices. Public conferences are held to explain the application process and include appropriate time for audience questions regarding the competition process.	ATP's most recent notice of availability of funds appeared in the Federal Register on April 18, 2002 (67 FR 19160-19164); see also numerous GAO reviews of ATP's selection process.	9%	0.1
10 (Co 3.)	*Does the program have oversight practices that provide sufficient knowledge of grantee activities?*	Yes	ATP project managers closely track projects during the grant period, review performance, and recommend termination of funds for underperforming projects; ATP's Business Reporting System systematically gathers data on grantee activities and performance, including data for the Composite Ranking System for completed projects.	DOC's budget justification, annual DOC performance plans and reports, and individual ATP reports present data from the Business Reporting System and the results of ATP's new Composite Performance Rating System.	9%	0.1
11 (Co 4.)	*Does the program collect performance data on an annual basis and make it available to the public in a transparent and meaningful manner?*	Yes	ATP's Business Reporting System routinely and systematically gathers data on grantee activities and performance, including data for the Composite Ranking System for completed projects; aggregate data is presented in public reports.	DOC's budget justification, annual DOC performance plans and reports, and individual ATP reports present data from the Business Reporting System and the results of ATP's new Composite Performance Rating System.	9%	0.1
Total Section Score					100%	100%

	Questions	Ans.	Explanation	Evidence/Data	Weighting	Weighted Score
Section IV: Program Results	**(Yes, Large Extent, Small Extent, No)**					

	Questions	Ans.	Explanation	Evidence/Data	Weighting	Weighted Score
1	*Has the program demonstrated adequate progress in achieving its long-term outcome goal(s)?*	Small Extent	ATP has one overarching outcome goal: to accelerate private investment in and development of high-risk, broad-impact technologies. ATP's annual performance measures suggest some progress over time, and while there are many unknowns, special economic studies demonstrate the net public benefits that derive from specific ATP projects. However, effects are difficult to measure and it is hard to obtain the data necessary to identify the actual impact of ATP funding.	Data are presented in DOC's budget justification and annual DOC performance plans and reports. External reviews by the National Research Council and numerous economic impact studies attempt to identify economic and social benefits associated with ATP projects. In one impact study, the benefits of just a few projects analyzed in depth exceeded program costs to date (studies available at nist.atp.gov); however, these are anticipated benefits that have not yet been realized.	20%	0.1

Long-Term Goal I:	Accelerate private investment in and development of high-risk, broad-impact technologies.
Target:	As with most R&D programs, the overarching long-term outcome goal is not measurable directly. ATP uses a set of annual quantitative indicators to demonstrate progress towards the long-term goal (see below); ATP also uses special studies to estimate the economic and social benefits from individual projects.
Actual Progress achieved toward goal:	Due to the nature of R&D and the scope of the ATP program, it is not possible to comprehensively measure the net benefits of all ATP investments made to date.

2	*Does the program (including program partners) achieve its annual performance goals?*	Yes	ATP routinely meets or exceeds its annual quantitative performance targets. These targets represent progress towards the program's long-term goal.	The three measures provided below collectively represent indicators of performance towards ATP's long term goal. See also DOC's budget justification and annual DOC performance plans and reports	20%	0.2

Performance measure I:	Cumulative number of publications generated by ATP-funded research
Performance Target:	FY 2001 target: 720
Actual Performance:	FY 2001 actual: 747
Performance measure II:	Cumulative number of patents generated by ATP-funded research
Performance Target:	FY 2001 target: 790
Actual Performance:	FY 2001 actual: 800
Performance measure III:	Cumulative number of technologies under commercialization
Performance Target:	FY 2001 target: 180
Actual Performance:	FY 2001 actual: 195

	Questions	Ans.	Explanation	Evidence/Data	Weighting	Weighted Score
3	*Does the program demonstrate improved efficiencies and cost effectiveness in achieving program goals each year?*	No	Annual performance improvements do not yet indicate an increasing return on investment over time. Early estimates on recoupment also seem modest in both the near- and long-term. However, performance targets have been achieved at specified budget levels, and program expenditures have leveraged an equal level of private sector R&D investment.	Data are presented in DOC's budget justification and annual DOC performance plans and reports.	20%	0.0
4	*Does the performance of this program compare favorably to other programs with similar purpose and goals?*	Yes	ATP is structurally different than other Federal technology programs such as the SBIR and DARPA, however, there are enough similarities to warrant comparison. Comparable data is not currently available to directly compare programs, but given ATP's cost-sharing component and rigorous review process, OMB thinks the program does compare favorably with these other programs.	Unlike SBIR, ATP is open to companies of all sizes and is available for all technologies, while much of SBIR funding is agency or mission-specific and DARPA is focused exclusively on DoD mission-driven technology interests. Unlike either SBIR or DARPA, ATP is a partnership program that requires cost-sharing from all grantees.	20%	0.2
5	*Do independent and quality evaluations of this program indicate that the program is effective and achieving results?*	Yes	External advisory committees and formal evaluation studies conducted by the National Research Council have found the Program to be effective. However, other indicators (such as the difficulty the program would have recouping its costs) raise questions.	See the reports of the ATP Advisory Committee (available at http://www.atp.nist.gov/atp/adv_com/reports.htm) and the NIST VCAT. See also see NRC, *The Advanced Technology Program: Challenges and Opportunities*, 1999 (available at http://books.nap.edu/catalog/9699.html); and NRC, *The Advanced Technology Program: Assessing Outcomes* 2001 (available at http://www.nap.edu/catalog/10145.html).	20%	0.2
Total Section Score					100%	67%

Federal Grants to Advanced Cell Technology, Inc.

BACKGROUND

- In the fiscal year 2002 appropriations bill for the Department of Commerce (P.L. 107-77), $184.5 million was appropriated to the Advanced Technology Program (ATP), of which $60.7 million was made available for new grants.
  Source: http://www.congress.gov/cgi-lis/cpquery/R?cp107:FLD010:@1(hr278)

- On October 12, 2001, Advanced Cell Technology, Inc. (ACT) of Worcester, MA announced in a press release that it had been awarded a grant of $1.89 million from the National Institute of Standards and Technology (NIST) through ATP.
  Sources: http://www.advancedcell.com/2001-10-12.htm
  http://jazz.nist.gov/atpcf/prjbriefs/prjbrief.cfm?ProjectNumber=00-00-4380

- On November 25, 2001, ACT announced in a press release the publication of ACT's research into human cloning. According to the press release, ACT "performed somatic cell nuclear transfer (cloning) to form preimplantation embryos."
  Source: http://www.advancedcell.com/2001-11-25.htm

- In April 2002, the Office of Inspector General (OIG) of the Department of Health and Human Services (HHS) released the results of its investigation into the misuse by ACT of funds distributed through the National Institutes of Health.
  Source: http://www.access.gpo.gov/congress/house/pdf/107hrg/86435.pdf

- The investigation began after the Secretary of HHS sought a determination of whether any federal funds had been used to support ACT's human embryo cloning research. Federal funds appropriated through HHS are prohibited from being spent on human embryo cloning research (P.L. 108-447). No such restrictions exist for funding provided through the Department of Commerce.
  Source: http://www.congress.gov/cgi-lis/cpquery/R?cp108:FLD010:@1(hr792)

- The HHS/OIG investigation found that ACT claimed $149,917 in "unallowable" costs. The HHS/OIG recommended that ACT refund the $149,917 of unallowable costs.
  Source: http://www.access.gpo.gov/congress/house/pdf/107hrg/86435.pdf

- The HHS/OIG also had "continuing reservations regarding ACT's ability to continue as a going concern and the impact this would have on the continuity of research under the ongoing grants."
  Source: http://www.access.gpo.gov/congress/house/pdf/107hrg/86435.pdf

- Finally, according to the HHS/OIG, "the question of ACT's financial viability was raised in ACT's independent auditors' financial statement report for the two years ended December 31, 2000." It is not known whether past federal grants made the marginal difference between the success and failure of ACT as a business.
  Source: http://www.access.gpo.gov/congress/house/pdf/107hrg/86435.pdf

United States General Accounting Office

GAO

Report to the Ranking Minority Member, Committee on Science, House of Representatives

January 1996

MEASURING PERFORMANCE

The Advanced Technology Program and Private-Sector Funding

GAO/RCED-96-47

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-270551

January 11, 1996

The Honorable George E. Brown, Jr.
Ranking Minority Member
Committee on Science
House of Representatives

Dear Mr. Brown:

This report responds to your request that we assess the impact of the Advanced Technology Program (ATP), which is administered by the National Institute of Standards and Technology within the Department of Commerce. ATP's purpose is to provide support on a cost-sharing basis for industrial research and development projects—projects that have a significant potential for stimulating economic growth and improving the competitiveness of U.S. industry. Federal funding for ATP has grown sharply, from $68 million in fiscal year 1993 to $341 million in fiscal year 1995. Recently, however, budget proposals have suggested eliminating ATP's funding for fiscal year 1996.

As agreed with your office, our objective was to examine, as one way to assess ATP's impact, whether research projects would have been funded by the private sector if they had not received funds from ATP. We also examined ATP's impact in terms of other goals of the program, such as aiding the formation of joint ventures. We agreed on this approach because of the difficulty of assessing the net impact of ATP's investments in technology on the economy. For example, it is difficult to establish a causal link between a successful project and government funding earlier in the project. Moreover, the impact of ATP should be measured not only by its effect on the firms that receive funding but also by its effect on other firms—a difficult undertaking that our approach avoids.

To meet our objective, we focused on two groups of ATP applicants, which we called "winners" and "near winners." Both groups submitted proposals that were rated highest during ATP's review, but the near winners did not ultimately receive ATP funding. We surveyed by telephone all applicants that qualified as winners or near winners during ATP's first 4 years (1990-93). We achieved a 100-percent response rate from the 123 respondents that we included in our analysis (89 winners and 34 near winners). We asked the near winners if they had continued their proposed projects using other funding sources after ATP declined to fund them. Given the similarity in the qualifications of the proposals submitted by the

winners and near winners as determined by ATP, another purpose of this question was to determine whether the winners would have been likely to continue their projects without ATP funding. We also asked both groups if they had sought funding from other sources before applying to ATP. This question provided information on whether private-sector sources had the opportunity to fund proposed projects before an applicant sought ATP funding.

In our survey, we also collected information that provides an extensive profile of the respondents, which we used in some of our analyses; additional information from this profile is provided in appendix I. Appendix II contains our survey questions and an aggregate list of all the responses, and appendix III provides further detail about our objectives, scope, and methodology.

Results in Brief

ATP has funded research projects that would have been funded by the private sector as well as those that would not. Half of the near winners continued their projects without relying on ATP funding, while the other half discontinued their projects for various reasons. The winners were nearly evenly divided when asked if they would have pursued their projects even if they had not received ATP funding. Almost all the near winners that continued their projects did so on a modified schedule, meeting the projects' milestones later than scheduled in their proposals to ATP.

In most cases, private-sector sources did not have the opportunity to fund ATP projects. Of the 123 applicants we surveyed, 77,[1] or 63 percent, did not look for funding from other sources before requesting it from ATP. Those applicants that did look for funding looked for a long time and made many attempts to find funding, on average. Seven applicants turned down offers from private sources because they could not reach an acceptable funding arrangement.

Our survey also found that ATP had other effects. More than three-fourths of the joint-venture applicants indicated that they had come together solely to pursue an ATP project, thus satisfying ATP's goal of serving as a catalyst for the formation of joint ventures. Furthermore, of the 45 applicants that tried to find funding elsewhere before turning to ATP, about half were told by prospective funders that their projects were either too

[1]One applicant did not know.

risky or "precompetitive"[2]—characteristics that fulfill the aims of ATP funding.

Background

ATP's mission is to stimulate economic growth in the United States through technology development. The program seeks to accomplish that mission by sharing the cost of industrial research and development projects. The projects selected by ATP for funding are characterized by "a potential broad-based economic impact but a relatively high technical risk and a long time horizon," according to ATP.

ATP's guidance states that if the technical risk associated with a project is very low, federal funding should not be necessary. In addition, when submitting a research proposal, applicants must sign a form stating that "this proposal is not requesting funding for existing or planned research programs that would be conducted in the same time period in the absence of financial assistance under the ATP." This wording suggests that ATP should not fund projects that other sources would have funded or, when ATP does fund such projects, that ATP funds should enable applicants to complete their projects in a shorter time.

Applicants' Actions and Intentions to Find Funding Before Applying to ATP

Most ATP applicants did not look for funding from other sources before requesting it from ATP. In addition, the applicants were about evenly divided when asked if they intended to pursue their projects whether or not they received ATP funding.

When asked if they had searched for funding from other sources before applying to ATP, 63 percent of the applicants (77 of 123; one applicant did not know) said that they had not. Considering the winners and near winners separately, we found that 65 percent (58 of 89) of the winners had not looked for funding before applying to ATP, along with 56 percent (19 of 34) of the near winners.

Of the 45 applicants that had looked for funding before applying to ATP, about 53 percent (24 of 45) sought it from private sources only, 9 percent (4) from public sources only, and 38 percent (17) from some combination of private and public sources. On average, 42 of these 45 respondents (3 did not respond) searched for funding for 18 months before applying to ATP and made eight separate attempts to find funding.

[2]"Precompetitive" refers to the stage during research and development at which a preliminary assessment of a technology's commercial potential can be made but before commercial prototypes are developed.

When asked what reasons the non-ATP sources gave for not providing funding, 54 percent of these applicants (22 of 41; 4 did not respond) said that their projects were viewed as either too risky or "precompetitive"—both outlined in Commerce's regulations as reasons for ATP to fund projects. Sixteen percent (7 of 45) said they had turned down funding offers because they could not agree on terms with the prospective funder; 3 of these 7 eventually received ATP funding.

We asked the winners and near winners if they intended to pursue their projects whether or not they received ATP funding. When we considered the two groups together, 42 percent (52 of 123) said "yes" or "probably yes;" 41 percent (51) said "no" or "probably no;" and 16 percent (20) were uncertain. Of the respondents that said they intended to pursue the project, 94 percent (49 of 52) indicated that their projects' schedules would be modified and that the milestones would be met later than scheduled in their proposals to ATP. When we considered the ATP winners' answers alone, 40 percent (36 of 89) said "yes" or "probably yes;" 16 percent (14) were undecided; and 44 percent (39) said "no" or "probably no."

Most of the joint-venture applicants came together to apply to ATP. Seventy-six percent (26 of 34) said they had formed a new group to pursue the projects described in their ATP proposals. The remaining joint-venture applicants had worked together before applying to ATP, pursuing either the projects that they proposed to ATP or other projects.

Near Winners' Actions After ATP Declined to Fund Their Proposals

After ATP declined to fund their proposals, half of the near winners continued their projects using other funding sources. The near winners with certain characteristics were more likely to continue their projects than others.[3]

Half of Near Winners Continued Projects Using Other Funding Sources

Half of the near winners (14 of 28) continued their projects using other funding sources after ATP declined to fund them. These other funding sources included federal government programs other than ATP; state government agencies; and private funders, such as industry groups or trade associations, other private companies, venture capitalists, and the company itself. All 14 near winners used some private funding to continue

[3]In our findings for this section only, the total of near winners drops to 28 because 6 of the near winners were granted funding by ATP in a subsequent round of competition. Thus, we eliminated them from consideration here, focusing only on those that found funding from sources other than ATP.

their projects; 8 of these financed their projects using private funds only.[4] Ninety-three percent (13 of 14) of the projects that were continued were or are being carried out on a modified schedule, meeting their milestones later than scheduled in the proposals submitted to ATP.

Some Groups of Applicants Were More Likely Than Others to Continue Their Projects Using Other Funding Sources

Some near winners were more likely than others to continue their projects after ATP declined to fund them. For example, 86 percent (12 of 14) of the near winners whose projects were under way before they applied to ATP continued them, compared with 14 percent (2 of 14) of those whose projects were not under way. Similarly, 77 percent (10 of 13) of the near winners that had looked for funding from other sources before applying to ATP continued, compared with 27 percent (4 of 15) that had not looked for funding before applying. Table 1 groups the near winners according to different characteristics and shows odds ratios, which indicate the degree of association between the characteristics of these groups and the likelihood of their continuing their projects. Odds ratios measure the association between two variables through a single value. The closer the odds ratio is to 1.00, the weaker the association. For more information on odds ratios, see appendix III.

[4]Some of the near winners that continued their projects using other funding sources likely benefited, during their search for other funding, from having been rated highly by ATP. We did not evaluate the extent to which this "halo effect" may have occurred; however, we acknowledge that a high rating from ATP might have proved beneficial to some near winners.

Table 1: Odds Ratios Showing Association Between Characteristics of Certain Near Winners and Continuation of Their Projects

Characteristics of near winner A	Characteristics of near winner B	Odds ratio: How many times more likely was near winner A to continue the project than near winner B?
Project under way before near winner applied to ATP	Project not under way before near winner applied to ATP	36
Looked for funding from other sources before applying to ATP	Did not look for funding from other sources before applying to ATP	9.17
Funds 50 percent or more of research and development internally	Funds less than 50 percent of research and development internally	2.5[a]
Single applicant	Joint venture	2.75
Company with more than 10 FTEs[b]	Company with 10 or fewer FTEs	1.6[c]
Company with more than 50 FTEs	Company with 50 or fewer FTEs	1.6
Company with more than 100 FTEs	Company with 100 or fewer FTEs	1.39[d]
Company with more than 500 FTEs	Company with 500 or fewer FTEs	1.05

[a]Nine companies did not indicate what percentage of their research and development they fund internally; therefore, they are not included in this calculation.

[b]FTE = full-time equivalent.

[c]Nine companies did not provide their number of FTEs; therefore, they are not included in this calculation.

[d]Because this odds ratio is close to 1.00, we can say that the odds of a company with 100 or more FTEs continuing its project are about the same as the odds of one with fewer than 100 FTEs continuing its project.

In addition, single applicants more often continued their projects than joint-venture applicants: 58 percent (11 of 19) of the single applicants continued their projects, while only 33 percent (3 of 9) of the joint-venture applicants continued theirs. Seventy-one percent (5 of 7) of the companies that generally fund 50 percent or more of their research and development from their own internal company funds continued their projects. In contrast, 50 percent (6 of 12) of the companies that generally fund less than 50 percent of their research and development from their own internal company funds continued their projects. (Nine companies did not indicate what percentage of their research and development budgets they fund internally.)

Finally, among the near winners, the smaller companies continued their projects somewhat less frequently than the larger companies.[5] For example, 50 percent (3 of 6) of the near-winner companies with 50 or fewer full-time equivalents (FTE)[6] continued their projects, while 62 percent (8 of 13) of the near-winner companies with more than 50 FTEs continued theirs. (Nine companies did not provide the number of FTEs for their companies.)

Some Near Winners Did Not Continue Their Projects

Fourteen near winners did not continue their projects after ATP declined to fund the projects. The reason they most often gave for not continuing was lack of funding (cited by 11 near winners). Two near winners indicated that their projects were too long-term; one cited market changes; one said that the project was too risky; and one joint-venture near winner said that its newly formed partnership had not worked out. (The near winners could provide more than one reason.)

Of the near winners that did not continue their projects, 64 percent (9 of 14) searched for funding but did not find it. Eight of these nine reapplied for ATP funding during a subsequent round of competition. Six of the nine are no longer looking for funding to continue their projects.

Status of Projects Funded by ATP and Other Sources

ATP funded 89 projects from 1990 to 1993, and 14 near winners carried out their projects using other funding sources during this time. Sixty-four percent of these projects (66 of 103) were still under way at the time of our survey. Twenty-seven percent of the projects (28 of 103) had been completed, while 5 had been discontinued. The respondents to our survey listed the status of the four remaining projects as either suspended or delayed. When we asked all the applicants that had carried out their projects how satisfied they were with either the projects' technical direction and progress (for ongoing projects) or outcome (for completed projects), 94 percent (84 of 89) of the winners and 79 percent (11 of 14) of the near winners whose projects were funded by other sources indicated that they were at least generally satisfied.

[5]Joint-venture applicants were not included in this comparison because they may include companies of different sizes.

[6]Measures of FTE indicate a company's size by estimating how many full-time employees are represented by all part-time and full-time employees considered together.

Conclusions

According to the results of our survey, ATP funds both projects that would have been funded in its absence and projects that would not have been funded. In addition, ATP achieves other goals, such as aiding the formation of joint ventures and helping companies achieve research milestones faster. These results should be considered together when assessing ATP's impact.

Agency Comments and Our Evaluation

We provided a draft of this report to the Department of Commerce for comment. Commerce found much of the report to be well done but recommended certain changes. For example, Commerce felt that the report needed to highlight our survey's results showing that those research projects of near winners that were continued with alternative funding continued at a slower pace than planned. We have revised the report as appropriate. Commerce's written comments, along with our detailed responses, are provided in appendix IV.

We conducted our assessment from July 1994 through December 1995 in accordance with generally accepted government auditing standards. As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to the Secretary of Commerce; the Director, National Institute of Standards and Technology; the Director, ATP; the Inspector General, Department of Commerce; the Director, Office of Management and Budget; and other interested parties. We will also make copies available to others on request.

Please call me at (202) 512-3841 if you or your staff have any questions. Major contributors to this report are listed in appendix V.

Sincerely yours,

Victor S. Rezendes
Director, Energy and
Science Issues

Contents

Figures

Abbreviations

ATP	Advanced Technology Program
FTE	full-time equivalent
GAO	General Accounting Office
NIST	National Institute of Standards and Technology
R&D	research and development

Appendix I

Profile Information for Single-Applicant Companies

In our survey, we asked individual applicants for general information which, taken together, provides a profile of their companies. We used some of this information for the analysis summarized in table 1 of this report. We include here supplemental profile information that provides an overall picture of the coverage provided by the Advanced Technology Program (ATP). This information includes the size of the companies based on the number of employees as well as on gross sales. We requested these figures for the fiscal year completed before the company applied to ATP. We also asked for the year the company made its first sale as an indicator of the age of the applicant company. Included also are figures for the sources that each company relies on for its overall research budget. We again asked companies, in answering this question, to base their responses on the fiscal year completed before they applied to ATP.

Figure I.1: Number of Full-Time Equivalent Employees, Including Both Outsourced and Permanent Employees

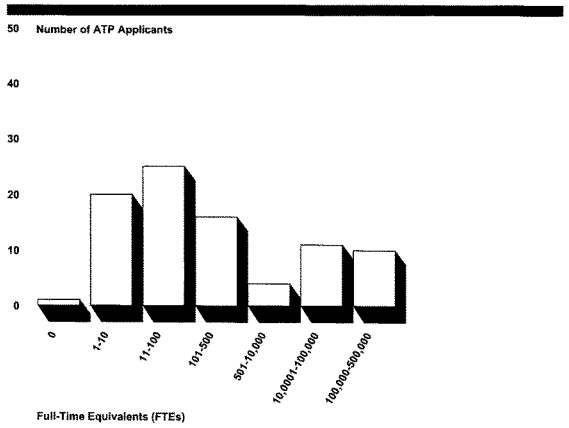


Figure I.2: Total Value of Gross Sales in Fiscal Year Before Company's Application to ATP

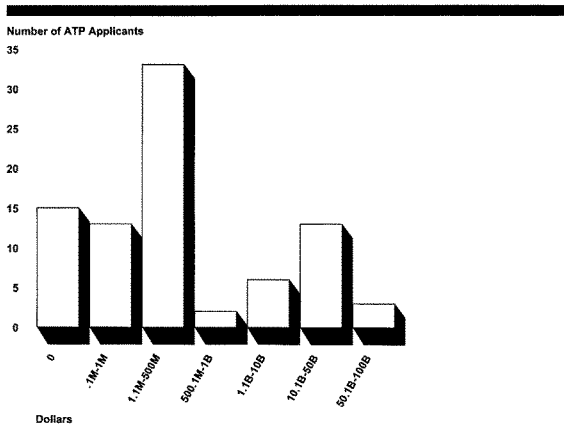


Figure I.3: Year of Company's First Sales

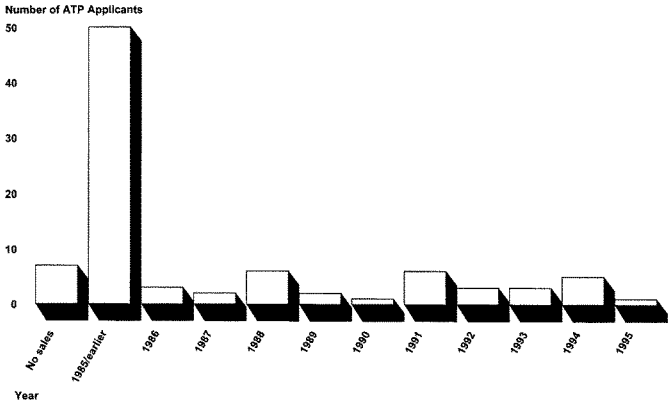


Figure I.4: Percentage of Company's Direct Research and Development (R&D) Budget Provided by Federal Government Agencies

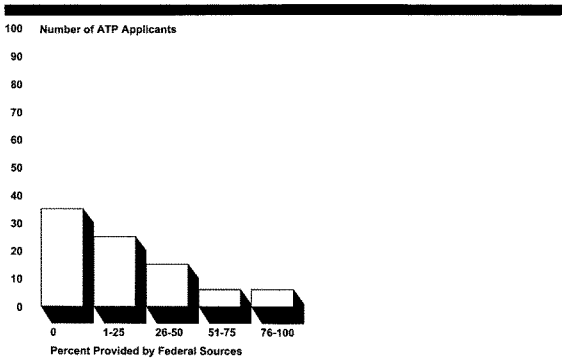


Figure I.5: Percentage of Company's Direct R&D Budget Provided by State Government Agencies

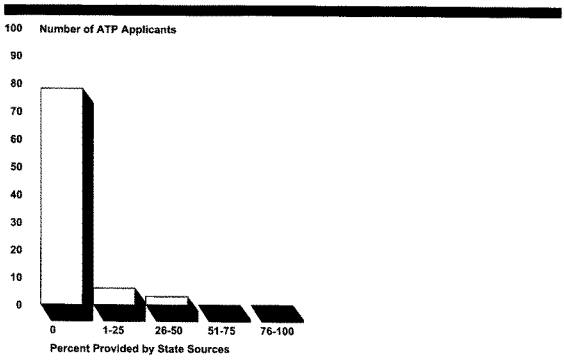


Figure I.6: Percentage of Company's Direct R&D Budget Provided by Venture Capitalists

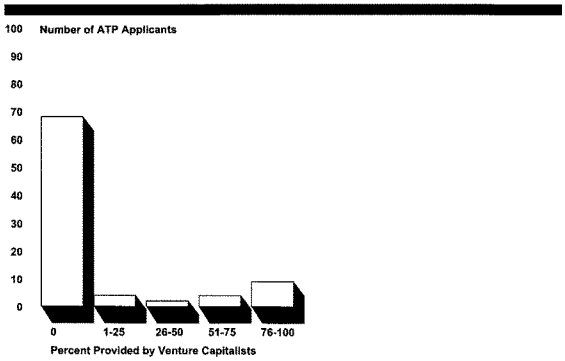


Figure I.7: Percentage of Company's Direct R&D Budget Provided Through R&D Contracts With Other Companies

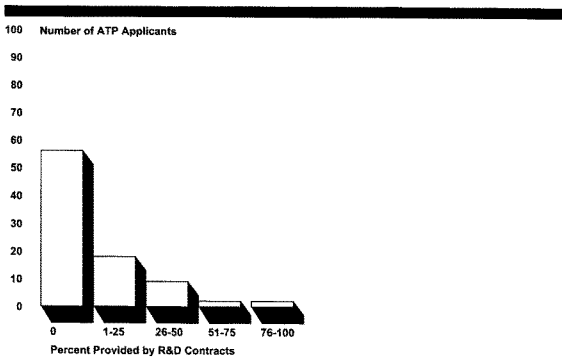


Figure I.8: Percentage of Company's Direct R&D Budget Provided From Internal Funding

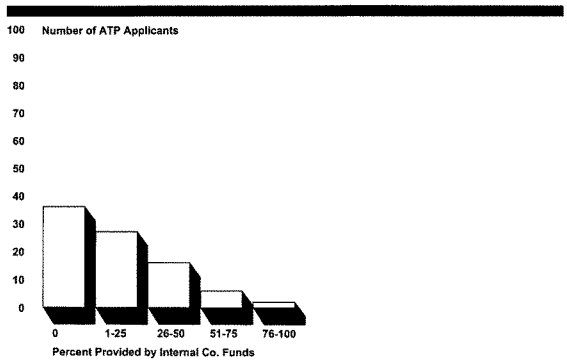


Figure I.9: Percentage of Company's Direct R&D Budget Provided by Industry Groups or Trade Associations

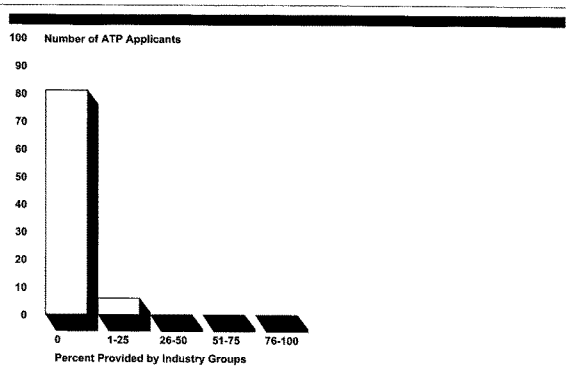
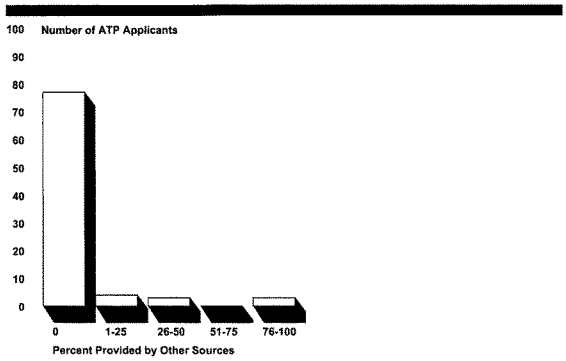


Figure I.10: Percentage of Company's Direct R&D Budget Provided by Other Sources



Appendix II

Survey Questions and Response Frequencies for Winners and Near Winners of ATP Awards

United States General Accounting Office

GAO

Survey of ATP Award Winners (Completed Questionnaire with Frequencies)

INTRODUCTION

The U.S. General Accounting Office (GAO), an agency that examines issues and programs for Congress, is evaluating some of the impacts of the Advanced Technology Program (ATP).

If your proposal was submitted by a joint venture, answer in terms of your experience with the joint venture's ***proposal***, rather than with a participating company. We recognize that joint ventures may separate various duties among participating companies, but please answer the questions as best you can.

If the proposal was submitted by a single applicant, answer in terms of your experience with the company's proposal. By the company we mean the entire company (for small businesses), or the unit or division of the company that submitted the ATP proposal (for large businesses).

Note: These frequencies were tabulated after excluding eleven respondents; therefore, some of these statistics may not match those in the body of the report. See appendix III for details.

SECTION I: COMPANY BACKGROUND INFORMATION

1. How many ATP award winners?

   89 Winner

2. Indicate type of application.

   23 Joint venture
   66 Single applicant

3. In what year did this company begin operations?

   8 1803 to 1899
   7 1900 to 1929
   6 1930 to 1952
   6 1953 to 1973
   38 1974 to 1994
   24 Missing

4. In what year, if any, did the company first generate sales?

   35 1985 or earlier
   3 1986
   2 1987
   5 1988
   2 1989
   1 1990
   5 1991
   1 1992
   3 1993
   3 1994
   6 Have not had any sales
   23 Missing

1

5. How many full-time equivalent employees did your company have when you applied to ATP? Include outsourced as well as permanent employees.

37 0 to 100
4 101 to 200
5 201 to 300
2 301 to 400
0 401 to 500
16 Over 500
25 Missing

6. In what year did the member companies of the joint venture agree to pursue the proposal described in the ATP proposal?

6 1990
9 1991
5 1992
3 1993
66 Missing

7. In what year did the joint venture actually begin working on the project?

0 1985 or earlier
0 1986
0 1987
0 1988
0 1989
2 1990
4 1991
10 1992
2 1993
5 1994
0 1995
0 Not started yet
0 Don't know
66 Missing

8. Did the joint venture come together as a new group to pursue the project described in the ATP proposal, or was the joint venture already together working on it?

18 Joint venture came together to pursue the ATP project
2 Joint venture was pursuing ATP project together, before ATP
3 Joint venture was pursuing other unrelated projects together, before ATP
66 Missing

9. What percentage of the company's DIRECT R&D budget was provided by ***federal government agencies*** ? Base your answers on the last fiscal year completed before you applied to ATP.

26 None
17 1 to 20%
10 21 to 40%
4 41 to 60%
7 61 to 100%
25 Missing

10. What percentage of the company's DIRECT R&D budget was provided by ***state government agencies***? Base your answers on the last fiscal year completed before you applied to ATP.

57 None
6 1 to 20%
1 21 to 40%
0 41 to 60%
0 61 to 100%
25 Missing

2

11. What percentage of the company's DIRECT R&D budget was provided by ***industry groups or trade associations***? Base your answers on the last fiscal year completed before you applied to ATP.

58	None
6	1 to 20%
0	21 to 40%
0	41 to 60%
0	61 to 100%
25	Missing

12. What percentage of the company's DIRECT R&D budget was provided by ***other private companies***? Base your answers on the last fiscal year completed before you applied to ATP.

40	None
13	1 to 20%
6	21 to 40%
4	41 to 60%
1	61 to 100%
25	Missing

13. What percentage of the company's DIRECT R&D budget was provided by ***venture capitalists***? Base your answers on the last fiscal year completed before you applied to ATP.

49	None
3	1 to 20%
1	21 to 40%
1	41 to 60%
10	61 to 100%
25	Missing

14. What percentage of the company's DIRECT R&D budget was provided by ***internal funding from company income***? Base your answers on the last fiscal year completed before you applied to ATP.

20	None
10	1 to 20%
4	21 to 40%
2	41 to 60%
28	61 to 100%
25	Missing

15. What ***other funding sources*** did you use? Base your answers on the last fiscal year completed before you applied to ATP.

1	Banks
1	Corporate investors, not venture capitalists
1	High net worth individual
1	Internal funding from interest, dividends, gifts, etc.
1	Licenses related to R&D contracts
1	Owner's funds
2	Private individuals, not venture capitalists
1	Universities
80	Missing

SECTION II: ATP PROPOSAL HISTORY

16. Did you seek funding from other sources to pursue the project described in the ATP proposal BEFORE you sought funding from ATP?

30	Yes
58	No
1	Don't know
0	Missing

17. How long did you seek this funding?

13 0 to 12 months
11 13 to 24 months
4 Over 25 months
61 Missing

18. How many full-time equivalent persons were assigned to help seek funding for the project during this period? Include outsourced as well as permanent employees.

28 0 to 5
1 Over 5
60 Missing

19. Where did these persons seek funding?

12 U.S. Federal government agencies other than ATP
3 State government agencies
10 Industry groups/trade associations
14 R&D contracts with other private companies
9 Venture capitalists
9 Internal funding from company income
2 Other
59 Missing

20. How many attempts did you make to obtain funding from ***federal government agencies***?

1 None
5 1 to 2 attempts
4 3 to 4 attempts
2 Over 4 attempts
77 Missing

21. How many attempts did you make to obtain funding from ***state government agencies***?

0 None
2 1 to 2 attempts
0 3 to 4 attempts
1 Over 4 attempts
86 Missing

22. How many attempts did you make to obtain funding from ***industry groups/trade associations***?

1 None
6 1 to 2 attempts
3 3 to 4 attempts
0 Over 4 attempts
79 Missing

23. How many attempts did you make to obtain funding from ***other private companies***?

0 None
4 1 to 2 attempts
0 3 to 4 attempts
10 Over 4 attempts
75 Missing

24. How many attempts did you make to obtain funding from ***venture capitalists***?

0 None
2 1 to 2 attempts
3 3 to 4 attempts
4 Over 4 attempts
80 Missing

4

25. How many attempts did you make to obtain funding from ***internal funding from company income***?

__0__ None
__2__ 1 to 2 attempts
__3__ 3 to 4 attempts
__4__ Over 4 attempts
__80__ Missing

26. Were any of your attempts to obtain funding unsuccessful because you turned down funding that had terms or conditions you would not accept?

__3__ Yes
__26__ No
__1__ Don't know
__59__ Missing

27. When you submitted the ATP proposal, did you intend to pursue the project whether or not you received ATP funding?

__27__ Yes
__9__ Probably yes
__14__ Uncertain
__17__ Probably no
__22__ No

28. Did you intend to pursue the project on the same schedule as described in the ATP proposal or on a modified schedule? If modified, when would the milestones be met?

__0__ Sooner than in the ATP proposal
__2__ At the same time as in the ATP proposal
__34__ Later than in the ATP proposal
__53__ Missing

29. Was the project described in the ATP proposal underway PRIOR to submission of the proposal to ATP?

__21__ Yes
__68__ No

30. Was the funding level of the on-going project less than, about the same as, or higher than the amount requested by ATP?

__19__ Less than the ATP request
__1__ About the same as the ATP request
__1__ Higher than the ATP request
__68__ Missing

SECTION III. PROJECT STATUS & PROJECT RESULTS

31. What is the status of the project described in the ATP proposal?

__55__ Underway
__28__ Completed
__3__ Discontinued
__3__ Other

32. How satisfied, if at all, are you with the technical direction and progress/outcome of the project?

__60__ Very satisfied
__24__ Generally satisfied
__0__ Neither satisfied or dissatisfied
__1__ Generally dissatisfied
__0__ Very dissatisfied
__4__ Don't know

5

33. Which statement BEST describes the results you expected to have at the end of the project at the time you applied to ATP?

55 Project sold commercially
21 Process used internally
9 Product or process used by another firm with compensation
1 Product or process used by another firm without compensation
3 Don't know

34. When you applied to ATP, were you aware of other U.S. companies that were also conducting technical work toward objectives of the ATP proposal?

29 Yes
59 No
1 Don't know

35. If you have any additional comments or information you would like to provide please do so in the space below.

_____

_____

_____

_____

Thank you, this concludes the questionnaire!

6

United States General Accounting Office

GAO

Survey of ATP Award Near Winners (Completed Questionnaire with Frequencies)

INTRODUCTION

The U.S. General Accounting Office (GAO), an agency that examines issues and programs for Congress, is evaluating some of the impacts of the Advanced Technology Program (ATP).

If your proposal was submitted by a joint venture, answer in terms of your experience with the joint venture's ***proposal***, rather than with a participating company. We recognize that joint ventures may separate various duties among participating companies, but please answer the questions as best you can.

If the proposal was submitted by a single applicant, answer in terms of your experience with the company's proposal. By the company we mean the entire company (for small businesses), or the unit or division of the company that submitted the ATP proposal (for large businesses).

Note: These frequencies were tabulated after excluding eleven respondents; therefore, some of these statistics may not match those in the body of the report. See appendix III for details.

SECTION I: COMPANY BACKGROUND INFORMATION

1. How many ATP award near winners?

   28 Near winners

2. Indicate type of application

   9 Joint venture
   19 Single applicant

3. In what year did this company begin operations?

   2 1803 to 1899
   3 1900 to 1929
   1 1930 to 1952
   6 1953 to 1973
   7 1974 to 1994
   9 Missing

4. In what year, if any, did the company first generate sales?

   12 1985 or earlier
   0 1986
   0 1987
   1 1988
   0 1989
   0 1990
   0 1991
   2 1992
   0 1993
   2 1994
   1 1995
   1 Have not had any sales
   9 Missing

5. How many full-time equivalent employees did your company have when you applied to ATP? Include outsourced as well as permanent employees.

8	0 to 100
0	101 to 200
2	201 to 300
0	301 to 400
2	401 to 500
7	Over 500
9	Missing

6. In what year did the member companies of the joint venture agree to pursue the proposal described in the ATP proposal?

2	1989
1	1990
2	1991
2	1992
1	1993
20	Missing

7. In what year did the joint venture actually begin working on the project?

1	1987
1	1990
1	1991
1	1992
4	Not started yet
1	Don't know
19	Missing

8. Did the joint venture come together as a new group to pursue the project described in the ATP proposal, or was the joint venture already together working on it?

6	Joint venture came together to pursue the ATP project
1	Joint venture was pursuing ATP project together, before ATP
2	Joint venture was pursuing other unrelated projects together, before ATP
19	Missing

9. What percentage of the company's DIRECT R&D budget was provided by ***federal government agencies*** ? Base your answers on the last fiscal year completed before you applied to ATP.

7	None
5	1 to 20%
2	21 to 40%
2	41 to 60%
3	61 to 100%
9	Missing

10. What percentage of the company's DIRECT R&D budget was provided by ***state government agencies***? Base your answers on the last fiscal year completed before you applied to ATP.

17	None
0	1 to 20%
2	21 to 40%
0	41 to 60%
0	61 to 100%
9	Missing

2

11. What percentage of the company's DIRECT R&D budget was provided by ***industry groups or trade associations***? Base your answers on the last fiscal year completed before you applied to ATP.

19 None
0 1 to 20%
0 21 to 40%
0 41 to 60%
0 61 to 100%
9 Missing

12. What percentage of the company's DIRECT R&D budget was provided by ***other private companies***? Base your answers on the last fiscal year completed before you applied to ATP.

13 None
1 1 to 20%
3 21 to 40%
1 41 to 60%
1 61 to 100%
9 Missing

13. What percentage of the company's DIRECT R&D budget was provided by ***venture capitalists***? Base your answers on the last fiscal year completed before you applied to ATP.

16 None
1 1 to 20%
0 21 to 40%
0 41 to 60%
2 61 to 100%
9 Missing

14. What percentage of the company's DIRECT R&D budget was provided by ***internal funding from company***? Base your answers on the last fiscal year completed before you applied to ATP.

6 None
4 1 to 20%
2 21 to 40%
1 41 to 60%
6 61 to 100%
9 Missing

15. What ***other funding sources*** did you use? Base your answers on the last fiscal year completed before you applied to ATP.

1 High net worth individual
27 Missing

SECTION II: ATP PROPOSAL HISTORY

16. What reasons, if any, did ATP cite for declining your ATP award?

15 Insufficient business plan
0 Technology not precompetitive/generic
0 Technology posed too little risk
5 Lack of available ATP funding
14 Other
0 Don't know

3

17. What were the "other" reasons cited by ATP?

1 ATP wants to support companies not universities in technology development proposals
1 Felt company did not have an adequate understanding of the chemistry of why the technology
1 Joint venture partners disagreed on direction of project at last minute
1 Lack of an adequate transfer plan
1 Lack of experience of team
1 Limited experience in commercialization
1 Matching funds on low side
1 Not a viable invention
1 One member of joint venture withdrew
1 Some minor technical issues
2 Technical content was incomplete
1 Too little company commitment for money
1 Uncertain about meeting proposal objectives

18. Did you seek funding from other sources to pursue the project described in the ATP proposal BEFORE you sought funding from ATP?

13 Yes
15 No

19. How long did you seek this funding?

6 0 to 12 months
4 13 to 24 months
2 Over 25 months
16 Missing

20. How many full-time equivalent persons were assigned to help seek funding for the project during this period? Include outsourced as well as permanent employees.

13 0 to 5
0 Over 5
15 Missing

21. Where did these persons seek funding?

7 U.S. Federal government agencies other than ATP
2 State government agencies
1 Industry groups/trade associations
8 R&D contracts with other private companies
5 Venture capitalists
5 Internal funding from company income
2 Other
15 Missing

22. How many attempts did these persons make to obtain funding from ***federal government agencies***?

0 None
2 1 to 2 attempts
2 3 to 4 attempts
2 Over 4 attempts
22 Missing

23. How many attempts did these persons make to obtain funding from ***state government agencies***?

0 None
1 1 to 2 attempts
0 3 to 4 attempts
0 Over 4 attempts
26 Missing

24. How many attempts did these persons make to obtain funding from ***industry groups/trade associations***?

0 None
0 1 to 2 attempts
1 3 to 4 attempts
0 Over 4 attempts
27 Missing

4

25. How many attempts did these persons make to obtain funding from ***other private companies***?

0	None
2	1 to 2 attempts
1	3 to 4 attempts
5	Over 4 attempts
20	Missing

26. How many attempts did these persons make to obtain funding from ***venture capitalists***?

0	None
1	1 to 2 attempts
2	3 to 4 attempts
1	Over 4 attempts
24	Missing

27. How many attempts did these persons make to obtain funding from ***internal funding from company income***?

0	None
4	1 to 2 attempts
0	3 to 4 attempts
0	Over 4 attempts
24	Missing

28. Were any of your attempts to obtain funding unsuccessful because you turned down funding that had terms or conditions you would not accept?

3	Yes
10	No
15	Missing

29. When you submitted the ATP proposal, did you intend to pursue the project whether or not you received ATP funding?

13	Yes
1	Probably yes
4	Uncertain
2	Probably no
8	No

30. Did you intend to pursue the project on the same schedule as described in the ATP proposal or on a modified schedule? If modified, when would the milestones be met?

0	Sooner than in the ATP proposal
0	At the same time as in the ATP proposal
13	Later than in the ATP proposal
1	Don't know
14	Missing

31. Was the project described in the ATP proposal underway PRIOR to submission of the proposal to ATP?

14	Yes
13	No
1	Don't know

32. Was the funding level of the on-going project less than, about the same as, or higher than the amount requested by ATP?

11	Less than the ATP request
2	About the same as the ATP request
1	Higher than the ATP request
14	Missing

5

33. What percentage of the funding for the ongoing project was provided by ***federal government agencies***?

9 None
0 1 to 20%
1 21 to 40%
1 41 to 60%
3 61 to 100%
14 Missing

34. What percentage of the funding for the ongoing project was provided by ***state government agencies***?

10 None
3 1 to 20%
1 21 to 40%
0 41 to 60%
0 61 to 100%
14 Missing

35. What percentage of the funding for the ongoing project was provided by ***industry groups or trade associations***?

14 None
0 1 to 20%
0 21 to 40%
0 41 to 60%
0 61 to 100%
14 Missing

36. What percentage of the funding for the ongoing project was provided by ***other private companies***?

12 None
1 1 to 20%
0 21 to 40%
0 41 to 60%
1 61 to 100%
14 Missing

37. What percentage of the funding for the ongoing project was provided by ***venture capitalists***?

12 None
0 1 to 20%
1 21 to 40%
0 41 to 60%
1 61 to 100%
14 Missing

38. What percentage of the funding for the ongoing project was provided by ***internal funding from company income***?

4 None
2 1 to 20%
2 21 to 40%
0 41 to 60%
6 61 to 100%
14 Missing

SECTION III. PROJECT STATUS & PROJECT RESULTS

39. We understand that you were declined an ATP award. Since then, have you begun the project described in the ATP proposal?

14 Yes
14 No

40. Is the project's schedule the same as described in the ATP proposal, or is it modified? If modified, when would the milestones be met?

0 Sooner than in the ATP proposal
1 At the same time as in the ATP proposal
13 Later than in the ATP proposal
14 Missing

6

41. What percentage of the funding for the project described in the ATP proposal, on which you are now working is being provided by ***federal government agencies***?

9	None
0	1 to 20%
0	21 to 40%
1	41 to 60%
4	61 to 100%
14	Missing

42. What percentage of the funding for the project described in the ATP proposal, on which you are now working is being provided by ***subsequent competition round held by ATP***?

0	None
0	1 to 20%
0	21 to 40%
0	41 to 60%
0	61 to 100%
14	Missing

43. What percentage of the funding for the project described in the ATP proposal, on which you are now working is being provided by ***state government agencies***?

11	None
3	1 to 20%
0	21 to 40%
0	41 to 60%
0	61 to 100%
14	Missing

44. What percentage of the funding for the project described in the ATP proposal, on which you are now working is being provided by ***industry groups or trade associations***?

11	None
1	1 to 20%
1	21 to 40%
0	41 to 60%
1	61 to 100%
14	Missing

45. What percentage of the funding for the project described in the ATP proposal, on which you are now working is being provided by ***other private companies***?

12	None
1	1 to 20%
0	21 to 40%
0	41 to 60%
1	61 to 100%
14	Missing

46. What percentage of the funding for the project described in the ATP proposal, on which you are now working is being provided by ***venture capitalists***?

12	None
0	1 to 20%
1	21 to 40%
0	41 to 60%
1	61 to 100%
14	Missing

7

47. What percentage of the funding for the project described in the ATP proposal, on which you are now working is being provided by ***internal funding from company income***?

6 None
0 1 to 20%
2 21 to 40%
2 41 to 60%
4 61 to 100%
14 Missing

48. How long did you look for funding after the ATP proposal was declined? If you looked for funding while the ATP proposal was under review, also include that time in your answer.

1 Did not look for funding after being declined
27 Missing

49. Where did you look for funding to continue or begin the project described in the proposal before you found funding?

7 U.S. Federal government agencies other than ATP
5 Subsequent competition round held by ATP
1 State government agencies
2 Industry groups/trade associations
4 R&D contracts with other private companies
4 Venture capitalists
1 Internal funding from company income
0 Other
14 Missing

50. How many attempts did you make to obtain funding from ***federal government agencies***?

0 None
4 1 to 2 attempts
1 3 to 4 attempts
2 Over 4 attempts
21 Missing

51. How many attempts did you make to obtain funding from ***subsequent competition round held by ATP***?

0 None
4 1 to 2 attempts
1 3 to 4 attempts
0 Over 4 attempts
23 Missing

52. How many attempts did you make to obtain funding from ***state government agencies***?

0 None
1 1 to 2 attempts
0 3 to 4 attempts
0 Over 4 attempts
27 Missing

53. How many attempts did you make to obtain funding from ***industry groups/trade associations***?

0 None
2 1 to 2 attempts
0 3 to 4 attempts
0 Over 4 attempts
26 Missing

54. How many attempts did you make to obtain funding from ***other private companies***?

0 None
2 1 to 2 attempts
0 3 to 4 attempts
1 Over 4 attempts
25 Missing

8

55. How many attempts did you make to obtain funding from ***venture capitalists***?

- 0 None
- 0 1 to 2 attempts
- 2 3 to 4 attempts
- 0 Over 4 attempts
- 25 Missing

56. How many attempts did you make to obtain funding from ***internal funding from company income***?

- 0 None
- 1 1 to 2 attempts
- 0 3 to 4 attempts
- 0 Over 4 attempts
- 27 Missing

57. Were any of your attempts to obtain funding unsuccessful because you turned down funding that had terms or conditions you would not accept?

- 0 Yes
- 10 No
- 18 Missing

58. What is the status of the project described in the ATP proposal?

- 11 Underway
- 0 Completed
- 2 Discontinued
- 1 Other
- 14 Missing

59. How satisfied, if at all, are you with the technical direction and progress/outcome of the project?

- 4 Very satisfied
- 7 Generally satisfied
- 0 Neither satisfied or dissatisfied
- 3 Generally dissatisfied
- 0 Very dissatisfied
- 14 Missing

60. Which statement BEST describes the results you expected to have at the end of the project at the time you applied to ATP?

- 6 Project sold commercially
- 4 Process used internally
- 3 Product or process used by another firm with compensation
- 0 Product or process used by another firm without compensation
- 1 Don't know
- 14 Missing

61. When you applied to ATP, were you aware of other U.S. companies that were also conducting technical work toward objectives of the ATP proposal?

- 6 Yes
- 8 No
- 14 Missing

62. Have you attempted to obtain funding from sources other than ATP, or from ATP in a subsequent competition round, to CONTINUE/BEGIN the project described in the ATP proposal?

- 9 Yes
- 4 No
- 3 Don't know
- 14 Missing

9

63. Where did you look for funding to continue or begin the project described in the proposal before you found funding?

2 U.S. Federal government agencies other than ATP
8 Subsequent competition round held by ATP
0 State government agencies
0 Industry groups/trade associations
2 R&D contracts with other private companies
0 Venture capitalists
0 Internal funding from company income
0 Other
19 Missing

64. How many attempts did you make to obtain funding from ***federal government agencies***?

0 None
1 1 to 2 attempts
1 3 to 4 attempts
0 Over 4 attempts
26 Missing

65. How many attempts did you make to obtain funding from ***subsequent competition round held by ATP***?

0 None
8 1 to 2 attempts
0 3 to 4 attempts
0 Over 4 attempts
20 Missing

66. How many attempts did you make to obtain funding from ***state government agencies***?

0 None
0 1 to 2 attempts
0 3 to 4 attempts
0 Over 4 attempts
28 Missing

67. How many attempts did you make to obtain funding from ***industry groups/trade associations***?

0 None
0 1 to 2 attempts
0 3 to 4 attempts
0 Over 4 attempts
28 Missing

68. How many attempts did you make to obtain funding from ***other private companies***?

0 None
1 1 to 2 attempts
0 3 to 4 attempts
1 Over 4 attempts
26 Missing

69. How many attempts did you make to obtain funding from ***venture capitalists***?

0 None
0 1 to 2 attempts
0 3 to 4 attempts
0 Over 4 attempts
28 Missing

70. How many attempts did you make to obtain funding from ***internal funding from company income***?

0 None
0 1 to 2 attempts
0 3 to 4 attempts
0 Over 4 attempts
28 Missing

10

71. Were any of your attempts to obtain funding unsuccessful because you turned down funding that had terms or conditions you would not accept?

0 Yes
9 No
19 Missing

72. Are you still pursuing funding for the project?

3 Yes
6 No
19 Missing

73. How long have you been seeking/did you seek funding since the ATP proposal was declined?

4 0 to 12 months
3 13 to 24 months
2 Over 25 months
19 Missing

74. How many full-time equivalent persons were assigned to help seek funding during this period? Include outsourced as well as permanent employees.

8 0 to 5
1 Over 5
19 Missing

75. When you applied to ATP, were you aware of other U.S. companies that were also conducting technical work toward objectives of the ATP proposal?

7 Yes
6 No
1 Don't know
14 Missing

76. If you have any additional comments or information you would like to provide please do so in the space below.

_____

_____

_____

_____

Thank you, this concludes the questionnaire!

11

Appendix III

Objectives, Scope, and Methodology

The objective of this report was to examine whether funds from ATP are used to support research projects that would not have been funded by the private sector, or if it replaces private funds that would have otherwise been available. To meet this objective, we requested from ATP a rank-order listing of all the applicants that received a score from the Source Evaluation Board[1] for their ATP proposal during the program's first four rounds of competition (1990-93).

In the first four rounds of competition, the Source Evaluation Board gave scores only to proposals that had been determined to have "very high" scientific and technical merit and that had passed a screening stage in which it was determined that the proposals satisfied the program's requirements. The Source Evaluation Board then assigned a score to all of the proposals on the basis of a business review and all the criteria contained in Commerce's regulations. According to ATP officials, on the basis of this score, the proposals with strong technical and business merit were ranked and recorded on a list before the final oral review stage. ATP provided that list to us. Using this list, we identified those that received ATP awards as "winners" and those that did not receive ATP funding as "near winners."

In our first primary research question, we asked the near winners if they had continued their proposed projects using other funding sources after ATP declined to fund them. We developed this question to shed light on whether ATP winners (given their similarity to the near winners) would have continued their projects using other funding sources if ATP funding had not been provided. In our second primary research question, we asked the winners and near winners if they had sought funding from other sources before applying to ATP. This question provided information on whether private-sector sources had the opportunity to fund the proposed projects before the applicants sought federal funding.

Our work was structured in three phases. First, we interviewed ATP officials, winners, and near winners to increase our understanding of ATP's review process and the applicants' experiences with it. We spoke with representatives of other research and development (R&D) funding sources, such as the National Venture Capital Association. We also reviewed the

[1]For each competition, ATP forms a Source Evaluation Board to rank the proposals. A typical board consists of about a dozen senior-level managers from the National Institute of Standards and Technology (NIST), supplemented with additional technical consultants from NIST and other federal laboratories. The board members' backgrounds vary widely. The board may include, for example, an electrical engineer, a chemist, a biotechnologist, a materials scientist, a computer scientist, and others with business and economics expertise.

relevant economic, policy, and evaluation literature and consulted with outside experts on the overall design of our assessment.

Next, we designed a computer-aided telephone interview in which we requested several pieces of information from each applicant.[2] Specifically, we asked questions on (1) the applicant's general characteristics, such as the size of the company and its sources of R&D funding; (2) the history of the project put forth in the ATP proposal, such as whether the project was under way before the applicant requested funding from ATP; and (3) the project's status (for winners and near winners that continued their projects using other funding sources). We got expert review of a preliminary version of the questions from knowledgeable consultants.

To test the validity of the questions, we pretested a draft survey instrument with three ATP award winners and four near winners. We selected them using the following factors: the round of competition in which the application was submitted, geographic location, type of applicant (single company applicant or joint venture), company's size, proposal technology area, and award status (award winner or near winner). We conducted the first three pretests in person in Gaithersburg, Maryland and Somerset, New Jersey; we conducted the remaining four by telephone with winners and near winners located in Ann Arbor and Auburn Hills, Michigan, and San Jose and Menlo Park, California. On the basis of the comments and reactions from the experts' review and our pretests, we revised the telephone interview questions so that they would be uniformly interpreted and understood.

In the final phase of our work, we conducted telephone interviews with all the applicants that qualified as winners or near winners during ATP's first four rounds of competition, a total of 128 (89 winners and 39 near winners). Our survey achieved a 100-percent response rate. In our findings for both research questions, we excluded 5 near winners, reducing our total number of respondents to 123. We did this because these five near winners indicated that ATP had disqualified them late in the review process because new information indicated that their proposals did not satisfy the program's basic requirements. For example, in one instance ATP decided that the applicant would do the project without ATP funding and in another ATP decided that the project did not focus on precompetitive or generic research. In our findings for the second research question only, our total of near winners drops to 28 because 6 near winners eventually received

[2]The computer was programmed to skip questions that were irrelevant to the individual respondent. For example, those involved in joint ventures were not asked for the year of their first sale. In these cases, the computer tabulated the results as a missing response. See app. II.

ATP funding in a subsequent round of competition, eliminating them from our consideration because we focused only on near winners that found funding from sources other than ATP.

To examine how certain characteristics affect whether the near winners continued their projects, we calculated "odds ratios." Odds ratios measure the association between two variables. The closer the odds ratio to 1.00, the weaker the association; the further from 1.00, the stronger.[3] To illustrate, table III.1 reports the number of joint-venture and single-applicant near winners that did and did not continue their project after ATP declined to fund them.

Table III.1: Number of Joint-Venture and Single-Applicant Near Winners That Continued Their Projects After ATP Declined to Fund

	Joint ventures	Single applicants
Continued	3	11
Did not continue	6	8

The odds ratio is calculated through cross multiplication and division—(11x6) divided by (3x8)—for a value of 2.75. Rounding to 3, we interpret this odds ratio to mean that single-applicant near winners were about three times more likely than joint-venture near winners to continue projects after ATP declined to fund them.

[3]For more detail on the theory underlying odds ratios and their calculation, see William Page, "Interpretation of Goodman's Log-Linear Model Effects: An Odds Ratio Approach," Sociological Methods & Research, Vol. 5, No. 4, May 1977.

Appendix IV

Comments From the Department of Commerce

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

THE SECRETARY OF COMMERCE
Washington, D.C. 20230

Mr. Victor S. Rezendes
Director, Energy and Science Issues
Resources, Community, and Economic
Development Division
U.S. General Accounting Offices
Washington, D.C. 20548

Dear Mr. Rezendes:

We appreciate the opportunity to comment on the draft report, *Performance Measurement: The Advanced Technology Program and rt, Private Sector Funding*, (GAO/RCED-96-47, Code 307723). We note that the General Accounting Office (GAO) has not allowed us the usual 30 days to provide comments on this draft report. Our comments are enclosed.

Some of the concerns noted in the enclosure are sufficiently important that unless they are taken into account by GAO before the report is finalized, we believe the report's conclusions would be potentially misleading at best and erroneous at worst. Much of the report is well-done; and so, if our recommendations are taken into account conscientiously, this could be a valuable and generally accurate report.

If your staff requires additional information about the Department's response to your report, they may contact the Advanced Technology Program's Senior Economist, Rosalie Ruegg, at (301) 975-6135.

Sincerely,

Ronald H. Brown

Enclosure

December 14, 1995

Department of Commerce (DOC) Comments on GAO Draft Report
Measuring Performance: The Advanced Technology Program

Our most important concern is that in stating the conclusion, GAO must not bury in the text of the report critical caveats that might be overlooked by the casual reader. These caveats are critically important to the conclusions that readers may draw. With these caveats, readers will correctly interpret the GAO's findings. Without them, readers will likely draw invalid conclusions.

The GAO's survey results support the conclusion that the ATP is meeting its objective of funding projects that either would not be pursued at all or projects that would have been pursued without ATP funding, but at a much slower pace.

- Of the respondents who said they intended to pursue the project whether or not they received ATP funding, nearly all indicated that without the ATP award their milestones would be met later than those set forth in the proposal.

- The remainder of those who responded (other than "uncertain) indicated that they would have been unlikely to pursue the research at all without the ATP.

- The fact that some of the near winners were able subsequently to obtain funding is perfectly consistent with ATP's decision not to fund them. If we believe that an applicant does not need ATP funds to pursue the project, we do not fund them. (One of our selection criteria is "Degree to which ATP support is necessary.")

- The fact that the scale of on-going research was expanded by the ATP award is consistent with ATP's goal.

- The fact that a higher percentage of ATP awardees indicated satisfaction with the technical direction and progress/outcome of their project than the near winners continuing may indicate that those continuing without ATP were not able to pursue the full project.

See comment 1.

- As GAO correctly concludes, the survey results indicate that the ATP successfully fosters joint research ventures.

Because it decouples the results of two appropriately coupled questions, the GAO's first statement on pages 3 and 11 is misleading, and needs to be corrected.

- Our experience has been that if companies are asked, "Would you have pursued the project without ATP funding?" there is a very high potential for multiple interpretations of the question. At one extreme, some companies assume they are being asked whether without ATP funds they would have continued any amount of work at all in the general subject area of the proposal. Others may assume they are being asked whether the precise project would have been pursued with no changes. Still others will take an interpretation somewhere between these two extremes. For this reason, we have found that the more meaningful question to ask in this regard is,

  "Without ATP cost-sharing, how would your R&D in this specific area have differed with regard to schedule, scope of project, riskiness of technical and business goals, collaborations, etc.?"

- The GAO appropriately asked a follow-on question about whether the project schedule would have been different without the ATP, but unfortunately, it failed to include the other important ways a project can be altered -- e.g., scope, scale, and riskiness of goals -- in the follow-on question. And, according to two other third-party surveys, if given the chance, the companies would also have indicated a smaller-sized effort, less ambitious research goals, and/or a less comprehensive project without the ATP award.

- More importantly, the GAO failed to report in its summary of results and conclusions, the results of the follow-on question that revealed that nearly all of those who said they planned to pursue the research without ATP, said that the research schedule would be slower without ATP. (However, the GAO did correctly report in part on the bottom of page 5 the results of the paired questions, and that information deserves to be highlighted more.)

See comment 2.

To address these concerns, we strongly urge the GAO to change the first paragraph of the executive summary section titled "Results in Brief" on page 3 and the "Conclusions" section on page 11 to read along the lines of the following. (This wording is fully consistent with the caveats noted on page 5 of the GAO report.)

ATP funds research projects that either would not have been funded at all without the ATP, or would likely have been

funded by others but at a slower pace and/or with less ambitious and less risky goals. Nearly all of those who said they would have pursued their project to some extent without ATP cost sharing indicated that the project schedule would have been modified without ATP cost sharing and that milestones would be met later than those set forth in the proposal to ATP. The survey questions did not ask whether, in such cases, the technical goals would also have been less ambitious and less risky without ATP cost sharing, but other surveys carried out by ATP to which we had access indicate that this also might be so in many cases.

- We also urge that the report state clearly that accelerating the pace of research is but one of the ways that the ATP funding may alter those projects that might have been pursued without ATP.

Were these recommended changes to be made, we believe the GAO survey can provide useful insight into the differences between the winners and near winners of ATP awards.

See comment 3.

Paragraph 1 of page 1 of the report states that the ATP funding for FY95 was $431 million. That is incorrect. Because of the $90 million rescission, the actual funding for FY95 was $341 million.

See comment 4.

GAO's Comments

The following are GAO's comments on the Department of Commerce's letter dated December 21, 1995.

1. While our draft Conclusions section referred to the pace of research projects, we have added a sentence to our report's Results-in-Brief on this point. In our opinion, however, Commerce's overall conclusion based on our survey results overlooks a number of significant points. First, although ATP appears to enable applicants to complete their research projects faster, companies still find it worthwhile to pursue the projects, although on a slower schedule, without ATP funds. Second, when asked, "What reasons, if any, did ATP cite for declining your ATP award?," only one applicant said that ATP had decided the project would be done without ATP funding. (Subsequently, that project did not find funding elsewhere.) Third, while our survey results do indicate that a higher percentage of ATP awardees indicated satisfaction with the technical direction and progress/outcome of their projects than the near winners, nothing in our survey supports Commerce's conclusion about what those results indicate.

2. Our draft Conclusions section referred to the pace of continued research projects, and we have added a sentence to our Results-in-Brief section on this point. While Commerce is concerned with multiple interpretations of one of our survey questions, we reduced the potential for multiple interpretations by instructing our interviewers to say specifically, "I'll be asking you several questions about the history and status of 'the project described in your ATP proposal,' which I'll sometimes refer to as 'the project.' By this we mean a project that you consider to be essentially the same as the one in the proposal." If further clarification was needed, the interviewer would add, "To be 'essentially the same project,' it should focus on the same technical work as the one in the ATP proposal."

We used this wording to allow the respondent to rely on his or her own judgment in determining if the work that had continued was still the same project—despite changes in scope, schedule, and riskiness, among other things—or if in the respondent's judgment, changes have resulted in a different project altogether. At a minimum, the project had to include the same technical work, even though, for example, some intended commercial applications of the work had changed.

3. As noted in comments 1 and 2, we feel that Commerce's conclusion overlooks a number of significant points based on our survey results.

4. We have made the suggested change.

Appendix V

Major Contributors to This Report

Resources, Community, and Economic Development Division, Washington, D.C.	Bernice Steinhardt, Associate Director Robin M. Nazzaro, Assistant Director Alice G. Feldesman, Supervisory Social Science Analyst Andrew J. Vogelsang, Evaluator-in-Charge George Warholic, Senior Evaluator Patton Stephens, Staff Evaluator Kelly Ervin, Social Science Analyst Mitchell B. Karpman, Senior Operations Research Analyst Judy Pagano, Senior Operations Research Analyst
Office of the Chief Economist	Loren Yager, Assistant Director
General Government Division, Washington, D.C.	Kevin B. Dooley, Senior Evaluator (Computer Science)

ATP Response to Senator Levin's Inquiry, May 2005

ATP: Delivering Results

Overview

The Advanced Technology Program is a public-private partnership designed by Congress to encourage companies to develop innovative and high-risk technologies for broad national benefit. ATP's bottom line is broad benefits for the nation – economic growth and better quality of life – rooted in innovative enabling technologies. In specific, this industry/government partnership has fostered benefits that extend well beyond the companies involved in the project; technologies with broad potential applications, particularly across different industrial sectors; and path-breaking technologies that open up new potential markets or make possible wholly new products or industrial processes. The Program's results have been impressive. The Nation's $2.3B investment has catalyzed an additional $2.1B of private investment. The projected returns for the American people from just a small portion of ATP projects far exceed the taxpayer dollars invested. Forty-one studied projects, just 6 percent of the ATP portfolio, have returned estimated economic benefits exceeding $17B:

Economic Benefits of 41 Selected ATP Projects in 10 Studies	
Tissue Engineering	$10.90B
Data Storage	3.00B
Flow Control Machining	1.15B
Advanced Composites	1.00B
Component Based Software	0.80B
Refrigeration	0.45B
2mm Auto Body Consortium	0.20B
Mammography	0.20B
HDTV Technologies	0.13B
Printed Wiring Board	0.04B
Combined Net Economic Benefits	**$17.87B**

Private Capital Markets have Failed to Provide Sufficient Funds for Enabling Technology Development

Even with large amounts of capital available for investment (the U.S. Venture Capital Industry was estimated to be at about $10B in 2004), the types of technology funded by ATP are not readily funded by this sector:

- Venture capitalists typically fund businesses that are already engaged in later stage business activities and well into product development. According to Branscomb and Auerswald[1], only seed financing rounds by venture capitalists are dedicated to early-stage technology development.
- VentureSource data for 2001-2004 summarized show that in 2004 only $105 million out of a total of $20 billion in VC investments (about one half of one

[1] Branscomb and Auerswald, "Between Invention and Innovation" (2002)

percent of VC investments), fund the type of technology development funded by ATP.

ATP Investments Impact All Sectors of the Economy

ATP Investments deliver results in all sectors of the economy:

Transportation:

- ATP investments have applications in the airline, automobile, pipeline, highway, trucking, maritime, and railroad industries. For example, one ATP project developed a new way to manufacture composite structures to be used in bridges and other infrastructure applications because they are lightweight and resistant to rust and corrosion. Decreased installation and maintenance costs are expected to be among the major benefits of using composite structural shapes in infrastructure rebuilding.
- One recently-funded project will combine vision and radar sensor technology to create a new type of auto safety system that will detect approaching hazards, measure their rate of motion, determine if and where a collision will occur, and trigger mitigating actions, such as applying brakes, pre-tensioning seat belts, and firing side airbags, with a near-zero false alarm rate.

Healthcare:

- ATP is saving the lives of cancer patients and reducing their pain. For example, a desktop-size, first-of-its-kind, bioreactor grows stem cells and produces clinically useful quantities of cells from small amounts of bone marrow and umbilical cord blood and is useful for a broad range of cellular therapies.
- ATP is making the future detection of breast cancer more affordable for routine use. For example, ATP enabled a next generation, all-digital mammography system that will produce fast and accurate mammograms at lower cost and make routine use more affordable.
- ATP is improving orthopedic care. For example, a new bioabsorbable polymer derived from tyrosine for medical implants does not adversely affect tissue or bone or emit toxic substances when it degrades and eliminates the need for a second surgical removal.

Telemedicine

- ATP is turning telemedicine into reality and making healthcare more accessible to rural populations. For example, new technology gives rural patients access to a board certified radiologist 24 hours a day, 7 days a week, and, reduced time to transmit and interpret radiology reports from 10 hours to 15 minutes; and, reduced the number of transfers and repeat exams.

Homeland Security

- ATP's investment in homeland security-related projects covers all critical areas: Critical Physical Infrastructure, Surveillance and Intelligence, Technologies for Incident Response, Biometrics, Chemical/Biological/Radiological/Nuclear Exposure, and Critical Infrastructure Protection/Cyber Security. One project, for example, is developing large-area digital X-ray inspection systems with heretofore-unavailable accuracy for near error-free screening of cargo and sealed container freight at airports, seaports, and other points of entry.

Funds Needed to Restore ATP in FY2006

To continue its work, ATP would need $150 million in FY2006. This would include $60.7 million for new awards, funding of FY 2006 mortgages resulting from all prior-year awards, and intramural funding of $13.3 million for the NIST Laboratories. This is important for the following reasons:

- Seizing the technological high ground is key to U.S. manufacturing competitiveness.
    - Full restoration of ATP is needed to help the United States transform manufacturing with highly efficient value-added processes thereby buttressing against the loss of traditional manufacturing jobs in the U.S., resulting in-part from the lower foreign labor costs.
    - Investing in technologies that have the potential to spawn many new industries, and create and sustain high-quality jobs, will provide widespread economic benefit in the coming decades.
    - Three out of four of the small companies in the first 100 completed projects have doubled in size since ATP funding.
- Funding ATP research has and will continue to result in award-winning technological advances impacting entire industries and helping to address some of the Nation's most pressing national needs in areas such as healthcare, energy, environment, and homeland security.

6252 Preston Ave., Livermore, CA 94551
183 Northpointe Blvd., Suite 700, Freeport, PA 16229

May 20, 2005

The Hon. Thomas Carper
Member, Committee on Homeland
Security and Government Affairs
United States Senate
Washington, DC 20510

The Hon. Carl Levin
Member, Committee on Homeland
Security and Government Affairs
United States Senate
Washington, DC 20510

Dear Sen. Carper and Sen. Levin,

As an entrepreneur and founder of a high-tech start-up I want to thank you for your support for the Advanced Technology Program (ATP) and for your efforts to speak on the program's behalf at the upcoming Subcommittee on Federal Financial Management, Government Information, and International Security oversight hearing entitled, "An Assessment of Federal Funding for Private Research and Development.". My company, RAPT Industries, was a recipient of an ATP award (2003-2005). RAPT is developing a revolutionary new process for manufacturing precision optics. ATP has played a critical role in our success, funding our technology development when NO OTHER source of commercial funding was available.

As you know, the ATP has supported the development and commercialization of new technologies through a system of highly competitive grants, 3/4ths of which go to small businesses. The program has always had its critics, principally within the community of libertarian economists whose complaints run the gambit from "corporate welfare" to "unnecessary intrusion of the government in the private sector".

It is easy to understand their scorn. If you work in a think tank inside the Beltway, the landscape of technology commercialization in the United States probably looks quite simple. Markets function with perfect efficiency, new technologies are recognized while in the laboratory, and commercialization is funded by large corporations or by heroic venture capitalists with a vision for the economy of the future. From this perspective, ATP has no place.

However outside the Beltway things are not so simple. The United States is blessed with the most prolific and productive R&D base anywhere in history. However a shocking number of new innovations DO NOT SEE THE LIGHT OF COMMERCIALIZATION FOR YEARS – mostly because the chasm that exists between science and technology as it is developed in the nation's universities, government laboratories and corporate R&D centers, and the frontier of commercialization and business creation.

Crossing this chasm is the most challenging and risky stage for the growth of a new company and a new industry. Ironically, this chasm does not efficiently winnow the few good ideas from the pack. Rather, crossing the chasm is mostly a function of luck, with money and perseverance also required. As one seasoned entrepreneur told me: very few

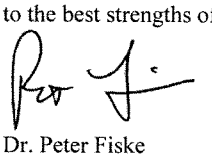
companies die because of their technology, most die because they don't have the money to get to the other side of the chasm.

As a scientist, entrepreneur and founder of a small technology company that has received funding from private investors, government grants and the ATP, the reality on the ground is not as tidy as the think-tank economists would have you believe. Private sector investment in technology commercialization has a mixed record: only 1 in 10 venture-funded companies ever end up making much money for their investors. And private sector investment is focused on a few very specific markets – those that promise the most rapid growth and the possibility for cash-out. And let's not forget the spectacular herd mentality that can sometime seize the investment community: remember the Dot.com bubble and the Telecoms bubble? Corporate R&D spending has a similar mixed record: companies often fail to recognize the emergence of a disruptive technology and spend billions squeezing incremental performance improvement from the existing technology they use.

Technology commercialization is HARD. It is also CRITICAL to the growth and economic competitiveness of the United States. For those of us out here in the trenches, the ATP is a vital source of support. ATP is unique in that it specifically focuses on helping bridge the chasm from the lab to the marketplace. Unlike the much larger SBIR programs that are run in many agencies, ATP provides stable and market-oriented support for small companies as they cross the chasm. Unlike the private sector, ATP invests in new technologies and new companies at a stage when the venture community would still turn up their nose. And let's not forget that venture capital is concentrated in only a handful of major metropolitan centers in the US.

Perhaps more importantly, the ATP is a beacon for scientists and would-be entrepreneurs that directs their attention to the value of technology commercialization. Whether or not an applicant company succeeds in winning a coveted ATP grant, the application and review process provides insightful and trenchant feedback for a company's commercialization plans at a critical early stage in the life of a new company.

As a nation we can choose to confront the forces of globalization through productivity-enhancing innovation and entrepreneurship or compete on the basis of low wages and lowered environmental and health standards. ATP is a small but valuable tool that plays to the best strengths of the US economy. Let's not lose it.



Dr. Peter Fiske
Co-founder – RAPT Industries, Inc.
Livermore, CA and Freeport, PA

USACA

UNITED STATES ADVANCED CERAMICS ASSOCIATION

April 27, 2005

The Honorable Senator Paul Sarbanes
United States Senate
Washington, DC 20510

Dear Senator Sarbanes,

As the Budget Committee moves to Conference on H. Con. Res. 95, the members of the United States Advanced Ceramics Association (USACA) request the Senate Conferees to incorporate the amendment introduced by Senator Levin (amendment 238) for the Advanced Technology Program (ATP) of the National Institute of Standards and Technology (NIST) in its entirety into the Budget Resolution. The amendment called for a funding level of $142.3 million.

The Committee is to be commended for the wise investment in the Advanced Technology Program last year. ATP helps create new jobs via funding of high-risk, high payoff projects from all technology areas. ATP creates a bridge between small, medium and large sized companies, research labs and the market place. To date, ATP has provided funding to participating organizations located in 44 states and the District of Columbia in advanced materials, biotechnology, electronics, energy, environmental and hydrogen technologies, imaging, nanotechnology, optics, photonics, and semiconductor technologies. Federal dollars are leveraged with private sector funds to support research and development of cutting-edge technologies with commercial potential and societal benefits.

The members of USACA consider advanced ceramics technologies, one of the areas funded through ATP, as integral to key US defense and energy systems. Its membership is comprised of corporate interests from the manufacturing sector and ranges from the largest U.S. industrial companies to smaller corporations dedicated solely to the manufacture of advanced ceramics products. The members of USACA believe that the NIST ATP is a unique and successful federal program driving American business and technology growth and should be funded.

On behalf of the members of the United States Advanced Ceramics Association, thank you for your consideration of this request.

Sincerely,

Jeff Serfass
Executive Director
US Advanced Ceramics Association

cc: Senator Carl Levin

www.altarum.org
Office of the President

May 26, 2005

The Honorable Carl Levin
Ranking Member
Senate Committee on Armed Services
SR228 Russell Senate office Building
Washington, DC 20510

Dear Senator Levin:

I am writing to express my strongest possible support for the continuation of the ATP program which I understand is now faced with a threat to its funding.

As a former Vice President of Research at General Motors, and the current CEO of the nonprofit Altarum Institute, I can speak with authority on the critical role programs like ATP play in moving promising technologies off "the bench" and into the marketplace where they can make a valuable and lasting contribution to our nation's competitiveness and the quality of life of our citizens.

Some of the most promising technologies often languish for lack of the bridge funding needed to help them cross this divide from demonstration to market. I have seen the value of the ATP program in providing such critical bridge assistance and I strongly encourage you and your Senate colleagues to do all that you can to restore funding to this vital program.

Thank you for your leadership on this matter and do no hesitate to contact me should you think there is anything else I can do to assist you in your efforts.

Sincerely,

Kenneth R. Baker
President and CEO

3520 Green Court, Suite 300, Ann Arbor, MI 48105-1579 • P.O. Box 134001, Ann Arbor, MI 48113-4001 • (734) 302-5602 • fax (734) 302-4996

Coherix
3980 Ranchero Drive · Ann Arbor, MI 48108

May 25, 2005

Dear Senator Levin,

During the 90s, I served as Chairman of the Auto Body Consortium headquartered in Michigan. We submitted a proposal and won an NIST ATP competition to reduce manufacturing variation in the manufacturing of auto bodies. The project was called the 2 Millimeter Program.

The results of this University/Industry/Government collaboration were remarkable. We significantly improved quality while lowering cost and shortening the time required to bring new models to market. Water leaks, rattles, wind noise and many other customer annoying problems were eliminated.

A NIST GCR 03-856-1 report entitled "CLOSING THE COMPETITIVE GAP: A Retrospective Analysis of the ATP 2mm Project, details the economic impact of this project. To Summarize, this $5 million investment by the government resulted in a growth in GDP of $600 million and the full-time equivalent jobs is almost 10,000.

The bottom line is the NIST ATP is the only government program designed specifically to facilitate such University/Industry/Government collaboration to increase global competitiveness of America's industry. We proved through teaming of America's Universities, Industry and Government we can capitalize on the $Billions we are spending on University Research by suppliers rapidly innovating products to infuse into America's major corporations to thwart foreign competition.

Who benefits from this type of collaboration? First customers benefit. Recently I purchased a Cadillac STS. This Michigan built vehicle ranks very high in the JD Powers quality surveys. I have been a supplier to Toyota in Japan since 1971 and can tell you this vehicle is as good if not better than any Toyota built today.

Second, you might ask GM CEO Rick Waggoner or Gary Cowger Group VP GM Global Manufacturing what contribution the NIST ATP 2 Millimeter Program had on the quality of GM Cars and Trucks. They are both very knowledgeable of the project.

Third, suppliers benefited from the enhancements in technology brought about from the research funded by the NIST ATP funding. Fourth, Universities benefit from seeing their research results actually being implemented and benefiting society. The educational benefits to the students were also significant. Many found good jobs working for the companies that got to know them during the project.

Who received the $5 million funding? In the case of the Auto Body Consortium 2 Millimeter Project ALL of the funding went to the Universities to fund research. Industry provided engineers, equipment and facilities. Industry received NO NIST ATP FUNDING!!

What could we do next if NIST ATP funding was available? The Auto Body Consortium 2 Millimeter Project changed the way auto bodies are manufactured in America and today our quality is competitive. We are now discussing with the domestic auto industry a similar collaboration for changing the way Engines, Transmission, and Chassis subsystems are manufactured (As example; one Detroit auto maker spends $1.2 Billion annually on transmission warranty). Industry recognizes the success of the previous NIST ATP projects. Our Universities are also excited about another successful project. We are ready to proceed; however, we need the NIST ATP.

I don't know how other states are using NIST ATP to enhance global competitiveness of their industries; however, in Michigan we have seen tremendous success with NIST ATP. I would welcome the opportunity to meet with any members of congress who are interested in learning of my first hand experience with the NIST ATP.

Dwight Carlson
Chairman, CEO
Coherix, Inc.
dwightc@coherix.com
734 922 4061

T/J Technologies Inc.
3850 Research Park Drive, Suite A
P.O. Box 2150
Ann Arbor, MI 48106
734-213-1637/ FAX: 734-213-3758

Senator Carl Levin
269 Russell Office Building
United States Senate
Washington, DC
20510-2203

29 May 05

Dear Senator Levin-

We at TJ Technologies recently became aware that usefulness of the Department of Commerce National Institute of Standards and Testing Advanced Technology Program (NIST ATP) is again being questioned. As a small business that is now significantly contributing to this country's war on terror, country's space exploration program, and to the global automotive industry because of technologies we developed and demonstrated under our two ATP contracts, we at T/J Technologies fully understand and appreciate the contributions of the ATP to U.S. small technology businesses.

NIST awarded TJ two high risk, early stage materials technology development and demonstration contracts. One contract was for the development and demonstration of high performance, affordable materials for advanced lithium-ion batteries, the other for the development and demonstration of advanced, high performance materials for direct methanol fuel cells. Upon successful completion of both contracts, we were awarded advanced stored energy research and development contracts from the Department of Defense, NASA, and global automakers. Because of our business success, we were recently named one of Michigan's "50 Companies To Watch".

Without these programs, TJ Technologies would not be a leader in the development of advanced lithium-ion batteries and JP-8 powered PEM fuel cells for ground vehicle, space vehicle, air vehicle and air launched weapon applications.

I certainly hope that the NIST Advanced Technology program will be allowed to continue to select and nurture technologies that other government agencies and the investment community deem as too high risk. We are proof that this program works.

Sincerely,

James Chew
Chief Strategy Officer

Office of the President

May 27, 2005

The Honorable Senator Carl Levin
269 RUSSELL SENATE OFFICE BUILDING
WASHINGTON DC 20510

Dear Senator Levin,

As President of the world's leading nanotechnology company, I'm writing about a very important program that is currently at risk of being under-funded: the NIST Advanced Technology Program (ATP).

I've never been a big supporter of government spending on R&D funding — for any industry. I subscribe to the philosophy that private industry's role is to bring about innovation based on market drivers. While some mistakenly characterize the NIST-ATP as corporate welfare, I'll attest to the fact that the NIST-ATP fulfills a vital role in bringing the promise of nanotechnology to the American people.

Zyvex's NIST-ATP involves a partnership between the University of Texas at Dallas, the University of Virginia, Rensselaer Polytechnic Institute, and Honeywell, Inc. This program is a prime example of how a small, innovative nanotechnology company, partnering with key universities and businesses, can revolutionize the manufacturing industry by developing and commercializing microassembly and nanotechnology. And, Zyvex is a real-world example of a small business that is leveraging this program to commercialize nanotechnology — today. We are creating new markets and new jobs.

These nanomanufacturing technologies will not only allow the United States to regain the lead in this crucial global industry, they will also substantially stimulate our economy by enabling the U.S. to manufacture goods and services at a fraction of their current cost. I am enclosing some materials that describe the impact and importance of the NIST-ATP to our nation, specifically in regards to the acceleration of nanotechnology.

It's no surprise that America leads the world in technological innovation. Much of our leadership position and the jobs generated for Americans can be directly attributable to elected officials such as yourself, and American programs like NIST. In return, NIST fulfills a vital role in bringing the promise of nanotechnology to the American people.

1321 North Plano Road Richardson, Texas 75081
tel: 972 235 7881 fax: 972 235 7882 www.zyvex.com

As anyone who knows me will attest, I'm known for profitably growing companies, not wasting money. NIST is our business partner, not simply an organization that gives us money. We jointly share the cost and responsibility of bringing this new technology to the marketplace.

There is no doubt that the NIST-ATP bridges the funding gap in products and technologies that have public and private benefits with a five-to-ten year time to market. It's the ATP's cost-share structure that also serves as a model framework where government, universities, and industry can develop advanced technologies to meet our nation's challenges.

Without the ATP, nanotechnology products that can provide new defense capabilities, energy independence, job stimulation, and health benefits will share an uncertain future. Some of these products are currently five-to-ten years away from commercialization. Do we want to concede these technologies, and their benefits, to countries like Taiwan, Japan, and China — countries known for their abundance of cheap, educated labor and patience in investment horizons?

As you know, nanotechnology is a long-term solution for ensuring the United States' position as a leader: in the war on terrorism; solving pressing medical problems targeted to particular ailments; reaping the benefits of our research into the human genome project; and re-establishing the United States as a leader in manufacturing—creating thousands of new jobs and increasing the prosperity of the American people.

As I stated in my recent congressional testimony to the U.S. House of Representatives' Science Committee, I've grown increasingly wary as I travel all over the world and see how aggressive countries such as China, Taiwan, Japan, and the European Community are funding initiatives very similar to NIST. I ask myself what kind of economic opportunities our children will have if the United States loses its industrial competitiveness to other countries if we decrease the NIST-ATP's budget.

Many people will argue that with the War, these cuts are necessary. I ask how we can continue to fight a war on terrorism without developing the critical technology that is needed in the next decade. We're not only at war with terrorism, we are in the midst of a significant worldwide battle for technical prowess to sustain and increase our technological leadership in the world-the greatest economic battle of our lifetime.

Anything but increasing NIST-ATP's funding is surrendering our economic prosperity and giving up on our promise to our children — a promise for a higher quality of life. Your continued support and leadership of the NIST-ATP will ensure our future technological leadership position.

Thank you in advance for your assistance in this critical endeavor.

Sincerely,

Thomas A. Cellucci, Ph.D., MBA

FAWWAZ T. ULABY
VICE PRESIDENT FOR RESEARCH

THE UNIVERSITY OF MICHIGAN

4080 FLEMING BUILDING
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734 764-1185 FAX 734 763-0085
ulaby@umich.edu

May 26, 2005

The Honorable Carl Levin
459 Russell Senate Office Building
Washington, D.C. 20510

Dear Senator Levin:

I am writing to provide the University of Michigan's strongest endorsement of the National Institute of Standards and Technology's (NIST) Advanced Technology Program or ATP. The U-M has been a research partner to companies participating in the ATP since NIST began funding these projects in 1990. In fact, the U-M was a key research partner in an early, preeminently successful, ATP project, the Auto Body Consortium.

The goal of the Auto Body Consortium project was to determine ways to minimize the variation in the manufacturing assembly process of U.S. automobiles. At the time of the project award, Toyota's auto body variations following final assembly were superior to American-made vehicles (less than or equal to 2 mm). The Auto Body Consortium, with General Motors and Chrysler in the lead, and the U-M and other automotive suppliers as partners, was able to develop processes and tools that achieved auto body assembly tolerances that matched or exceeded those of Toyota. U-M faculty and students were critical in this development.

The Auto Body Consortium is just one example of the power of the NIST ATP in bringing diverse companies and research organizations together. The Auto Body Consortium would never have been formed; original equipment manufacturers (OEMs), their suppliers, and academia would never have joined forces if not for the NIST ATP. In essence, the NIST ATP is a unique government-industry partnership that assists companies in accelerating the development of high-risk enabling technologies that can lead to new products or more competitive processes. The U-M has partnered with numerous companies (Michigan companies and otherwise) on over fifteen ATP projects since the program's inception.

The NIST Advance Technology Program has been, and continues to be, one of the more effective federal programs that combines U.S. university research expertise with the needs and expertise of U.S. industry. The results of its projects bear directly on U.S. competitiveness. We at the University of Michigan strongly endorse the continued support of the NIST Advanced Technology Program.

Sincerely,

Fawwaz T. Ulaby

FTU/jcr

May 2, 2005

The Hon. Frank Wolf
Chairman
Subcommittee on Science, State, Justice, Commerce and
Related Agencies
House Committee on Appropriations
H - 309
The Capitol
Washington, DC 20515 - 6017

Dear Chairman Wolf;

The undersigned companies, associations, universities and colleges and professional societies write to you on behalf of more than one million scientists and engineers, and 90 percent of America's industrial capacity. We urge Congress to increase investment in the National Institute of Standards and Technology (NIST) — which is vital to our industrial innovation, global competitiveness, and national security — by at least 7 percent overall from its FY 2005 level of funding, i.e. from $695.3 million to $744 million.

Under the Administration's FY 2006 request, overall NIST funding has been slashed by 23.5%, or $163.4 million to only $532 million. While not a large agency, ongoing damage to NIST must be seen as part of a larger pattern of erosion of U.S. scientific talent and capability.

It is vitally important that we understand the causal link between federal investment in our innovation infrastructure, and the ensuing benefits which result from this investment. In particular, we ask your support for the following NIST Programs:

1. NIST Laboratories

The world-leading standards and measurement work carried on by NIST for a century underlies every test or experiment carried out in industry and higher education and provides the foundation for U.S. quality control, innovation and competitiveness. Any list of specific applications is lengthy and impressive. A cursory glance of essential programs would include: building and fire codes (including smoke detector sensitivity standards which have prevented many fire-related deaths every year); dealing with the terrorist threat; bullet-proof body armor; precision machining and semiconductor manufacturing; nanotechnology; cyber security; health care quality; voting technology; new fuel composition technologies; and the energy efficiency of appliances.

The NIST Labs appropriation from Congress provides a foundation for NIST laboratories to conduct critical, and compensated, work on behalf of numerous other Executive Branch agencies like the Department of Homeland Security, the U.S. Department of Energy, the Department of Defense, EPA, etc.

Many independent studies show that every dollar invested in NIST measurement and standards programs returns at least three dollars in national economic benefits. In the last few years, NIST scientists have garnered two Nobel prizes in physics, yet the cuts in the FY '06 budget guarantee risk a significant reduction in force because the President's budget proposal does not include sufficient funds for other NIST priority programs.

We support the Administration's request to provide $420.6 million for NIST's laboratory programs. Unfortunately, as recent Congressional hearings have demonstrated, it is unclear how much of this amount will actually go toward NIST Labs programs and how much will be needed to shut down the Advanced Technology Program (ATP) which is scheduled for elimination. Finally, a 12.7 % increase in NIST Labs' budget will only partly compensate for damaging cuts which occurred two years ago.

2. Manufacturing Extension Partnership (MEP):

We oppose slashing the MEP Program, which would be cut 56.5% from $107.5 million to $46.8 million. Instead, we request Congressional support for MEP of at least $115 million. This would enable MEP to conduct activities at last year's level, plus an additional 7 percent increase of $ 8 million to cope with inflationary increases and enable the same level of effort from FY '05.

The MEP is a nationwide network of centers that supports centers that provide hands-on technical and business assistance to smaller manufacturers. Working through not-for-profit managed centers, the Centers are funded by federal, state, local and private resources to serve manufacturers. That makes it possible for even the smallest firms to tap into the expertise of knowledgeable manufacturing and business specialists all over the U.S.

Centers often help small firms overcome barriers in locating and obtaining private-sector resources. MEP has assisted over 149,000 firms to date. In a survey of NIST MEP clients served from October 2002 through September 2003, 4,865 companies around the country reported that as a result of NIST MEP services, they: **created or retained 50,000 jobs; increased sales by $1.5 billion; retained another $2.6 billion in sales; and invested $912 million in modernization**.

As American manufacturing stagnates and U.S. manufacturing jobs continue to flow overseas (more than 2.3 million in the past three years alone), Congress should fund MEP at a minimal level to help our manufacturing sector remain competitive.

3. Advanced Technology Program (ATP)

NIST's Advanced Technology Program (ATP) has been one of the most successful of all federal R&D programs. ATP bridges the gap between the lone researcher with a break-through idea, the entrepreneur, the research lab and the market place.

ATP creates new jobs and helps struggling small companies survive their perilous journey through the "valley of death," i.e. the period between invention and proof of concept of a technology, and the actual financing, development and commercialization of the technology. ATP has awarded 709 project grants from a universe of more than 5,200 deserving applications over the past decade.

We can only conjecture what potential inventions and technologies were passed over by ATP's dedicated staff due to budget restraints. We will never know for sure what patents were lost and what industries of the 21st Century could have enjoyed a U.S. base of operations but for "budgetary savings" that short-changed ATP, our economy and our workforce during the last Recession.

Out of 709 projects selected by the ATP since its inception, well over half of the projects included one or more universities as subcontractors or joint-venture members. Seventy-nine percent of all single-company awards are won by small firms, and half of all joint ventures are led by small or medium-sized companies. The ATP is the most thoroughly reviewed federal R&D program -- and it has held up to the scrutiny. A National Academies of Science panel headed by Intel co-founder Gordon Moore (of "Moore's Law" renown) found as follows: "The ATP is an effective federal partnership program ... [I]t appears to have been successful in achieving its core objective, that is, enabling or facilitating private-sector R&D projects ... where social returns are likely to exceed private returns to private investors."

We request that ATP be funded at the level recommended in the Senate Budget Resolution adopted in March 23 of this year: $142.3 million.

4. Baldrige Quality Award

Also not to be overlooked are the Baldrige Quality Award – we support the Administration request to increase its funding by 4.9% to $5.7 million from $5.4 million. This small sum is matched by about 20 times that effort in industry — and each year thousands of organizations use the Baldrige criteria to improve their own performance standards. A hypothetical portfolio of the stocks of Baldrige award-winners has outperformed the S&P 500 Index in 9 years out of 10, and by margins of up to 6:1. How many federal programs far surpass original expectations?

Conclusion

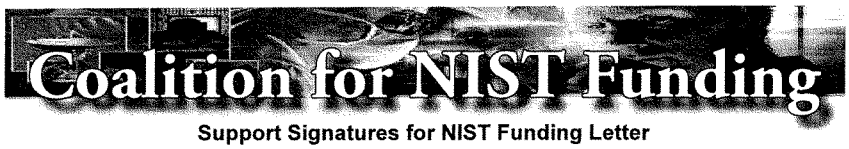
NIST is a vital agency whose work to make American industry the most efficient and productive in the world should be promoted, not cut back.

Deep cuts in NIST's budget are totally inappropriate at a time when America's foreign competitors are closing in on us with a wide array of technologies and strategies. With our innovation "ecosystems" being challenged worldwide on virtually all fronts, America cannot afford to short-change NIST and our nation's innovation future.

Sincerely,

The Undersigned

(Please see attached listing current as of May 2, 2005)



Support Signatures for NIST Funding Letter
May 2, 2005
Bolded Entry indicates Endorsing Organization or Individual

Kellie Johnson
President
ACE Clearwater Enterprises
Torrance, CA

Gunther Baubock
VP, Development and Storage Business
Advanced MicroSensors, Inc.
Shrewsbury, MA

Matthew Dugas
Advanced Research Corporation
White Bear Lake, MN

American Chemical Society
Washington, DC

American Dental Association
Washington, DC

American Dental Research Association
Washington, DC

Dr. Peter S. Unger, President
American Association for Laboratory Accreditation
(A2LA)
Frederick, MD

AMT - The Association for Manufacturing Technology
McLean, VA

Kurt R. Klimpel, Ph.D.
President and COO
Aqua Bounty Pacific, Inc.
San Diego, CA

Dr. Mary Low Good
ASTRA, The Alliance for Science & Technology Research in America
Washington, DC

John Yochelson
President
BEST (Building Engineering and Science Talent)
San Diego, CA

Stanley Satz, Ph.D.
President
Bio-Nucleonics Pharma, Inc.
Miami, FL

Roger Cochetti
Group Director
CompTIA
Arlington, VA

Debra Waggoner
Director, Public Policy
Corning Incorporated
Washington DC

Dean Kristina Johnson
Pratt School of Engineering
Duke University
Durham, NC

Nancy M. Bacon
Senior Vice President
Energy Conversion Devices, Inc.
Rochester Hills, MI

David Ephron
R&D Consultant
Portland, OR

Federation of Materials Societies
Washington, DC

Rick Jackson
Executive Director
FIATECH
Bethesda, MD

Russ Fleming
Arab, Alabama

Dr. F. M. Scherer
Harvard University Emeritus
Cambridge, MA

Hewlett-Packard
Palo Alto, CA

IEEE-USA
Washington, DC

Amy Salzhauer
Partner
Ignition Ventures
Cambridge, MA

Innovation is America's Economic Heartbeat

Don't Flat Line our Future!

Clay Campbell
System Administrator
INCOGEN Inc.
Williamsburg VA

Industrial Research Institute
Arlilngton, VA

Infineon Technologies
Washington, DC

Information Technology Association of America
Rosslyn, VA

Intel Corporation
San Clara, CA

David W. Bergman, CAE
Vice President, Standards, Technology and International Relations
IPC — Association Connecting Electronic Industries
Bannockburn, IL

G. Groot Gregory
Vice President
Lambda Research Corporation
Littleton MA

Arnold H. Kritz
Professor of Physics
Lehigh University
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Lucent Technologies
Murry Hill, NJ

National Association of Manufacturers
Washington, DC

Rebecca R. Taylor
Senior Vice President
National Center for Manufacturing Sciences (NCMS)
Ann Arbor, MI

James Fraine
CEO/President
Neocera, Inc.
Beltsville, MD

John Myers
Vice President of Development
NVE Corporation
Eden Prairie, MN

Ohio Aerospace Institute
Cleveland, Ohio

Optical Society of America
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Arpad A. Bergh
President
Optoelectronics Industry Development Association (OIDA)
Washington, DC

Mitchell M. Rohde, Ph.D.
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Quantum Signal LLC
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Revivicor Inc
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Tom Tillett
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Innovation is America's Economic Heartbeat

Don't Flat Line our Future!

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Why Increase NIST Funding, and Why Now?

The **National Institute of Standards and Technology (NIST)** is a crown jewel of U.S. scientific achievement and publicly-funded science. Founded in 1901 as the National Bureau of Standards, NIST is administered as a part of the U.S. Department of Commerce's Technology Administration. NIST is an essential part of a now-deteriorating federal scientific infrastructure.

A decade-long failure to adequately fund basic scientific research for the physical sciences and engineering has already had dire consequences for U.S. job creation, competitiveness, and our national security. A recent Benchmarking Study by the **Task Force on the Future of American Innovation** (see www.futureofinnovation.org) details the effects of long neglect of America's basic research infrastructure, of which NIST is a key component.

NIST programs play a critical, if unappreciated, role in the health of the underlying basic scientific research necessary to remain competitive in the robust and globally competitive 21st Century Economy.

U.S. Industry & Science Need a Healthy National Institute of Standards and Technology

Massive cuts in the NIST Budget in FY '06 have been proposed to help balance the federal budget. Specifically, the Administration's FY '06 Budget for NIST calls for cutting $163.4 million from the agency — a 23.5% decrease overall.

Four critical NIST programs have been allowed to languish over the past decade, each of which has tremendous impact on U.S. job creation, innovation, and scientific progress, as detailed below.

NIST Laboratories — From Nobel Laureates to Layoffs?

The NIST laboratories play an important, niche-role in today's complex technology-driven economy. Industry relies on the NIST labs for measurements and standards that no one else can provide. We need NIST's measurements and standards capacity so that we can make and improve products and services. For example: measuring and manufacturing nano-sized scale materials and devices; developing new and secure information and communications technologies that work together easily; improving the efficiency and quality of U.S. manufacturing; and enhancing homeland security.

The labs cover practically every area of science and technology. Their work is carried out by a relatively small but very talented team of researchers – **who have garnered two Nobel Prizes in Physics and a MacArthur "Genius Award" in just the past eight years.** The impact of the NIST labs' work is documented in dozens of economic studies showing an enormous return on investment: every dollar invested in NIST labs returns at least three dollars in economic benefits to the nation. Too often, because of their relatively small size, their location in the Commerce Department, and the "nuts and bolts" infrastructural role that the labs play, they are overlooked when R&D budgets are set.

While NIST Labs would ostensibly receive an increase in their FY '06 funding under the President's proposal, the increase is illusory: most of these monies will be devoted to catching up with past shortfalls within the Labs budgets or accounting for NIST Program terminations or reductions, like the ATP and MEP Programs.

NIST's Manufacturing Extension Partnership (MEP) Program

The MEP is a nationwide network of centers that supports centers that provide hands-on technical and business assistance to smaller manufacturers. Working through not-for-profit managed centers, the Centers

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are funded by federal, state, local and private resources to serve manufacturers. That makes it possible for even the smallest firms to tap into the expertise of knowledgeable manufacturing and business specialists all over the U.S.

These specialists are people who have had experience on manufacturing floors and in plant operations. Each center works directly with area manufacturers to provide expertise and services tailored to their most critical needs, which range from process improvements and worker training to business practices and applications of information technology. Solutions are offered through a combination of direct assistance from center staff and outside consultants.

Centers often help small firms overcome barriers in locating and obtaining private-sector resources. MEP has assisted over 149,000 firms to date. In a survey of NIST MEP clients served from October 2002 through September 2003, 4,865 companies around the country reported that as a result of NIST MEP services, they: **created or retained 50,000 jobs; increased sales by $1.5 billion; retained another $2.6 billion in sales; and invested $912 million in modernization.**

In 2003, the MEP was sliced by two-thirds despite support by more than 300 Members of Congress who spoke up too late. In 2004, it was saved at the last minute and received about $108 million. Now, the Administration proposes slashing it to about $45 million per year.

Creating New Jobs & Industries: The Advanced Technology Program (ATP): A World-Emulated Program Bridging the Gap Between Invention and Innovation

NIST's **Advanced Technology Program** (ATP) has been one of the most successful of all federal R&D programs. ATP bridges the gap between the lone researcher with a break-through idea, the entrepreneur, the research lab and the market place. ATP creates new jobs and helps struggling small companies survive their perilous journey through the so-called "valley of death," i.e. the period between invention and proof of concept of a technology, and the actual financing, development and commercialization of the technology. ATP has awarded 709 project grants from a universe of more than 5,200 deserving applications over the past decade.

Out of 709 projects selected by the ATP since its inception, well over half of the projects included one or more universities as subcontractors or joint-venture members. Seventy-nine percent of all single-company awards are won by small firms, and half of all joint ventures are led by small or medium-sized companies. The ATP is the most thoroughly reviewed federal R&D program -- and it has held up to the scrutiny. A National Academies *of Science panel headed by Intel co-founder Gordon Moore (of "Moore's Law" renown) found as follows: **"The ATP is an effective federal partnership program ... [i]t appears to have been successful in achieving its core objective, that is, enabling or facilitating private-sector R&D projects ... where social returns are likely to exceed private returns to private investors."***

NIST's Malcolm Baldrige National Quality Award Program is a Huge Success ...

... that costs almost nothing — a mere $5 million or so, matched by 20 times that effort in industry — and each year thousands of companies use the Baldrige criteria to improve their performance. A hypothetical portfolio of the stocks of award-winners has outperformed the S&P 500 Index in 9 years out of 10, and by margins of up to 6:1. How many federal programs far surpass original expectations?

Q: What Can Congress do to Help Restore Discovery, Job Creation & Competitiveness Through NIST?

A: INCREASE NIST FUNDING!

Core Findings and Recommendations

The National Academies Committee on Government-Industry Partnerships
Review of ATP [1]

1. The Committee finds that the Advanced Technology Program is an effective federal partnership program. The selection criteria applied by the program enable it to meet broad national needs and help ensure that the benefits of successful awards extend across firms and industries. Its cost-shared, industry-driven approach to funding promising new technological opportunities has shown considerable success in advancing technologies that can contribute to important societal goals such as improved health diagnostics (e.g., breast cancer detection), developing tools to exploit the human genome (e.g., colon cancer protection), and improving the efficiency and competitiveness of U.S. manufacturing.[2]
2. The program's peer review of applicants for both technical feasibility and commercial potential supports its goal of helping advance promising new technologies that are unlikely to be funded through the normal operation of the capital markets.[3]
3. The program has set a high standard for assessment involving both internal and independent external review. The quality of this assessment effort lends credence to the program's evaluation of its accomplishments.[4]
4. The extensive assessments of the program show that it appears to have been successful in achieving its core objective, that is, enabling or facilitating private sector R&D

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[1] Text is excerpted from National Research Council, *The Advanced Technology Program: Assessing Outcomes*, Charles W. Wessner, ed., Washington, D.C.: National Academy Press, 2001. These summary findings and recommendations are elaborated and documented below. In addition to the papers and proceedings in this volume, the Committee issued National Research Council, *The Advanced Technology Program: Challenges and Opportunities*, Washington, D.C.: National Academy Press, 1999. The ATP assessment program also provides extensive documentation regarding the contributions of the program. See Annex D in this volume. See also William F. Long, *Advanced Technology Program: Performance of Completed Projects: Status Report Number 1*, NIST Special Publication 950-1, March 1999.

[2] See Section I in this chapter. For a summary of the differentiating characteristics of the ATP, see Maryann Feldman's analysis in Section C of the Introduction and the study by Feldman and Kelley, "Leveraging Research and Development: The Impact of the Advanced Technology Program," both in this volume.

[3] With regard to the ATP selection process see the presentation by former ATP Director, Lura Powell, in the first volume of this study, National Research Council, *The Advanced Technology Program: Challenges and Opportunities*, *op. cit.*, pp. 53-56; with regard to the role of venture capital finance and the need for a bridging mechanism, see the statement by Todd Spener of Charter Financial in the same volume, pp. 90-91, as well as the presentation by Joshua Lerner of the Harvard Business School, pp. 88-90. See also the presentation by venture capitalist David Morgenthaler in Panel I of the Proceedings of this volume and the summary of his statement in Section C of the Introduction to this volume. See also Lewis M. Branscomb and Philip E. Auerswald, *Taking Technical Risks: How Innovators, Managers and Investors Manage Risk in High-Tech Innovation.* Cambridge: MIT Press, 2001, Chapter 5 and *passim.*

[4] See Section I in this chapter and the description of the program, its current results, and the ATP assessment effort by Rosalie Ruegg and the positive review of the assessment program by Irwin Feller of Pennsylvania State University in Panel II in this volume. See also the panel discussion led by Richard Nelson of Columbia University, including the description of the ATP assessment, its early beginnings, and its focus on tools for assessing technology spillovers in National Research Council, *The Advanced Technology Program: Challenges and Opportunities*, *op. cit.*, pp. 71-80.

projects of a type, or in an area, where social returns are likely to exceed private returns to private investors.[5, 6]

5. The Committee does recommend a series of operational improvements designed to make this program more effective and suggests several measures designed to bring the benefits of the ATP to other national initiatives and to state technology programs through enhanced cooperation.[7]

Accomplishments of the Advanced Technology Program

A. Meeting Legislative Goals:

The Advanced Technology Program is achieving the goals ascribed to the program in the Omnibus Trade and Competitiveness Act of 1988. As initially stated, its goals were "to assist U.S. business in creating and applying the generic technology and research results to (1) commercialize significant new scientific discoveries and technologies rapidly and (2) refine manufacturing technologies." (P.L. 100-418). The ATP emphasizes economic growth and advances the competitiveness of U.S. firms

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[5] See, for example, the paper by Maryann Feldman and Maryellen Kelley, "Leveraging Research and Development: The Impact of the Advanced Technology Program," in this volume. The study by Albert N. Link, "Enhanced R&D Efficiency in an ATP-funded Joint Venture," documents the impact of an ATP joint venture designed to reduce the costs and timing required to develop a suite of new technologies for the U.S. printed wiring board industry. The study finds a dramatic effect on R&D efficiency, resulting in cost savings on the order of $35 million while reducing cycle times for new product and process development. The project resulted in productivity improvements for member companies, diffusion of new technology to other producers, and improved competitive positions for and retained employment at participating companies. The study by David Austin and Molly Macauley, "Estimating Future Benefits from ATP Funding of Digital Data Storage," estimates substantial consumer welfare gains from ATP-funded innovations in digital data storage although the final impact is dependent on the adoption of the technologies. Similarly, the paper by Tayler H. Bingham, "Estimating Economic Benefits from ATP Funding of New Medical Technologies," projects substantial social returns, much larger than the projects' private returns, primarily due to the projected positive spillovers to patients treated with new technologies. These technologies focus on the diagnosis and treatment of cancer; the treatment of diabetes, damaged ligaments and tendons; and the transplanting of xenogeneic organs. The overview of the progress of ATP awards by Rosalie Ruegg, "Taking a Step Back: An Early Results Overview of Fifty ATP Awards," documents both commercialization progress and knowledge creation and dissemination. The latter is documented through outside recognition of the project's technical accomplishments, patents filed and granted, patent-tree citations, collaborative relationships, and knowledge disseminated through new products and processes. Ruegg records substantial evidence that benefits are extending well beyond those captured by award recipients. The papers cited above are included in this volume.

[6] For an excellent review of the factors affecting the generation and impact of social returns or spillovers, see Adam B. Jaffe, *Economic Analysis of Research Spillovers: Implications for the Advanced Technology Program,* NIST GCR 97-708, December 1996. For additional ATP-supported research on social benefits, see Edwin Mansfield, *Estimating Social and Private Returns from Innovations Based on the Advanced Technology Program: Problems and Opportunities,* NIST GCR 99-780, January 1996; William F. Long, *Performance of Completed Projects, Status Report Number 1, op. cit.*; Wesley M. Cohen and John Walsh, *R&D Spillovers, Appropriability, and R&D Intensity: A Survey-Based Approach,* Gaithersburg, MD: National Institute of Standards and Technology, Forthcoming; and Michael S. Fogarty, Amit K. Sinha, and Adam B. Jaffe, *ATP and the US Innovation System: A Methodology for Identifying Enabling R&D Spillover Networks with Application to Microelectro-mechanical Systems (MEMS) and Optical Recording,* Gaithersburg, MD: National Institute of Standards and Technology, Forthcoming.

[7] See Sections II and III in this chapter.

by fostering technologies with potentially large net social value for the nation that might not otherwise emerge in time to maximize their competitive value.[8]

B. Supporting Enabling Technologies:

The ATP focuses its support on enabling technologies that face substantial technical barriers yet which also have the potential for broad-based economic benefits. Program goals and examples of technologies illustrating the ATP approach and meeting the program's current operational objectives are:

1. Improved manufacturing efficiency and competitiveness. ATP contributions are illustrated by Extrude Hone's contribution to manufacturing efficiency and the environment and by the successful U.S. Printed Wiring Board consortium.[9] Other contributions include an "ion implantation" technology to reliably process larger, and hence more productive, 300mm wafers economically. The ATP helped fund the development of advance process control (APC) technology for semiconductor production, which increases process consistency and yield.[10] Working with large and small companies, the program also helped develop a novel insulating material to improve performance of computer chips.[11] These innovations should help maintain the exceptionally high historical annual growth in productivity, on the order of 25-30 percent, which characterizes the semiconductor industry.

2. More rapid commercialization of technologies with positive spillovers, such as the mammography diagnostic instrument recently brought to market.[12] Work is also under way to develop miniaturized DNA analyzers designed to increase the speed of research and medical testing for diseases such as HIV, strep infections, or cancer.[13]

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[8] The Introduction to this volume provides the policy context which led to the creation of the ATP and other cooperative programs and summarizes legislation designed to encourage cooperative technology programs. The legislation establishing the ATP is reproduced in Annex A.

[9] For a discussion of the manufacturing and environmental efficiencies made possible by Extrude Hone's advanced manufacturing processes, see the presentation by Larry Rhoades in Panel III of this volume. For a summary of the accomplishments of the PWB consortium see the analysis by Albert Link, "Enhanced R&D Efficiency in an ATP-funded Joint Venture" in this volume.

[10] The APC technology was developed in cooperation with SEMATECH and leading U.S. firms, such as Honeywell, Inc., Advanced Micro Devices, and IBM, among others.

[11] Developed by Texas Instruments and NanoPore, Inc., a small New Mexico-based company, the insulator is called Xerogel, which consists of a highly porous, glass material used as a low dielectric constant insulating layer in integrated circuits. The innovation has led to an estimated twenty patents and patent applications and represents a positive development for U.S. industry.

[12] Recently approved for clinical use by the Food and Drug Administration, the new system represents a significant technological advance in breast cancer detection. It uses a unique amorphous silicon detector that provides high quality imaging which can be digitally enhanced and rapidly verified. A 1995 ATP project awarded to General Electric and EG&G Reticon developed a new manufacturing process that significantly reduced the manufacturing cost of the amorphous-silicon panels used in the new detection system, making this superior detection system more affordable and available to a greater number of women. See http://www.nist.gov/public_affairs/update/upd000410.htm#Health See also footnote 40 in this chapter.

[13] See National Research Council, *The Advanced Technology Program: Challenges and Opportunities*, *op. cit.*, p. 55. Microtechnologies under development offer significant advances in the convenience and speed of DNA

3. Contributing to the development of technologies embodying recent scientific discoveries, such as the award to PPL Therapeutics to develop a way to produce valuable stem cells from adult human cells, possibly creating a non-controversial alternative to the use of embryonic stem cells. Stem cells hold the promise of fighting diseases ranging from heart failure to Parkinson's.[14]

4. Catalyzing and supporting research partnerships between industry on the one hand and U.S. university researchers and federal laboratories, on the other. Through 2000, 176 universities have been involved in the program, participating in over half (56 percent) of the program's 522 projects, either as full participants or subcontractors. Some 50 projects have included federal laboratories. These partnerships help speed the transfer of publicly-funded basic research and expertise to industry.[15]

C. An Exceptional Assessment Effort:

The ATP assessment program has produced one of the most rigorous and intensive efforts of any U.S. technology program. This program has two elements: an in-house effort based at NIST Headquarters and an external effort contracted with the independent National Bureau of Economic Research.[16] The quality, quantity, and analytical range of these studies are impressive. Over 58 case studies and other assessments have been completed; substantial additional work is under way.[17] With regard to this assessment program, several points emerge:

1. It is important to note that these studies, by their very nature, do not endorse every aspect of the program. They do provide valuable insights into the operation and impact of the program.

2. The broad scope of the studies offers insights into the operations of the U.S. innovation system, for example, with respect to early-stage finance of

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analysis. One such company, Affymetrix, has developed chip systems which can detect genetic variations related to HIV, cancer, and drug metabolism. The company has also received a grant from the Human Genome Research Institute.

[14] See Erika Jonietz, "Sourcing Stem Cells: Could New Research End the Embryo Debate?" *Technology Review*, January/February 2001, p. 32.

[15] For an earlier discussion of this point, see the presentation in Panel II by Rosalie Ruegg, Director of the ATP Economic Assessment Office at the time of the conference. The universities most involved in ATP projects include: Stanford University; the University of Michigan, Ann Arbor; the Massachusetts Institute of Technology; Cornell University; Johns Hopkins University; the University of Minnesota; Carnegie Mellon University; Pennsylvania State University; the University of California, Berkeley; and North Carolina State University.

[16] See the discussion of the ATP assessment program in Panel III of National Research Council, *The Advanced Technology Program: Challenges and Opportunities, op. cit.*, pp. 70-82, especially p. 79. This section describes ATP's substantial involvement of outside experts, both in the selection process through peer review, and the valuable input provided from the outset of the program through consultations with leading economists from the National Bureau of Economic Research (NBER), which included important contributions by Professors Zvi Griliches and Edward Mansfield. This collaboration continues under the overall direction of NBER's Adam Jaffe.

[17] See Annex D of this volume for a list of studies commissioned by the ATP Economic Assessment Office.

promising technologies and the impact of the intellectual and economic spillovers derived from the program.[18]

3. These studies are also making a contribution to our understanding of the U.S. innovation system and to the development of methodologies to measure the impact of federal and state technology programs such as the ATP.[19]

4. Few other federal technology programs have embraced this level and intensity of assessment and sought to apply its results as diligently as the ATP.[20]

II. Recommendations to Improve the Program

A. Extend the window for award applications, accelerate the decision-making process for awards, and extend substantially the period in which awards can be made. New, commercially-relevant technologies are often time sensitive. Fixed periods for firms to apply to the program and long delays in notification of awards may reduce the attractiveness of the program, in particular to new, small firms. Faster decision-making also would enhance the value of the debriefing process for unsuccessful firms.[21] This revolving application process will

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[18] National Research Council, *The Advanced Technology Program: Challenges and Opportunities, op. cit.*, pp. 79-80. See also Adam Jaffe, "The Importance of 'Spillovers' in the Policy Mission of the Advanced Technology Program," *Journal of Technology Transfer*, 23(2):11-19, 1997; E. Mansfield, *Estimating Social and Private Returns from Innovations Based on the Advanced Technology Program: Problems and Opportunities, op. cit.*; Wesley M. Cohen and John Walsh, *R&D Spillovers, Appropriability, and R&D Intensity: A Survey-Based Approach, op. cit.*; and D. Mowery, J. E. Oxley, and B. S. Silverman, *Knowledge Spillovers and R&D Joint Ventures*, Gaithersburg, MD: National Institute of Standards and Technology, Forthcoming.

[19] As noted above, an excellent example is the recent work by L. M. Branscomb and P. E. Auerswald, *Taking Technical Risks, op. cit.* Initially sponsored by the ATP, this volume reviews some of the factors affecting early-stage financing and notes a serious gap between the creation of an idea and its realization in a technology that meets market requirements for investors. With regard to interaction with state programs see Marsha R.B. Schachtel and Maryann P. Feldman, *Reinforcing Interactions Between the Advanced Technology Program and State Technology Programs, Volume I: A Guide to State Business Assistance Programs for New Technology Creation and Commercialization*, Washington, D.C.: U.S. Department of Commerce, April 2000.

[20] For example, the SBIR program, currently allocated over $1.2 billion annually, is six times larger than the ATP, yet it has been subject to almost no systemic external assessment, apart from a series of GAO reports and the recently completed National Research Council study, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, Washington, D.C.: National Academy of Press, 2000. Similarly, widely used cooperative research and development agreements (CRADAs) normally have limited assessment mechanisms. These limitations are described by D. Mowery in "Using Cooperative Research and Development Agreements as S&T Indicators: What do We Have and What Would We Like?," a presentation before the National Science Foundation conference, *Workshop on Strategic Research Partnerships*, 13 October 2000, publication of proceedings pending. Some partnership programs have benefited from regular assessment such as the Program for Next Generation Vehicles and the Advanced Battery Consortium. See National Research Council, *Review of the Research Program of the Partnership for a New Generation of Vehicles: Sixth Report*, Washington, D.C.: National Academy Press, 2000, and National Research Council, *Effectiveness of the United States Advanced Battery Consortium as a Government-Industry Partnership*, Washington, D.C.: National Academy Press, 1998.

[21] For a description of program modifications undertaken by the ATP management in the course of this review, see Alan P. Balutis and Barbara Lambis, "The ATP Competition Structure," in this volume.

provide greater opportunity for applicants. It will also give the ATP management earlier and more accurate information concerning the rate of awards than is available under an annual award process.[22]

B. Retain the debriefing process for unsuccessful applicants. Unsuccessful awardees find the debriefing process after an unsuccessful application to the ATP to be valuable even though more than three-fifths of the non-winners do not proceed with any aspect of the R&D project that they proposed to ATP.[23]

C. Concentrate a significant proportion of the awards in selected thematic areas. One of the key features of the ATP is its use of general competitions, which are open to proposals from all areas of technology. The goal of the program is to compensate for market imperfections that result in under-investment in certain types of technologies, a goal that distinguishes it from mission-oriented (and mission-constrained) R&D programs.[24] These general competitions should be maintained. At the same time, they could be usefully supplemented by allocating a proportion of ATP funding in selected thematic areas where the current technological opportunities are particularly promising for broad economic or social benefits. Awards to thematic areas can also be a means of addressing elements of important national missions and of generating synergies between related projects, and among companies, laboratories, and universities in areas of current technological promise. In these cases, the program should attempt to reap the higher returns from realizing complementarities and synergies among projects and R&D-performing institutions.[25]

D. Enhance current efforts to integrate assessment results into the decision process. As noted, the quality of the ATP assessment effort is a major attribute of the program. The integration of the results of the assessments must remain a major goal of the program.[26] The early release of outside assessments to the research community would facilitate the dissemination of the research results.

E. Increase the Nation's Return on the Operation of the Program

1. Maximizing Return: As noted above, the program is achieving its goals.[27] It has a deserved reputation as a program that is well-managed and

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[22] Faster decision making has also been a concern for the SBIR program. The Department of Defense launched a successful initiative known as the Fast Track for firms able to demonstrate the ability to attract third-party finance. See National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative, op. cit., passim.*

[23] See the paper by Maryann P. Feldman and Maryellen R. Kelley, "Leveraging Research and Development: The Impact of the Advanced Technology Program," in this volume.

[24] J. Lerner and C. Kegler, "Evaluating the Small Business Innovation Research Program: A Literature Review," in National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative, op. cit.*, pp. 309-314. For an informed discussion of U.S. technology policy see L. M. Branscomb and R. Florida, "Challenges to Technology Policy in a Changing World Economy," in Branscomb and Keller, *Investing in Innovation, op. cit.*

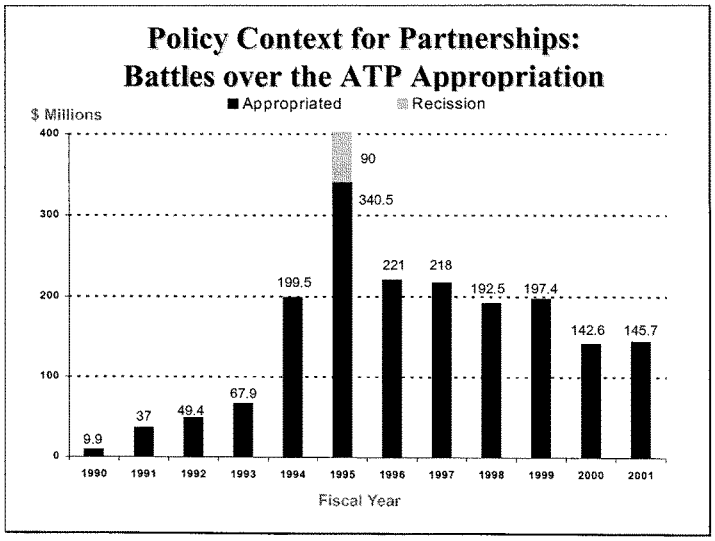
[25] The generation of "social capital" made possible by these awards underscores the role of government finance for technological innovation.

[26] See Panel II, in this volume, where current efforts to integrate evaluation findings are described.

[27] This does not mean that all awards are crowned with success. As would be expected for a high-risk R&D program, a significant portion of the awards do not succeed. This experience strongly parallels the experience

under which awards are fairly awarded.[28] In our view, based on this review of the program, the ATP could use more funding effectively and efficiently, consistent with the goals set for the program. A more predictable funding base would also ensure that the program continues to attract quality proposals, provide flexibility to address new opportunities and ensure the maximum return on existing investments.

2. **Stability for R&D Funding:** In any case, every effort should be made to provide greater stability in the funding of the program. The current instability creates uncertainty for participants and potential applicants about the funding of multi-year program commitments and is particularly difficult for small firms.[29]



of venture-backed investment. For example, one study found that out of a sample of 794 venture capital investments made over three decades, only 22.5 percent ultimately succeeded in going public: see P.A. Gompers, "Optimal investment, monitoring, and the staging of venture capital," *Journal of Finance* 50(5):1461-1489. Concerning program evaluation, see the discussion in Panel II, especially the remarks by Irwin Feller of Pennsylvania State University, in this volume and Panel IV, especially the presentation on "Economic Returns to New Medical Technologies" by Taylor Bingham of the Research Triangle Institute, also in this volume. Concerning program accomplishments (and failures), see the overview provided by Rosalie Ruegg, "Taking a Step Back: An Early Results Overview of Fifty ATP Awards," in this volume.

[28] Feldman and Kelley, "The Case for Government R&D Additionality," *op. cit.* The authors provide evidence that the investment community attaches value to the ATP awards through the highly selective and competitive nature of the award process. A significant percentage of even the non-winners in the selection process found the debriefing process to be helpful suggesting useful guidance for improving the firm's technical and/or business planning was made available.

[29] Roger Noll and Linda Cohen emphasize the need to avoid large swings in annual funding for R&D programs. See *The Technology Pork Barrel*, Washington, D.C.: The Brookings Institution, 1991, p. vii.

F. Continue Focus on Small Business: A significant portion of the program funds (i.e., more than 60 percent) are awarded to small business. This reflects small business's unique capabilities as a source of low-overhead innovation.[30] Notwithstanding this recognition of the innovative capabilities of small business, the diversity of the ATP awards, involving both large and small companies, is an important feature of the program, and should be retained (see G below). The substantial size of the ATP awards, their multi-year disbursement, and the opportunity to collaborate with other institutions (e.g. universities) and larger firms make ATP funding particularly attractive to small firms. The ATP can thus contribute to the development of new technologies that meet its criteria of broad social benefits and enhance returns on the U.S. investment in research.

G. Retain Joint Ventures and Large Company Involvement: The participation of large companies is a unique and valuable characteristic of the ATP.[31] Large companies bring unique resources and capabilities to the development of new technologies and can be valuable partners for technologically innovative companies new to the market.[32] The participation of larger companies can also ensure better access to downstream markets for the small firms with which they collaborate under this program.[33] Accordingly, awards to joint ventures involving large companies

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[30] David B. Audretsch and Roy Thurik, *Innovation, Industry, Evolution, and Employment*, New York: Cambridge University Press, 1999.

[31] Dr. Mary L. Good describes the leverage offered by an ATP award to win internal support for a promising technology at Allied Signal. As Dr. Good describes it, the award fit the conditions associated with ATP (i.e., early technology development, an enabling technology, and collaborative work with universities resulting in the creation of a new material). She adds that the capabilities of a large company (i.e., expensive equipment and experienced technologists) were crucial to the success of the award. L. M. Branscomb et al., *Managing Technical Risk: Understanding Private Sector Decision Making on Early Stage, Technology-based Projects*, NIST GCR 00787, prepared for the Advanced Technology Program, April 2000, p. 42

[32] For a further discussion of this point see C. Hill, "The Advanced Technology Program: Opportunities for Enhancement," in Branscomb and Keller, *Investing in Innovation, op. cit.*, p. 159-160. Hill suggests that because R&D decisions are often decentralized, large firms may operate much like independent, small firms particularly for projects that have high ratios of social to private returns.

[33] The development and marketing of the digitally-enhanced mammography diagnostic instrument (referred to in footnote 19) illustrates the synergy between large and small firms. The substantial marketing advantage of an established firm such as GE means the benefits of this new technology are rapidly and widely distributed. The laboratory manager responsible for developing the mammography diagnostic technology, Dr. Bruce Griffing, states that this promising technological development might well not have occurred in the absence of a government R&D award from the ATP. As noted above, this diagnostic system produces substantially fewer false positives. The lower false positive diagnoses reduce the need for expensive "workups" with the associated health care costs and personal trauma. Over time, the technology has the potential to virtually eliminate costs associated with film storage, retrieval, and transmission. The social benefits or spillovers appear substantial.

The development of this technology also illustrates the impact federal R&D awards can have on decision making in large companies where multiple options, established hurdle rates, and technological and market uncertainties mitigate against even promising technologies. As Dr. Griffing remarked in a recent seminar, "There is a valley of death for new technologies, even in the largest companies." *Between Invention and Innovation: Mapping the Funding for Early Stage Technologies*, Carnegie Conference Center, 25 January 2001, Washington, D.C.

should be retained. The current 60 percent funding requirement for large companies should also be retained; it should not, however, be significantly increased.

H. Coordinate ATP with SBIR: The SBIR and the ATP programs are different in important ways. However, they can be understood as separate steps on a national innovation ladder. In cases where applicants to the ATP do not have sufficiently developed business plans, but do have sound technologies, they might well be remanded *automatically* to an appropriate SBIR program. To the extent their technology has met the requirements of the ATP, SBIR program managers could be assured of the potential of the proposed technology.[34]

III. New Initiatives for the Program

A. Increased Collaboration on National Initiatives

ATP's collaboration with agencies responsible for national initiatives such as the Human Genome should be substantially increased. The Advanced Technology Program has established a "core competency" in its ability to screen, select, monitor, and assess projects of technological and commercial promise. As such, the ATP would be a valuable partner to research agencies and SBIR programs by working with them to develop valuable enabling technologies based on their investments in health and other areas such as environmental remediation.[35]

The National Institutes of Health have shown unparalleled capability in the funding of basic health-related research and have made enormous progress in specific areas such as the sequencing of the human genome. However, NIH investments tend to be focused on the generation and demonstration of new research ideas. The comparative advantage of the ATP is its ability to provide R&D funds to stimulate specific sectors and companies with the potential to develop these new ideas as commercial products and therefore make them available to a much wider group of users. An example of this approach is the ATP support for DNA tools, which is converting research findings into methods, devices, and reagents that actually work.[36] This type of collaboration between the ATP and health researchers should continue and expand.

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[34] To a limited extent, this process already occurs in reverse. Successful applicants to an SBIR program may subsequently apply to the ATP. However, firms that do not qualify in an early stage of their development for an ATP award may well meet the different criteria for an SBIR award. There are cases where firms have progressed from an early SBIR award to an ATP award. See Donna Fossum, et al, *Discovery and Innovation: Federal Research and Development Activities in the Fifty States, District of Columbia, and Puerto Rico,* Science and Technology Policy Institute, MR-1194-OSTP, 2000.

[35] See the statement delivered by Jeffrey Schloss on behalf of Francis Collins, the Director of the National Human Genome Research Institute at the National Institutes of Health, in the first volume of the Committee's review of the ATP. See National Research Council, *The Advanced Technology Program: Challenges and Opportunities, op. cit.,* pp. 56-59.

[36] *Ibid.*, p. 58.

B. Matching Grants by States

1. In some states, firms that receive ATP awards are currently eligible for grants from the state government. The NIST management should establish a regular outreach program to coordinate awards after the review process (or in conjunction) with state development programs.

2. **Matching State Funds:** Consideration should be given to providing matching state funds for ATP awardees.[37] Expanding the ATP's interaction with state programs to support high-technology companies within their borders would have a number of advantages. Making awards in parallel with state governments would:

a) **Increase Certification:** First, parallel awards would increase the certification impact of the ATP award in the local community by raising the firm's profile at the state level. This certification effect can serve to attract private investors by reducing uncertainty concerning the quality and potential commercial applications of the firm's technology.[38]

b) **Leverage Program Funding:** Second, parallel awards might enable the Advanced Technology Program to reduce the size of its base award to individual small business applicants, thereby significantly expanding the reach of the program at no additional cost. In cases where the award size remains constant, the leverage of the award would be significantly and immediately increased by the addition of state funds. Cooperation with state programs would have the additional benefit of aligning the ATP's resources with state efforts, particularly in existing or nascent technological clusters, thereby improving the opportunities for the program and the awardees to reach critical mass.

c) **Expand "Best Practice" Selection:** The ATP has exceptional expertise in the review of technically-sound, commercially-feasible proposals by small independent companies and joint ventures operating with the advantages of large companies (noted above). Care would be required to ensure that an alignment of awards does not compromise the ATP's rigorous selection process. At the same

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[37] The ATP currently refers potential recipients of its funds to state science and technology program offices for technical assistance. See C. Hill, "The Advanced Technology Program: Opportunities for Enhancement," in Branscomb and Keller, *Investing in Innovation, op. cit.*, p. 165. Positive interactions currently take place between state and federal programs such as the ATP. See Marsha R. B. Schachtel and Maryann P. Feldman, *Reinforcing Interactions Between the Advanced Technology Program and State Technology Programs, Volume 1: A Guide to State Business Assistance Programs for New Technology Creation and Commercialization*, NIST GCR 00-78, April 2000.

[38] Feldman and Kelley, *The Case for Government R&D Additionality, op. cit.*, conclude that "winning an ATP award significantly increases the firm's success in attracting additional funds from other sources for R&D activities." Their findings "provide strong evidence that the ATP award confers a halo effect on winners that makes them more likely to attract other funding when compared to non-winners of the same size...with projects of similar business and technical quality."

time, ATP cooperation with state agencies would have the advantage of leveraging the ATP's expertise in selection and assessment, contributing to the quality of the state selection process, and the reach of the NIST-based ATP while preserving the current quality of the ATP selection and assessment program.

The Steering Committee*

* For the Committee membership, see the front matter.

Questions from Senator Coburn
Hearing on "An Assessment of Federal Funding for Private Research and Development

(1) Of the organizations that received grants through the Advanced Technology Program since 1990, what percentage did not seek private funding before requesting grants from ATP? Please provide a list of those organizations as well as a list of projects, and the size of their respective federal grants, associated with each organization.

I believe it would be best to direct this question to NIST for a complete answer. The Academies have not gathered this information.

(2) Of the awards granted through ATP since 1990, what percentage focused on research not already conducted with private funds in the private sector?

It would be best to direct this question to NIST for a complete answer. The question suggests, however, that ATP is conducting research, whereas it in fact funds research in the private sector to be carried out by companies prepared to provide matching funds as a testimony to their commitment to and belief in the commercial value of this research.

(3) Please provide a list and description of every ATP-sponsored project that focused on research that was either in the process of being or already had been conducted with private funds in the private sector.

I believe it would be best to direct this question to NIST. We do not collect this information at the Academies. It is important, however, to keep in mind that many different technologies are explored by many different companies with a wide variety of capabilities and objectives. Because ATP involves a self-initiated application process, it is not possible for ATP managers to know the state of research and development on a given topic among all companies. The objective of the program is to expedite the development of technologies that show the promise of broad social benefits. It selects proposals put forward by the private sector for matching funds.

The Congress, through a variety of government agencies, has a long and remarkably successful history of funding technologies ranging from the telegraph to radio and airplanes to computers, semiconductors, satellites, and the Internet. Together these investments have repeatedly transformed the US economy.

NIST pointed out in its response to the GAO study that applicant firms must demonstrate that the proposed solution is particularly innovative relative to alternative approaches being pursued by foreign and domestic competitors. This does not necessarily mean they are the only possible solutions. Numerous organizations, both government and private, fund projects with similar research goals. For example, multiple public agencies and private entities are pursuing drugs to combat AIDS.

What makes each research project unique are the pathways or technical approaches to solving the problem. As the NIST leadership has pointed out, there is a distinction between funding projects with similar "research goals" versus funding projects with "unique project-specific objectives and technical approaches."

The reality is that the innovation process is exceedingly complex, involving many dead ends, alternative approaches, varying techniques, and always uncertain outcomes. Many times the most innovative developments are in fact not the intended objective of the R&D program. The spillover effects of developing new platform technologies can be very powerful as they are taken up and given different applications in the marketplace.

(4) *How do ATP's selection criteria ensure that ATP-sponsored research is not duplicative of past or ongoing private sector efforts?*

There is a distinction to be drawn between duplication and successful research. Multiple efforts on multiple paths are often required for "success." The implied assumption that public funds "crowd out" private funds is not sustained by empirical examination.[1]

(5) *If an applicant has not sought provide funding before requesting federal funds from ATP, is that applicant automatically disqualified?*

My understanding is that the ATP does require that firms seek private finance before applying to the program. It would be best to direct this question to NIST for a complete answer.

It is important to keep in mind that markets are never perfect. They are normally characterized by substantial asymmetries in information, both on the part of the investor and potential recipient of such investment. These problems are particularly acute in the case of new technologies. It is often hard for the investors to fully grasp the nature of the technology and its operation, the technology's potential contribution, and the scale of the market that might thus be available. Even extremely experienced venture capitalists, who normally invest in more mature technologies, normally succeed with only around a third of their investments.

(6) *Since 1990, how many grants awarded through ATP have gone to publicly-traded corporations and what is the cumulative dollar total of those grants? Please provide a specific list with each company name and individual grant amount.*

It would be best to direct this question to NIST for an answer.

(7) *Since 1990, what percentage of federal funds appropriated to ATP has been spent by ATP on activities not specifically associated with research and development such as marketing or promotion?*

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[1] See Paul David, Bronwyn Hall, and Andrew Toole, "Is public R&D a complement or substitute for private R&D? A review of the econometric evidence," *Research Policy* 29(4-5): 497-530 (2000).

I believe it would be best to direct this question to NIST for a complete answer.

(8) Since 1990, on average, what percentage of federal funds awarded to each project has been spent by grantees on activities not specifically associated with research and development?

It would be best to direct this question to NIST for a complete answer.

(9) Since 1990, what percentage of federal funds appropriated to ATP has been spent on conferences? Please provide a list of those conferences, including the date, location, and amount of federal money spent on each conference.

While NIST can perhaps provide a more complete answer to this question, it is important to recognize that conferences can and do contribute to a better understanding of the state of a field of inquiry, help spread knowledge about best practices, and can provide expertise and points of comparison to better assess the quality of applicants to a program. Conferences can also permit a better understanding of operational issues, provide opportunities for assessment, and help policymakers understand the challenges of early stage finance and the contributions of programs like ATP, SBIR, DARPA, and HSARPA, all of which seek to compensate for market failures in early stage technology.

(10) How many organizations that conduct research into human cloning or embryonic stem cell research have received grants from ATP? Please provide a list of each organization, associated project, and size of federal grant.

It would be best to direct this question to NIST. My understanding is that some of this type of research has moved offshore to countries such as the United Kingdom.

(11) Does ATP calculate the risk, expected rate of return, and actual rate of return on each project that receives a grant from ATP? If so, please provide a detailed description of the model used to calculate those figures, as well as the results of the calculations for each project. Please include the name, company, date, grant amount, and risk and return results of each analyzed project. If ATP does not perform these calculations, please provide a detailed explanation as to why risk and rates of return are not calculated.

It would be best to direct this question to NIST for a complete answer.

Questions from Senator Lieberman

(1) What information is available on applicants that tried to find funding via avenues other than the Advanced Technology Program?

It would be best to direct this question to NIST for a complete answer.

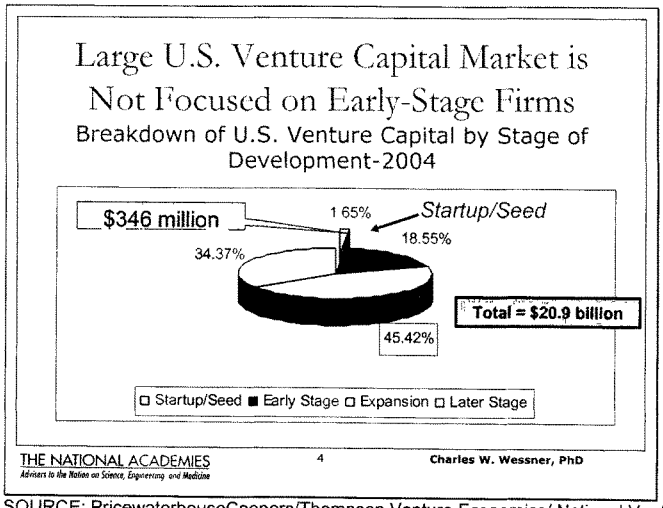
(2) *What information is available regarding applicants that were highly ranked by ATP but did not receive awards? Specifically, were they successful in receiving outside funding and obtaining their original project goals outlined in their ATP applications?*

Firms that receive ATP awards are significantly more successful in obtaining additional funding than non-winners. This "halo effect" from the ATP award is independent from the ratings of the project. The majority of the companies (62%) that apply to ATP and do not receive support generally do not proceed with the project.

A little more than a third of applicants do begin work on the proposed project but in most instances (over 75%), the project is pursued at a smaller scale. These results suggest that for the most part, ATP is attracting applicants that need support in order to proceed with their R&D plans.

(3) *In general, what data is available regarding available funding for early stage development, particularly the % of available VC funding?*

Despite the size of the U.S. venture capital market, little of it is available for early-stage funding. As noted in my testimony presentation and illustrated in the figure below, of the $20.9 billion in U.S. venture funding in 2004, only $346 million (1.65%) was available for startup/seed capital. See also the response to Senator Laughtenberg (Question 5, second bullet) below.



SOURCE: PricewaterhouseCoopers/Thompson Venture Economics/ National Venture Capital Association MoneyTree Survey, 2005

Venture funding, by its very nature, tends not to invest in early-stage, enabling technologies. In the course of the Academies' deliberations, David Morgenthaler, former president of the National Venture Capital Association, stated, "It does seem that early stage help by the government in developing platform technologies and financing scientific discoveries is directed exactly at the areas where institutional venture capitalists cannot and will not go."[2]

The remainder of this question might be better directed to NIST.

(4) *Please comment and provide any documentation addressing NIST's evaluation of the GAO 2000 study.*

The GAO 2000 report was the basis for Ms. Nazzaro's testimony. Although NIST was not a witness at this hearing, I cited the NIST director's evaluation of this partial study of the program and was encouraged to include excerpts from the NIST response by the Chairman. See below.

NIST's response to GAO report *Advanced Technology Program: Inherent Factors in Selection Process Could Limit Identification of Similar Research*, GAO/RCED-00-114 (Washington, D.C.: April 24, 2000)

Scope and Methodology
The GAO examined 3 of 38 completed ATP projects from ATP's status report entitled Performance of Completed Projects, dated March 1999. These projects were chosen from the following technology sectors: information, computers, and communication; electronics; and biotechnology. These three technology sectors represent 26 of the 38 completed ATP projects, or 68 percent.

GAO Comment: Three ATP Projects Addressed Similar Research Goals to Projects in the Private Sector

Methodologically, it is important to recognize the selection bias inherent in the small sample, less than 8% of completed awards, taken by GAO. Generalization about the program as a whole on the basis of these three projects is not warranted. The underlying assumption that it is inappropriate to have any overlap between ATP-funded research and private sector-funded research is also unwarranted.

As noted above, the innovation process is neither simple nor linear. Multiple approaches are desirable. It is for this reason that ATP criteria allow for the funding of competing approaches to addressing established industry-identified market needs.

As most researchers would recognize, there can be several research approaches to addressing the same problem. Successful proposals must effectively balance high technical risk with evidence of scientific and/or engineering feasibility for overcoming that risk. Proposers must discuss why the proposed solution has not been previously attempted or accomplished. ATP requires that

[2] Managing Technical Risk Understanding Private Sector Decision Making on Early Stage Technology-based Projects, NIST GCR 00-787, April 2000, p49

they demonstrate that the proposed solution is particularly innovative relative to alternative approaches being pursued by foreign and domestic competitors.

This does not necessarily mean they are the only possible solutions. Numerous organizations, both government and private, fund projects with similar research goals. This does not mean they are funding the identical technical approach to attain the research goal. What makes each research project unique are the pathways or technical approaches to solving the problem. There is a distinction between funding projects with similar "research goals" versus funding projects with "unique project-specific objectives and technical approaches."

As an example, NIST reports that in 1991, ATP officials gave the Communications Intelligence Corporation (CIC) $1.2 million for initial research into computer recognition of cursive handwriting, although similar (not identical) technology had already been developed, patented, and marketed. Many other companies were concurrently improving that technology, resulting in 450 new patents. However, the taxpayers' investment ultimately proved successful. In 2002, the company reached an agreement to license their technology into the Palm O/S. The software is also part of smart phones produced by Sony Ericsson, as well as other products. In recent market surveys, CIC has emerged as the leading supplier of biometric signature verification technology.

A study of patents demonstrates that technology developed under ATP is innovative. NIST reports that through FY 2003, ATP funded projects have filed 1,171 patents. A patent cannot be granted for anything that is part of the state-of-the-art, which is everything that has been made available to the public to date. Similarly, ATP projects have submitted 1,245 technical publications through FY 2003. These publications are a means to communicate research approaches and results to the technical community. They also provide an indicator to help safeguard against continuing to fund work duplicated elsewhere.

The fundamental point is that it is reasonable and appropriate that the Federal government should fund research that shares the same overall goal as research funded outside the government. If not, then Federal research on cures for cancer, AIDS, and a host of other diseases, wireless communications, computing technologies, manufacturing, etc. would be ended.

GAO Comment: ATP's Current Award Selection Process Is Unlikely to Avoid Funding Similar Research

- **ATP's Conflict-of-Interest Provision Limits Its Ability to Identify Similar Research**
- **Proprietary Information Limits ATP's Ability to Identify Similar Research**

Response:
ATP's peer-reviewed selection process is designed to ensure that funding is given to companies proposing new approaches to industry-identified goals. Patent and scientific literature searches are performed. A patent search, especially, provides insight into the state-of-the-art of a technology. The U.S. Patent Office includes some of the world's largest public patent databases containing recently published patent literature from top companies and individual inventors throughout the world.

Technical experts are selected from government agencies to review proposals. ATP matches these technical reviewers with proposals based on their subject matter expertise and familiarity with the state-of-the-art. Federal scientists, especially at NIST, have strong ties to industry and the work they are conducting. If a reviewer must recuse themself from reviewing a particular proposal, it is usually because they are working on a very similar line of research. In these instances, another expert is identified and matched with the proposal. A Source Evaluation Board (SEB), composed in part of scientists and engineers, discusses the relative merits of each proposal before making recommendations to funding officials.

It should be noted that not all privately funded technology is widely or ever marketed. In some instances, technology is held for the exclusive benefit of a few companies; in other cases it is shelved altogether. In these cases, the market may not always allocate scarce resources efficiently in a way that achieves the highest total social welfare. If the technology is not in the public domain, there are no broad economic benefits. All projects funded by ATP must have the potential for broad-based economic benefits and a clear pathway to those economic benefits.

Questions from Senator Laughtenberg

(1) Has ATP made changes to address the issues identified in GAO's 1996 report? Are there more recent examples of supposedly problematic projects than those identified by GAO and Heritage? Why haven't they been cited?

- NIST argues that the 1996 GAO study results support the conclusion that ATP is meeting its objective of funding projects that either would not be pursued at all or projects that would have been pursued without ATP funding, but at a much slower pace. This point is supported by the analysis prepared by Professor M.P. Feldman and Dr. M.R. Kelley in the Academies 2001 report on the Advanced Technology Program, "The Advanced Technology Program: Assessing Outcomes."

- It is our understanding that since the late 1990s, ATP has explicitly asked all applicants to "describe what efforts were made prior to applying to ATP funding to secure private capital to support this project wholly," conducted thorough patent and literature searches to augment its expert-board deliberations; and, evaluated whether similar projects were taking place through CRADAs in the ATP laboratories.

(2) Is it accurate that only one-third of ATP projects successfully bring new projects to market? If that is accurate, isn't the purpose of ATP to fund high-risk, high-reward projects, meaning that a large number of projects are expected to fail, and that's a price we're willing to pay because the projects that succeed do so spectacularly?

- It is misleading to emphasize that "only" 1/3 of ATP projects are successful. This implies that the Program should be more successful when in fact a higher success rate would suggest that it is not funding high risk R&D.
- It is accurate to state that roughly more than 1/3 of ATP's projects had new technologies under commercialization as of the end of FY2003 (i.e., 271 out of 709 or 38%).

- Yes, it is reasonable to expect a high percentage of ATP projects to fail to reach all of their technical objectives, given the high-risk nature of the R&D work funded. Some of what ATP describes as its "failures" add to the nation's technical knowledge base and some programs that initially found no immediate utility later proved extremely useful, as with the mirrors used for EUV lithography. In any event, project failures are in no way indicators of program failure.

(3) How many jobs does ATP support and create each year?

- Job creation is not a major goal of ATP and is therefore not a metric that has been traditionally used to judge ATP success. Anecdotal evidence suggests that ATP co-investment in early-stage technologies may over time help catalyze industries such as biochips and successful projects such as the project on printed wiring boards and the 2mm automotive project appear to have contributed to the competitiveness of the industries and therefore to job retention, at least for a time.

(4) When ATP and private sector fund similar research, does that improve the speed of development and thus yield economic benefits?

- Project participants indicate that they were significantly advanced as a result of ATP funding.
- In addition, firms that receive ATP awards are significantly more successful in obtaining additional private funding than non-winners of ATP awards. This "halo effect" from the ATP award suggests the private sector places a value on successful completion of NIST's highly competitive application process.

  The majority of the companies (62%) that apply to ATP and do not receive support generally do not proceed with the project. A little more than a third do begin work on the proposed project but in most instances (over 75%), the project is pursued at a smaller scale. These results suggest that for the most part, ATP is attracting applicants that need support in order to proceed with their R&D plans.

(5) Does America still face competitive pressures from abroad, from countries like China and India? Would it be a mistake to say that ATP is no longer necessary because America no longer faces competitive pressures from abroad?

- **Unparalleled Competition.** The global economy is creating competitive pressures that are unparalleled and certainly stronger than they were at ATP's inception. Today's competitors now include China and India as well as Japan and a host of other countries large and small, such as Korea, Taiwan, Singapore, Germany, Finland, and Brazil. The diversity and strength of the competition from established and emerging participants in the global economy pose significant and unprecedented competitive challenges for the United States.

  In such an environment, the ATP continues to fill a widely-recognized financing gap between basic research, where the U.S. spends $132 billion per year, and product development that, over time, can make significant contributions to U.S. competitiveness. It is an exceptional federal program designed specifically to promote long-range, high risk R&D in industry, thus enabling a higher rate of innovation in areas most likely to

bring broad economic benefits to the nation. Given industry's increased emphasis on short-term applied R&D and consequent reduced emphasis on early-phase (generic) technology research, this modest but effective program helps fill an important gap in early-stage finance.

- **Foreign Innovation Programs.** In addition to the competitive pressures from emerging markets such as China and India, most of our industrial competitors, including the European Union, Canada, Germany, Japan, and Finland have programs similar to the ATP in concept and often larger in scope and funding. All are viewed as an appropriate vehicle to promote innovation.
  - The European Union's Sixth Framework Program (FP6) for Research and Development (2002-2006) promotes multi-country R&D collaboration of the ultimate creation of a European Research Area. The FP6 directs is 17.5 billion euros to six priority areas, including life sciences, nanotechnology, information society technologies, and sustainable development.
  - In Canada, the Technology Partnerships Canada (TPC) program (founded in 1996) provides funding to small- and medium-sized firms for projects in environmental, aerospace and defence, and enabling technologies.
  - In Germany, the Ministry of Economics and Labor (BMWA) supports basic and pre-competitive research, with special emphasis on small and medium-sized firms located in the former East Germany.
  - In Japan, the "Teian-Kobo" competitive grant system (started in 1995) for pre-competitive technology shares some similarities to ATP.
  - In Finland, the Ministry of Trade and Industry's Technology Development Center (Tekes) promotes the technological competitiveness of Finnish industry through grants and other financial support for challenging and innovative projects.

(6) When a grant goes to a Fortune 500 company, does that necessarily mean that it is corporate welfare? Or does the federal government have a proper role in providing matching funds to large companies under programs like ATP?

- **Corporate Welfare?** The use of the term "corporate welfare" is misleading. The ATP is not an entitlement program. It does not provide support for a class or category of firms. It is a highly competitive award program, very similar to competitive scholarships that involve both personal and societal benefits. Less than 15% of the applicants win awards, and the awards are limited in time and amount. Consequently, the program does not breed dependency. Each project is finite in duration, with a maximum of five years.
- **Federal Success in Technology Development.** The federal government has a longstanding role in providing funding to large companies to develop new technologies, sometimes for military use, often for civilian applications. ATP supports leading-edge high-risk R&D on potentially important enabling technologies that have the potential to provide significant economic benefits to the U.S.
- **Valuable Contributions of Large Companies.** Large companies can be a major asset for the program, and can play an important role in bringing technologies developed in joint ventures forward to the market. Large companies offer significant advantages in certain industries and technology areas such as management expertise, marketing and

manufacturing capability, access to distribution channels, branding, and the ability to encourage collaborative R&D ventures.

- **Cost-Sharing with Industry.** ATP funds efforts that would not be undertaken with private funds alone and requires cost-sharing from industry. Companies involved must contribute significant resources; on average, about half the funding for ATP projects comes from private industry. For joint ventures, half or more of the funding must be provided by the companies. When applying on their own, large firms are required to provide a 60% cost-share.
- **The Role of Small Companies.** Approximately 66% of ATP funds go to small business.
- **Joint Ventures.** While large companies sometimes participate in ATP awards – particularly in joint ventures – so do hundreds of small and medium-sized companies. Most large companies participate in collaborative joint R&D ventures with small businesses, universities and non-profits.