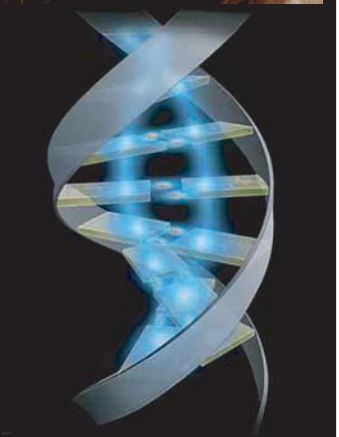
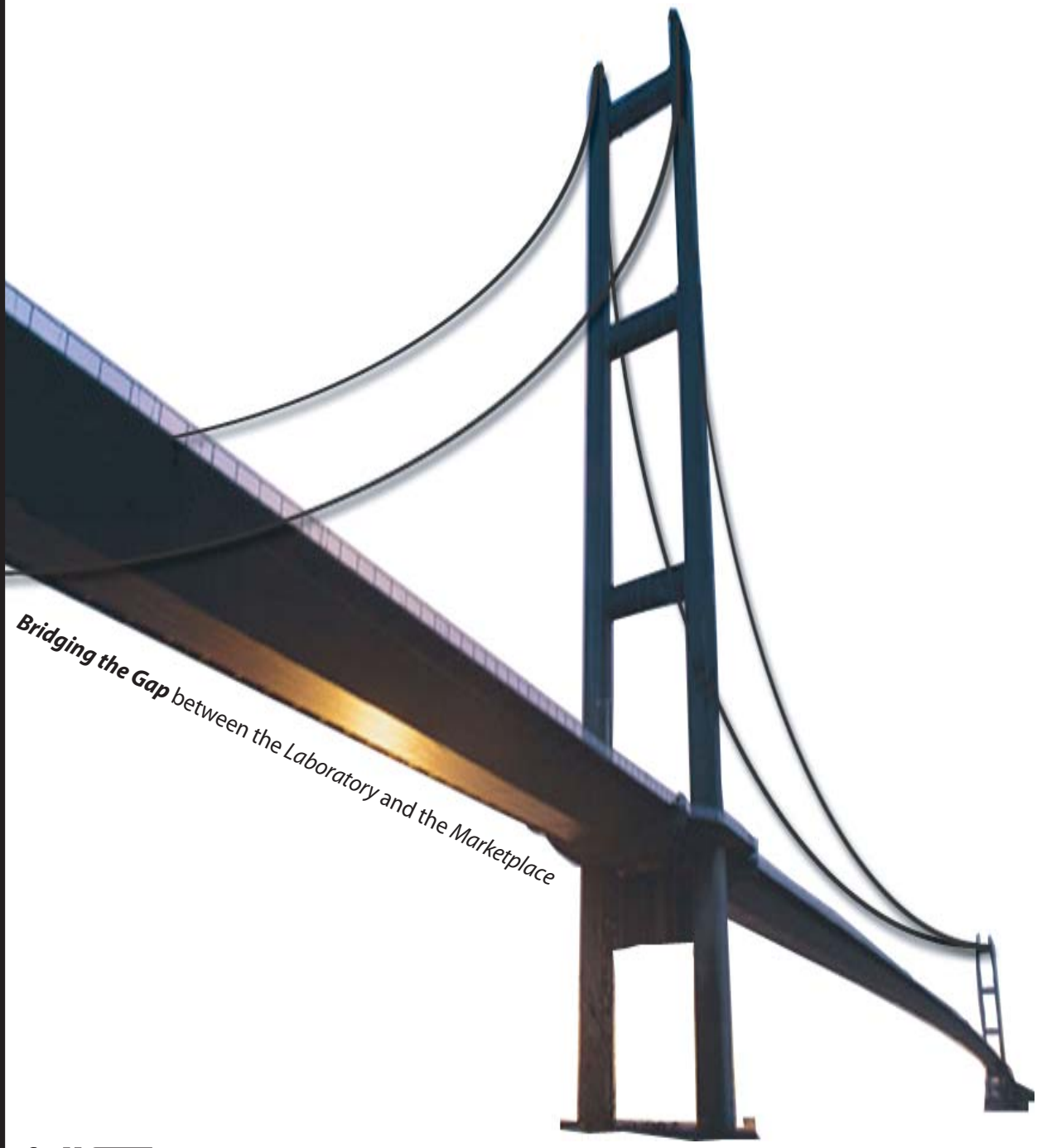


ADVANCED TECHNOLOGY PROGRAM

2005 Annual Report

of the

Advanced Technology Program Advisory Committee



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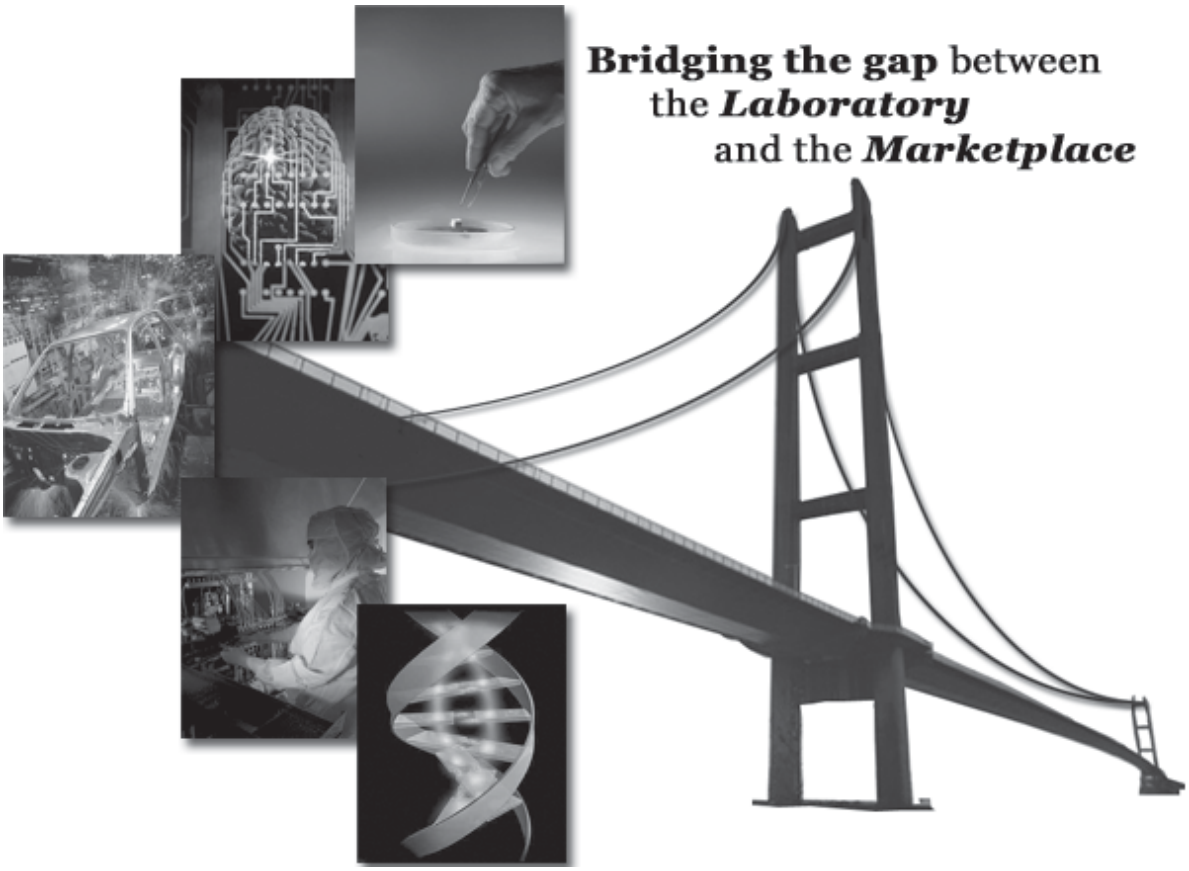
2005 Annual Report of the Advanced Technology Program Advisory Committee



U.S. Department of Commerce
Technology Administration
National Institute of Standards and Technology
Advanced Technology Program

February 2006

For information regarding the **Advanced Technology Program Advisory Committee**, contact:

Marc G. Stanley
Director
Advanced Technology Program
National Institute of Standards and Technology
100 Bureau Drive, Mail Stop 4700
Gaithersburg, MD 20899-4700

Tel: 301-975-5187
Email: *atp@nist.gov*

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ADVANCED TECHNOLOGY PROGRAM

Members of the ATP Advisory Committee

Dr. F. M. Ross Armbrecht, Jr.
Executive Director, Delaware Foundation for Science and Mathematics Education
Wilmington, DE
(Term expires 12/31/2008)

Mr. Michael G. Borrus
EIR, Mohr, Davidow Ventures (MDV)
Menlo Park, CA
(Term expires 12/31/2008)

Mr. John B. Byrd III
President , The Association for Manufacturing Technology
McLean, VA
(*Term expires 12/31/2007*)

Dr. Gail H. Cassell
Vice President, Scientific Affairs and Distinguished Lilly Research Scholar for Infectious Diseases
Eli Lilly and Company
Indianapolis, IN
(Term expired 12/31/2005)

Dr. Howard Frank
Dean, Robert H. Smith School of Business
University of Maryland
College Park, MD
(*Term expired 12/31/2005*)

Dr. Eric Haseltine
Associate Director of National Intelligence for Science and Technology
DNI
McLean, VA
(Term expires 12/31/2007)

Ms. Linda F. Powers
Managing Director
Toucan Capital Corporation
Bethesda, MD
(Term expires 12/31/2007)

From left to right: Dr. Howard Frank, Mr. Michael Borrus, Ms. Marsha Schachtel, Dr. F.M. Ross Armbrecht, Jr., and Dr. Alan Russell.

Dr. Alan J. Russell
Director, McGowan Institute for Regenerative Medicine and Professor of Surgery
University of Pittsburgh
Pittsburgh, PA
(Term expires 12/31/2007)

Ms. Marsha R. B. Schachtel (Committee Chair)
Senior Fellow, Institute for Policy Studies
Johns Hopkins University
Baltimore, MD
(Term expired 12/31/2005)

Mrs. Maria A. Thompson
President and CEO, T/J Technologies
Ann Arbor, MI
(Term expires 12/31/2006)

ADVANCED TECHNOLOGY PROGRAM

I. Introduction

The ATP Advisory Committee comprises prestigious individuals from industry, academia, and non-profit organizations with an interest in and knowledge of issues related to advanced technology and economic development. Its charter can be found on ATP's website at: *www.atp.nist.gov*.

The Committee acts in the public interest to

- Provide advice on ATP programs, plans, and policies
- Review and critique ATP evaluation efforts
- Assess the degree of success of ATP in achieving its legislatively mandated mission
- Function solely as an advisory body, in accordance with the provisions of the Federal Advisory Committee Act

This annual report includes two calendar year 2005 Committee meetings:

- March 22, 2005
- November 1, 2005

Each meeting consisted of public sessions during which ATP personnel briefed the Committee on plans, accomplishments, concerns, and issues. In addition, as noted in this report, the Advisory Committee often heard from outside experts in science and technology policy. Panel discussions helped to highlight important issues affecting ATP.

The meetings also included brief closed sessions during which budget and personnel issues were discussed and the Committee's recommendations were formulated. Following each meeting, minutes were prepared and posted on the ATP website. During, and at the conclusion of each meeting, the Committee provided feedback and advice to ATP and NIST management.

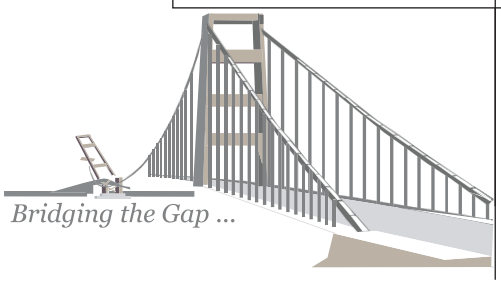
The Committee has found the Advisory Committee meetings to be intellectually stimulating. NIST and ATP are receptive to advice, and the Committee members feel that they have been able to contribute to further improving an already excellent program.

The section that follows (Section II) documents the Committee's findings and recommendations. Section III summarizes the two meetings that have taken place during this reporting period.

The Appendices provide information on published ATP evaluation reports, ATP "Gems" and Success Stories, and Status Reports completed since the last annual report and a customer satisfaction survey.

ADVANCED TECHNOLOGY PROGRAM

II. Findings and Recommendations



Findings:

1. The Committee was exceedingly disappointed to learn that again this year (FY 2006), the Advanced Technology Program will have no funding for new awards. While the Committee is well aware of the current climate of budget austerity, ATP is a worthwhile investment, even if only modest funding is available for new projects, because there is clear evidence that the economic benefits that have resulted from the Program greatly outweigh its costs. As noted in a recent retrospective survey of just 27 ATP projects, a government investment of $60.3 million generated revenues in excess of $600 million, representing a 10 to 1 return on the public investment. In many instances, these projects resulted in substantial cost savings, creation of intellectual property (102 patents pending or issued) and employment growth.

2. During its 2005 meetings, as described in Section III of this report, the Committee heard several presentations dealing with industry concerns over U.S. economic competitiveness. There is a growing consensus within the high-tech community that U.S. competitiveness in high-tech fields is in serious danger of eroding. China and India are making dramatic efforts to upgrade their technical process to world-class standards. Former Lockheed-Martin CEO Norman Augustine chaired a 20-member committee of the National Academy of Sciences that was asked by Congress to "examine threats to America's future prosperity." In a *Washington Post* op-ed piece (Dec. 6, 2005, p. A29), Augustine said, "To boost scientific and technological innovation, we recommend that the U.S. government increase research funding by 10 percent annually over the next several years, with primary attention devoted to the physical sciences, engineering, mathematics, and information sciences." More and more prestigious voices are urging our nation to devote attention to this problem. Programs like ATP are needed to address this concern.

3. Dr. Stampfer's presentation at the March 2005 meeting, described in Section III, as well as other presentations at Advisory Committee meetings in earlier years indicated that ATP is highly respected within the technology policy community around the world, and that ATP often serves as a role model for other nations' efforts to promote technological innovation in industry.

4. The Committee commends ATP for its efforts to form alliances with other government agencies. The presentation by Michael Rubino, an official of the marine fisheries part of NOAA, is an excellent example of synergy between ATP and other agencies. Both ATP and NOAA can benefit from such cooperation. We applaud ATP's efforts to strengthen ties with NIH, where opportunities for synergism are great.

5. The Committee commends ATP for its continuing efforts to strengthen ties with state technology agencies.

6. ATP's recent Customer Satisfaction Survey provides clear evidence that the Advanced Technology Program is perceived positively by the high-tech community that it serves.

7. Given the great uncertainty with regard to ATP funding for the past few years, the morale among ATP staff remains remarkably high. The caliber of the staff is one reason why ATP has been successful. ATP's program management continues to win praise. ATP's reputation for fairness and objectivity in proposal selection is unblemished.

8. The Committee believes that continuing efforts are needed to improve understanding by policymakers and the public of the Program's underlying philosophy, its track record, and the assessments completed to date. The Committee continues to be concerned that there is a lack of awareness about what ATP does and how it operates. We cannot help but believe that if some of ATP's critics took the time to study the program carefully and objectively, they would become supporters.

Recommendations:

1. The Committee urges the Administration and the Congress to seek ways to provide continuing ATP funding, not only for ongoing projects, but also for future competitions. If it is necessary to alter some provisions of the current ATP legislation (e.g., the role of large companies—a factor frequently cited by critics of the Program) to reach a broader consensus regarding the value of ATP, then such alterations should be considered. ATP's budget is a tiny fraction of the total R&D budget of the Federal government, but it leverages in a positive way other Federal expenditures, particularly the basic research budget. Given the concerns about U.S. competitiveness noted above, this is NOT the time to wind down ATP, a successful program that fuels America's high-tech sector.

2. Because certain areas such as healthcare and homeland security continue to be high priorities for the United States, ATP should continue to seek opportunities to do more in these topical areas. ATP has the legislative authority and the expertise to run competitions and manage projects for other Federal agencies, and these appear to be cases where ATP's ability to speed research discoveries into practice would be most usefully tapped for the benefit of the nation.

3. Because no funds for new awards have been appropriated for FY 2006, ATP should use this period to concentrate on management of ongoing projects to maximize their effectiveness and on efforts to better explain the program to key decision makers. As the Committee noted last year, it is apparent that many high-level policy makers still do not understand what ATP does and how it operates, and are not familiar with the impressive results from ATP's extensive assessment efforts. While ATP has worked diligently to inform such decision-makers, a continuing effort to educate is needed.

4. ATP might also work with other Federal agencies and other organizations to hold conferences to explore critical technology policy issues for the nation.

III. Summary of Committee Meetings in 2005

1. March 22, 2005 Meeting

This was the first meeting for Committee member John Byrd.

Mr. David Peyton - *National Association of Manufacturers*

David Peyton, Director of Technology Policy for the National Association of Manufacturers (NAM), described the work of NAM's Task Force on the Future of American Innovation. The task force brought together people from industry, industry organizations, government, and universities, to examine trends in science and technology, and address the issue of whether the United States is losing its competitive edge.

While the health sciences have been funded generously in recent years (through NIH), the physical sciences have fared less well. The conclusion of this task force is that the U.S. lead in technological prowess has been slipping as measured in a number of different ways. In recent years the number of U.S. graduate students has been dropping, and the number of foreign graduate students has been increasing. A few years ago the lines crossed, and today the number of foreign students enrolled in U.S. graduate schools exceeds the number of U.S. students. In spite of this trend, Asian students (e.g., China, South Korea, and Taiwan) are increasingly staying at home to attend graduate school, as their universities become world-class.

For many years the United States led the world in the number of science and engineering journal articles published. Around 1995 Europe passed us by, and the number of journal articles by Asian authors is now increasing rapidly. While the United States still leads in U.S. patent applications, European and Asian inventors are gaining ground, and patent applications from the fast growing economies of Southeast Asia are increasing steeply. Similarly, many of these countries are increasing their total R&D investments faster than the United States.

Between 1970 and the present, U.S. Federal investment in the physical sciences has decreased from nearly 0.1 percent of the U.S. Gross Domestic Product to less than 0.05 percent. China is catching up to the U.S. in high-tech-industry output of goods (e.g., aerospace, computers, and pharmaceuticals) In earlier years, developing countries like China manufactured predominantly low-tech products, but today China turns out iPods and lasers in addition to a plethora of low-tech products.

Advanced technology is critically important to the U.S. balance of trade. Between 1990 and 2003, the United States had a cumulative trade surplus of $243 billion for advanced technology products whereas the cumulative U.S. trade deficit for all goods was about $3.4 trillion. The other trends suggest that our nation will be hard pressed to maintain that surplus in high tech goods if those trends continue. In about 2001, our nation actually switched from a surplus trade balance in high-tech products to a deficit. The trend appears to be continuing downward at a steep rate.

NAM is striving to increase awareness of these trends. Of course there are other issues that affect technology development, for example, patent policy

streamlining and R&D tax credits. NAM believes that policy makers need to pay much more attention to all of the issues that affect our competitiveness in science and technology.

NAM believes that ATP is making an important contribution to U.S. technological competitiveness, and therefore the organization supports continued funding for the program.

U.S. venture capital firms are increasingly seeking investment opportunities in China, and Chinese firms are providing funds to establish new technology-based companies in the United States. Engineering enrollment in China has increased dramatically and now stands at about 1.25 million students. As they enter the workforce, they will certainly increase China's ability to continue to improve its high-tech industries.

The flow of manufacturing jobs offshore has been a principal concern, but now with growing global investment, R&D overseas is increasing rapidly. The U.S. certainly does not have a corner on innovation. Countries like China will not just manufacture goods, China will be doing sophisticated R&D as well, and creating technological innovations.

U.S. companies are increasingly supporting R&D in other countries. The United States must be a leader in innovation if we are to remain competitive.

It has been estimated that 90 percent of the world's economic growth in the next decade will occur outside the United States. There are a number of disincentives to manufacture in the U.S., including factors such as taxes, litigation, and heathcare costs. There is plenty of innovation in the U.S. and good basic science, but the U.S. too often fails to foster commercialization.

Dr. Hratch Semerjian - *NIST Acting Director*

NIST enables future growth by strengthening the innovation infrastructure through effective partnerships with industry, academia, and other government agencies. By means of examples, Semerjian showed how NIST's work advances manufacturing and services in virtually all areas where technology is important. Standards work facilitates international trade, improves public safety and health, and improves the quality of life.

NIST serves a broad customer base covering major industries. Major corporations and universities throughout the U.S. have partnerships with NIST.

NIST is undertaking a comprehensive study of the U.S. measurement system. A series of workshops will be held, involving experts from industry, government, and academia. These workshops will lead to reports on long-term measurement and standards needs for the nation.

ATP will have no new competitions this year. There is much expertise within ATP and we can and will make use of ATP's expertise and knowledge of industry in the measurement system study. Working with the laboratories in this effort is mutually beneficial.

Dr. Michael Stampfer - *Vienna Science and Technology Fund*

Dr. Stampfer is Managing Director of the Vienna Science and Technology Fund (WWTF). The Committee was grateful that he was able to attend this meeting and describe how attitudes towards fostering technology innovation in Europe in general, and in Austria in particular, compare to those in the United States.

Visits by ATP people to Austria to present information about the program have been greatly appreciated. ATP inspired the WWTF. Stampfer feels that ATP is "a world role model for program evaluation."

The purpose of the WWTF is to strengthen scientific research in the Vienna area. It is linked to regional economic policy making. Current thematic focus areas are biotech, mathematics, and "science for creative industries." The program features international reviews and evaluations.

Austria has enjoyed strong economic growth since World War II. When the Soviet Union collapsed, Austrian firms were able to make successful investments in Eastern Europe.

No large industrial players or large government laboratories are involved with the WWTF. The emphasis is on small university research groups that receive block grants or project funding. (Professors at Austrian universities have traditionally worked independently rather than in large group projects.)

Foreign investment (Germany, United States, and others) in Austrian industry has been growing. General University Funds have been shrinking in recent years. Three ministries provide funds for science and technology. Austria has an agency similar to the U.S. National Science Foundation that supports basic research. There is a strong R&D advisory council. Austria does not have research associated with major government procurement (analogous to the Defense Department's R&D programs in the United States).

While individual countries still have the most influence on technology policy, the EU's policy-making role is growing. The EU's Framework programs are the best example of the EU influence. However, management issues remain. The Framework Program # 6 involves 17 billion Euros for four years.

The EU established a goal (the "Barcelona Goal") of achieving a ratio of R&D funding to GDP of 3 percent by 2010, however, Stampfer thinks this goal is unlikely to be achieved by 2010. Within the EU there have been discussions about a common European Research Council analogous to the U.S. National Science Foundation.

Until recently there were few links between universities and industry in Austria, but that is changing as Austria strives to bridge the gap between university research and industry. Consortia are encouraged. Austria's GEN-AU program is a good example. Its goal is to strengthen networking genome research in Austria. The 12 projects and 90 working groups involve R&D not unlike that supported by ATP in its DNA Diagnostics competition.

Another example is the "K Plus Competence Centres." These centers are somewhat like the NSF industry-university engineering research centers in the U.S. Located close to universities, each involves 5 to 20 partner firms. Eighteen such centers have been formed.

Dr. Stampfer described a "bottoms-up" Austrian initiative called "Plattform," (Austrian Platform for Research and Technology Evaluation) to encourage program evaluation. Those who are being evaluated, as well as those who do the evaluations, participate in Plattform. It has an annual budget of 100,000 to 200,000 Euros. With a small secretariat, it currently has 15 R&D institutional members, plus government agencies and ministries. A newsletter is distributed, and workshops and conferences are held to foster best practices.

NIST's counterpart standards laboratories in Europe, e.g. PTB in Germany, have experienced pressure to collaborate to minimize duplication, but there have not been steps to implement it. The EU encourages cooperation. CERN is an example of successful European cooperation. Now there is interest in a European equivalent of the Global Positioning System.

Students from the former Soviet Union countries of Southeastern Europe have come to Austria, some to study music, and some for engineering. Austrian companies have established manufacturing plants in Southeastern Europe because of lower costs there. Austria is strengthening graduate science programs to attract more Ph.D. students.

Fewer European grad students are coming to the U.S., but more are coming to Canada. However, those who study in Canada today are more likely to return to their home countries than those students who came to the U.S. to study in earlier years. There seems to be less interest in studying in the U.S. now, perhaps because U.S. technology today is so military oriented. The future for civilian technology is brighter elsewhere in the world. An exception is in medicine. U.S. medical schools are still popular.

There is a proposal to double funding for the Framework Program even though it is not accompanied by a strong evaluation program. By contrast, in the U.S. the new Federal budget proposes to eliminate ATP even though ATP has an excellent evaluation program that has shown impressive results.

The Framework Program has some major restrictions, such as the requirement for a certain number of partners in each project. Partnerships are important in Europe, but there is less emphasis on technical risk than in ATP.

The government of Austria has a new program to encourage Austrian researchers who have gone to other countries to return to Austria. Quite a few R&D managers who were born in Austria currently live in the United States. Even if they do not return, Austria would like to establish networks to tap into their expertise.

In Europe there are disincentives to take on high risk and fail. That is less so in the United States. A U.S. company can experience bankruptcy and yet rise again to succeed. In Austria there are cultural as well as legal barriers for companies that fail. But entrepreneurship is now on the agenda at Austrian universities. Austrian universities now have a patent rights law somewhat like the Bayh-Dole Act in the United States.

Andrew Wang (ATP) - *Applicant Survey Results*

Dr. Wang of the ATP Economic Assessment Office described a survey of ATP applicants from the 2002 competition. (The competition that year involved three batches of proposals.) The survey included both awardees and non-awardees.

A total of 587 of the 891 applicants (66 percent) responded to the survey, representing 90 percent of the awardees, and 61 percent of the non-awardees.

ATP applicants are predominantly small companies. Eighty-nine percent of the applicants have fewer than 500 employees, and 49 percent have fewer than ten employees.

The most common reasons why companies applied to ATP were (in order of importance):

- Lack of internal funding
- Stability of ATP funding

- Dependence on external funding
- Validates technological potential
- Validates commercial potential
- Facilitates collaboration

ATP projects support new R&D directions:

- 86 percent represent new R&D direction for the company
- 95 percent represent new R&D direction for the industry or field of technology
- 68 percent fostered new individual ties
- 57 percent fostered new company partnerships
- 60 percent fostered stronger company relationships with other organizations

ATP projects frequently involve R&D collaboration with universities:

- 60 percent of projects are based on university research
- 20 percent of projects depend on technology licensed from universities.
- 40 percent of projects report that university involvement is critical

The technical risk of ATP projects is noticeably higher than that of typical R&D projects of the applicant companies, and the risk associated with awarded projects is higher than the risk of projects that did not receive awards. (This is to be expected, because ATP seeks high-risk projects, and projects deemed insufficiently high-risk are rejected.)

For projects that received awards, both internal and external funding increased following the award. For projects that did not receive awards, both internal and external funding decreased following notification of non-award.

Following notification of non-award, most projects that did not receive awards had either no activity or activity considerably smaller than the level of effort that would have occurred had the project been funded. Only a small percentage of projects proceeded at the proposed or greater levels of effort. (Of course ATP rejects projects when the selection board believes the project is likely to be pursued without ATP funding, so this result is to be expected.)

These data suggest that ATP is attracting and selecting the right kinds of projects (high-risk projects that are unlikely to be pursued without an ATP award). The conclusion is that ATP has had a positive impact on the ability of companies to pursue early-stage high-risk R&D.

Bettijoyce Lide (ATP) - *Healthcare Informatics*

Information technology is important for hospitals and clinics, for heath research, for medical training, and for home-based healthcare. Challenges include transporting, storing, and accessing massive amounts of data (while being cognizant of privacy concerns).

Better use of informatics can improve coordination, improve efficiency, reduce medical errors, and lower costs. Record keeping in most hospitals and doctors' offices has not changed much in generations, with hand-written records still commonplace. There would be major advantages in having universally available multimedia patient records. President Bush has called for improvements in medical informatics in his last two State of the Union addresses.

Ms. Lide mentioned that recently Cedar Sinai Hospital abandoned a $34 million computer system that did not prove to meet their needs. This certainly suggests that we have a way to go before medical informatics will be widely adopted and embraced.

Some have said that electronic health records could reduce medical costs by as much as 20 percent. Medical costs could represent as much as 17 percent of the U.S. GDP by 2011 unless more is done to lower them, and medical informatics is certainly a key to cost reduction.

ATP has devoted considerable resources to heathcare informatics R&D, and significant technical accomplishments have resulted. Between 1994 and 1998 ATP had a focused program on Information Infrastructure for Healthcare. Thirty-two projects involving 79 participants were awarded from among 221 proposals received. General competitions have produced additional awards related to this topic. ATP has invested about $150 million in medical informatics, with a comparable amount of industry cost sharing.

Berdy Medical Systems is a good example of an ATP success story. Berdy developed a system of natural speech recognition oriented toward medical terminology. The result is 90-percent speaker-independent and allows for a normal, uninterrupted flow of speech. The electronic patient record system is automatically populated as speech is inputted. Commercial systems are being deployed, and because the system speeds up record generation, clinicians using the system can see 20 percent more patients without extending their hours.

Technology developed by Vital Works automates clinical note taking. For 30 to 60 percent of patient charts it reduces errors of omission to as few as 1 percent. The Veterans Administration is using the system and experiencing savings of millions of dollars annually.

The 3M Company has developed software to make integration of legacy systems easier, and it provides the foundation for the Department of Defense Military Health System's electronic record system. The Advanced Technology Institute has developed a teleradiology network that makes a board-certified radiologist available around the clock to small rural medical facilities that previously had to send radiograms outside to be analyzed, causing lengthy delays in diagnosis.

ATP intramural funds have also helped the NIST laboratories develop new medical technologies and standards in areas such as image compression and medical electronic commerce.

The Journal of the American Medical Informatics Association has acknowledged the important contributions of ATP's staff in this discipline. (Ms. Lide has served on outside boards and high-level committees, and has been deeply involved in national conferences on this topic.) She and others from ATP are working closely with the Office of the National Coordinator for Health Information Technology. ATP is cooperating with the Center for Aging Services Technology (CAST), and is planning a joint workshop with CAST in 2006.

The Committee sees medical informatics as a logical area for ATP involvement. The venture capital community is not supporting it. Federal government support is clearly needed.

There are hurdles to the adoption of telemedicine technology. Doctors are licensed by individual states, so there are legal barriers for example, to having a

radiologist in one state examine X-rays or CAT scans from another state.

General Motors finds it difficult to compete with other automakers because of their high legacy costs for pensions and heath care. So, reducing healthcare costs affects industry broadly.

Usability studies are critical. Doctors will not willingly adopt a new electronic system unless it is very user-friendly.

Bill Bates - *Council on Competitiveness*

Mr. Bates is Vice President of the Council on Competitiveness. Founded in the mid-1980s by Hewlett-Packard executive John Young, the Council continues to study U.S. competitiveness and call attention to concerns. Whereas, when the Council was founded, concerns about U.S. competitiveness relative to Japan were in the forefront; today concerns about competition from other nations, e.g., China are uppermost. Bates described the Council's current National Innovation Initiative (NII), an effort to bring together the nation's best experts on innovation to create an agenda for addressing needs.

Today a number of other countries have higher per capita R&D expenditures than the United States, and are turning out more engineers. Our growing trade deficit is worrisome. Much of the U.S. debt is held by foreigners, and if someday a substantial number of them stopped loaning us money, this would present serious problems. Innovation has become globalized. The linear innovation model has been replaced by a dynamic innovation model. Single technical disciplines have been replaced by multidisciplinary technologies. The pace of innovation is quickening. New technologies come on stream faster than in past decades. Innovation is not just a technical issue. National policies (e.g., education, intellectual property, and regulation) have great impact on innovation.

Two NII summits have taken place—at MIT in 1998 and at U.C. San Diego in 2001. Nineteen prestigious CEOs and university presidents are involved in the NII effort.

Three major elements of the NII agenda are talent, investment, and infrastructure. The talent element involves issues such as the need for scholarships and graduate fellowships, upgrading K-12 and community college education, increasing the sophistication of technically trained people on business issues, portable health and retirement benefits, and worker training.

The investment element involves issues such as encouraging more and longer term research, making permanent the R&D tax credit, fostering regional technology clusters, coordinating better federal economic development programs, rewarding long term investment, and improving tort legislation.

The infrastructure element involves issues such as developing a Federal innovation strategy, forming alliances, restructuring patents, collaborative standards setting, developing industry roadmaps, and improving healthcare.

Implementing the NII requires outreach by influential people to the Administration and Congress, regional innovation summits, global outreach, and research to monitor how we are doing.

More than 500 innovation leaders and more than 30 associations and organizations participated in the NII Summit. In excess of 140,000 copies of the report

have been downloaded. Press coverage of the NII has been good. Steps are being taken to engage the Congress and the Administration, and a letter from Senators Ensign and Lieberman demonstrates congressional interest in the topic.

The Committee commended the Council for taking on this task. In most countries, the central government would pursue these kinds of initiatives. It is interesting that in the U.S., industry has taken the lead.

Industry is well represented at the highest levels of the Initiative. Universities are excited about the initiative, and many university people volunteered to shoulder the in-depth committee work of gathering and organizing the information.

With the Federal government reducing its role in technology innovation, the states are important actors.

Bates noted that one section of the Council's report stresses how important manufacturing is to innovation in the U.S., and that it needs more high level attention.

2. November 1, 2005 Meeting

This was Committee Chair Marsha Schachtel's last meeting. Four other committee members' terms are expiring: Ross Armbrecht, Michael Borrus, Gail Cassell, and Howard Frank. Eric Haseltine and Linda Powers have each agreed to serve a second term.

This was Alan Russell's first meeting as a committee member.

William Jeffrey - *NIST*

Dr. William Jeffrey, NIST Director, thanked Marsha Schachtel and the other committee members for their service. Jeffrey summarized his views regarding NIST's importance to the nation. Technological innovation is an important aspect of the competitive environment. Given the current importance of competitiveness, NIST is well positioned to foster innovation. With a total of three Nobel Prizes now, it is evident that the quality of NIST's scientific work is world class.

Emerging fields of science such as molecular manipulation present new technical challenges for NIST. NIST contributes to many areas of current national concern, such as, but not limited to, nanotechnology, toxic cleanup, homeland security, health care, voting standards, and supply chain integration. State-of-the-art measurements are ubiquitous in today's technologies, and NIST helps the U.S. take advantage of rapid changes in technology. Its facilities, such as the Cold Neutron Facility, are widely used and valued by industry and academia.

Marc Stanley - *NIST/ATP*

A number of attention-grabbing reports dealing with technology competitiveness issues have appeared in the recent past, from organizations such as the U.S. Council on Competitiveness, the National Research Council of the National Academy of Sciences, the President's Council on Science and Technology, and (as described below), the American Electronics Association (AEA). It appears that the issue of technology competitiveness is once again appearing on policymakers' radar screens.

William Archey - *American Electronics Association*

Mr. William Archey, President and CEO of the American Electronics Association, spoke to the committee about a new AEA report on technology competitiveness that has been attracting attention and praise. The AEA's conclusion is that while America is not in decline, its competitive advantage is eroding because other countries are catching up, and the U.S. is neglecting the factors largely responsible for the U.S.'s past competitive advantage.

Even if our nation were doing everything right, keeping up with international competition would be a challenge. But AEA believes we are *not* doing everything right. Other nations are implementing economic reforms (often the very ones urged by the U.S.) that are reaping dividends, and taking steps to foster technology development, while U.S. Federal R&D funding has been eroding.

Improving education for U.S. workers and adopting better crafted immigration policies are both important issues. High school students in the U.S. too often do not see science and engineering as exciting and rewarding, but rather unduly difficult and "nerdy," hence too few pursue these career options. If the

technology sector in the U.S. is to continue to grow, it will need a steady stream of trained people, including the best minds from overseas.

Countries need not invent new technology to be able to exploit it for economic benefit. Archey showed a number of charts with disturbing data on educational issues and how disproportionately our nation currently relies on foreign born scientists and engineers. Immigration policy since 9/11 has made it difficult for foreign scientists and engineers to come to the U.S., and one can presume that in the future, the best and brightest will go to other countries or stay at home instead, depriving us of their skills. As R&D around the world becomes increasingly sophisticated, there will be less incentive for bright people considering emigration to put the U.S. at or near the top of their lists.

Countries such as China and India are improving their universities to be world class, and graduating large numbers of engineers with high levels of skill. Countries that had once been seen as competing for low-cost manufacturing will increasingly be competing in high-level R&D.

Archey provided a list of important technology developments (e.g., the Internet) that resulted from Federal R&D funding, and then noted how Federal R&D funding as a percentage of GDP has dropped in the past twenty years. This is especially troublesome in the physical sciences, because most increases in Federal funding have gone to life sciences (in particular, NIH) for health related R&D.

Archey disagrees with those who urge a Federal hands-off policy for technology development. He sees a need for Federal efforts to foster advanced technology development in the United States. He pointed out that when figures for industrial R&D are cited, most of the dollars are for “D” (product development) with relatively sparse dollar amounts devoted to research in industry.

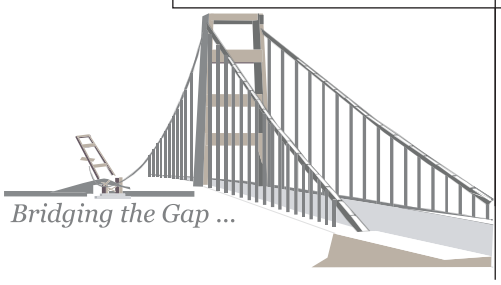
AEA hopes to awaken influential people in Washington to the seriousness of the challenges our nation faces.

The report, *Losing the Competitive Advantage, The Challenge for Science and Technology in the United States,* can be found at:
http://www.aeanet.org/publications/idjj_CompetitivenessMain0205.asp?bhcp=1

U.S. companies too often do not provide adequate funds for educating their workers (continuing education). One problem is that Congress provides so many earmarks in the education budget that high priority items sometimes fall by the wayside. AEA companies that have tried to promote improvements in education have had to deal with local school boards, the quality of which varies dramatically from place to place. Local AEA groups have tried to alert parents and teachers to these issues, and tried to convince them that the U.S. is slipping relative to other countries.

It is important to encourage scientists and engineers to serve on local school boards because they understand the importance of upgrading science and math curricula.

Funding is important, but so is leadership. If people at high levels do not understand these issues, then nothing will improve even if the money is there. One suggestion was to establish a cabinet level Secretary of Science and Technology.



R&D as a percentage of GDP has declined markedly, and in particular, there has been a severe decline in support for the physical sciences. Even DARPA, which traditionally had a reputation for long-term research, is currently focusing on shorter-term problems.

Aggregate R&D dollar figures can be misleading. The balance is important, for example, the balance between funding for life sciences and engineering and the balance between civilian and military R&D. Often it is the intersection of technology areas (e.g., biology and engineering) where the greatest breakthroughs occur. Very little defense R&D today is early-stage work. And, today venture capitalists are seeking to invest in companies that are closer to product. Many of the innovations that have been developed in the last few decades are based on research carried out 30 or more years ago. There have been shifts in priorities that are detrimental to commercial technology. Fortunately, the U.S. still has some top universities, such as Caltech and Stanford.

The Committee was awed by China's rapid progress. Maintaining our competitive edge is an increasing concern. The discussions currently underway in government and industry are inadequate. Industry needs to get the attention of the public, and it needs to support more continuing education. Without renewed emphasis on R&D in the technology sector, the nation will be milking the basic research of 30 years ago and "eating our seed corn." The lack of understanding of the importance of these issues by so many members of Congress is deeply troubling to the Committee.

Robert Atkinson - *Progressive Policy Institute*

Dr. Robert Atkinson is Vice President of the Progressive Policy Institute (PPI). His talk also dealt with the Federal role in R&D and its impact on the economy, and reflected material in his recent book, *The Past and Future of America's Economy,* published in 2004.

Atkinson has serious concerns about the direction of our economy. The U.S. trade deficit is huge and getting worse. With less national focus on R&D, fewer U.S. and foreign students are seeking careers in science and technology, there is less domestic corporate R&D, fewer S&T job opportunities, and the cycle could spiral downward.

The U.S. economy is driven to a large extent by technology innovation. After World War II there was a burst of technology-driven economic activity, and during the 1990s, concurrent with the growth of the Internet, there was another burst of economic activity related to technology. Periods of rapid technological change tend to be accompanied by stronger labor productivity growth. As each new wave of technology comes along, there is a period of rapid growth, then a leveling off, and then a new technology begins to replace the old. From the 1940s through the 1990s, the U.S. economy was characterized by corporate mass production. In the 1990s it began to shift towards an entrepreneurial knowledge-based economy.

The United States can no longer take its leadership in technology for granted. Our nation is not taking the steps necessary to maintain a lead. Other nations are catching up. Countries such as China and India that were previously seen as competing mainly in low cost manufacturing are now competing with us in advanced technology. Salaries for engineers and scientists are typically much lower in these countries, and as their technical workforces begin to match the levels of skill in the U.S., high-tech work could increasingly migrate offshore. A skilled programmer

in China or India will work for approximately one sixth of what a similar programmer would earn in the United States. These countries and others are turning out increasing numbers of well qualified scientists and engineers. Measures such as the ratio of R&D to GDP (other countries are setting aggressive goals to raise R&D spending relative to their GDPs), numbers of published technical papers, patents granted, manufacturing jobs, trade balance, and others all show that the U.S. is slipping relative to competing nations.

It has become increasingly attractive for U.S. corporations to perform some of their R&D activities elsewhere.

New England has done a better job of fostering R&D than some other parts of the country, hence New England's economy is doing better than, for example, the Great Lakes region. While some governors aggressively seek ways to enhance their states' positions in S&T, there is no national strategy to enhance the position of the U.S. relative to other nations.

Much of the national debate on education has focused on K through 12 education, but Atkinson believes that more attention needs to be directed towards university science and technology. PPI recommendations include a knowledge tax credit, expanded Federal R&D funding, and science and technology magnet schools.

The economists who are involved in shaping national economic policy for the U.S. tend to emphasize factors such as interest rates and taxes, but too frequently do not understand the importance of technology in fostering economic growth and too often tend not to favor a strong government role in promoting technology, in fact, some neoclassical economists are hostile to government promoting technology innovation as a way to achieve economic growth.

Companies may move activities offshore for reasons other than just cost. For high tech firms, labor is often not a major cost element. Efficiency of capital deployment is an important issue. It may be more efficient to site a new plant in China for a variety of reasons. Tax holidays and access to pockets of skill are factors, too. National boundaries are less important today.

As a share of value added, labor costs are still important. Currency manipulation in Asia is also a factor. China has policies that sometimes require a company that wishes to do business in China to transfer engineering functions to China, e.g., in order to get permission to build a manufacturing plant.

Michael Rubino - *NOAA*

Dr. Rubino is the manager of NOAA's Aquaculture Program. His presentation to the committee was timely for two reasons. First, ATP has funded interesting projects related to aquaculture, and this field appears to be of increasing importance to the United States. Secondly, ATP is seeking opportunities to cooperate with other Federal agencies involved in R&D, and NOAA has an interest in working with ATP.

Rubino reviewed the state of the art of aquaculture in the U.S. and around the world. Worldwide demand for seafood is increasing at the same time that the availability of natural seafood sources is declining due to over fishing/harvesting. Today 70 percent of U.S. aquaculture is catfish farming, but other types of products (e.g., shrimp, oysters, mussels, and

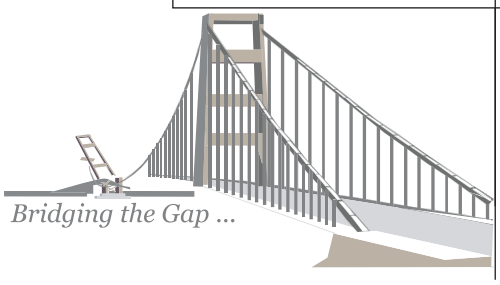
especially marine finfish) promise to become increasingly important in the future. There are two important new technology approaches in aquaculture today. First, the use of cages offshore and open ocean location, and secondly, the use of closed recirculating systems on land that recycle the water. Offshore production of species such as cod, cobia, and haddock is a growth industry. The environmental conditions in offshore locations often present favorable conditions for fish farming (relative to crowded and polluted near-shore locations). However, servicing offshore facilities can be a challenge in rough seas.

Importing of seafood to the U.S. is increasing. Currently, the inbalance of trade in seafood is nearly $8 billion. Asian countries, Mexico, Canada, and Chile are major exporters of seafood to the U.S. If the U.S. aquaculture industry can be helped to thrive, it will improve our balance of trade and create jobs and business opportunities in the U.S., including processing, feed and nutrition products, equipment and technology, and consulting services. Rubino believes that U.S. aquaculture production could triple from more than $1billion today to $3 billion by 2025 if policies are adopted to enable aquaculture to locate and operate in marine waters. Aquaculture affects other industries, too. For example, U.S. farmers sell soybeans to the Chinese for aquaculture feed.

In addition to a need for R&D funding for aquaculture, there are serious regulatory issues that need attention. Getting a license to practice aquaculture in the U.S. is difficult and time consuming. The Senate recently introduced new legislation to address some of these issues for offshore Federal waters (three to 200 miles offshore). It is too early to predict whether the legislation will pass.

R&D priorities for aquaculture include:

- Production: offshore, shellfish, recirculating, polyculture
- New species
- Hatcheries



- Feed, nutrition
- Disease, diagnostics and controls
- Eco-effective production, best manufacturing practices
- Biotech, industrial, and cosmetic products

High tech is coming to this industry. Sophisticated sensors and data telecommunications links that allow managers to monitor conditions in the aquaculture facility from the comfort of their offices are becoming available.

Aquaculture has a minor impact on the environment. In coastal aquaculture, pollution can be a problem if facilities are located in areas with little flushing from tides or currents. Closed systems have an advantage in that regard. Citing facilities further offshore tends to avoid water quality problems and may produce higher yields than in some coastal areas, but offshore locations may increase the cost of servicing the facilities. The aquaculture industry, working with scientists, has developed best management practices to minimize and avoid environmental problems.

Generally speaking, the nutritional benefits of eating more seafood greatly outweigh the adverse impacts associated with trace toxic elements in fish.

The efficiency of conversion (of feed to product) with aquaculture compares very favorably with other types of food production.

Marc Stanley commented that he is pleased that NOAA and ATP are working together to encourage those doing aquaculture research to apply to ATP. The potential for this industry appears to be huge.

In much of the world, the cost of feed is the major issue, but in the U.S., regulatory issues are the biggest hurdle to increasing production. This industry is small and fragmented, which delays regulatory reform.

There is growing interest in aquaculture within the Congress. One concern is that traditional fishermen may view aquaculture as unwanted competition, and oppose it, rather than view it as a new opportunity for those who adopt it.

International Economic Challenges

The committee received additional information on international economic challenges gathered from a number of sources. With a special emphasis on China, this information confirmed many of the trends that the previous speakers had already noted.

China is closing the gap with the U.S. in a number of important areas of technology, for example, environmental technology, medical technology, semiconductors, communications, and satellites. The number of R&D personnel in China is increasing. Cell phone and Internet usage in China have experienced dramatic growth. Not all R&D in China is innovative, but the best R&D is very good.

China is moving away from a centrally planned economy towards private sector firms that determine their own destinies. Science and technology are seen as extremely important to the future of the nation. Chinese scientists who have emigrated to other countries are encouraged to return. Technical personnel from Taiwan are also encouraged to come to the mainland.

Major government programs target particular industries. These long-range plans address traditional industries such as agriculture, but also new fields such as biotechnology.

China is studying the U.S. and European models for standards, and sees standards as a tool for protecting its industries. Presently, there is relatively little central coordination of standards issues, but that may change. More Chinese are participating in international standards groups such as IEEE.

Protection of intellectual property in China continues to be a concern. China appreciates patents more now than before, but this is still a high visibility issue.

China tends to reverse engineer products. The U.S. and Europe use performance standards, but the Chinese like to use design standards. There is some evidence that there is more transparency developing in China.

Important points to note:

- When numbers are cited for high tech exports from China, not all of value represented in the numbers may represent content from China. For example, if a complex circuit board is assembled in China and exported, some of the components in that board such as integrated circuits may have come from the United States or other countries.

- China welcomes foreign investment. A major company in China may have capital and

engineering talent flowing in from several countries, and it can be difficult to track flows of capital and personnel.

- As low-tech assembly business opportunities saturate, China is increasingly searching out opportunities for getting into more sophisticated and innovative technology ventures.

- It is easier to become a world leader in an emerging technology area where there is no clear leader. China is certainly interested in important non-traditional technology areas such as biotechnology and nanotechnology.

ADVANCED TECHNOLOGY PROGRAM

Appendix 1

Reports and Journal Articles Published by the Advanced Technology Program's Economic Assessment Office in FY 2005

ECONOMIC STUDIES

1. *The Role of the U.S. National Innovation System in the Development of the PEM Stationary Fuel Cell. NISTIR 7161*. February 2005. John Nail, Gary Anderson, Gerald Ceaser, and Christopher Hansen.

The authors participated in a multi-country study of national innovation systems and their impact on new technology development, sponsored by the Organization for Economic Cooperation and Development. In particular, they looked at the impact of the U.S. national innovation system on the commercial development of proton exchange membrane (PEM) fuel cells for residential power applications. Their findings include that private industry conducts significant amounts of basic research in fuel cells, partially driven by the importance of automotive, energy, and electronics industries in the participating countries. Energy security is considered another driver. Although industry receives the majority of new fuel cell patents issued, national laboratories and universities continue to publish the majority of the papers. Their findings support the value of public-private partnerships, such as ATP, especially projects that link private industry with universities or national laboratories.

2. *Evaluation of ATP's Intramural Research Awards Program*. NIST GCR 04-866. December 2004. Albert N. Link, and John T. Scott.

Between fiscal year 1992 through fiscal year 2000, ATP funded 1,052 intramural projects with $99 million allocated to researchers within NIST's Measurement and Standards Laboratories. ATP statute allows the program to allocate up to 10 percent of its annual appropriations internally for standards development and technical activities in support of ATP's mission. Using survey, case study, and benchmarking approaches, the authors conducted four case studies and approximated the social rate of return of the funded research. The four case studies include Wavelength References for Optical Fiber Communications: SRM 2517a, Injectable Composite Bone Grafts, Internet Commerce for Manufacturing, and Polymer Composite Dielectrics for Integrated Thin-Film Capacitors.

3. *Measuring Behavior Additionality in ATP Joint Venture Projects: Findings from the Advanced Technology Program*. Paper prepared for the OECD Working Group on Behavior Additionality. April 2005. Stephanie Shipp, Andrew Wang, Stephen Campbell, and Lorel Wisniewski (NIST), and Kerry Levin and Jennifer O'Brien (Westat).

This paper examines descriptive results from the Survey of ATP Joint Ventures which show that companies form an ATP joint venture to benefit from complementary R&D expertise, to pool resources with other firms, and to address a technical problem that is common to their industry. One clear behavioral effect evidenced was that the formation of a joint venture project fosters trust and cooperation among partners. Partners in fact show goodwill and trust each other to a high extent, and a regression

analysis confirmed that ATP involvement was an explanatory factor, along with effective governance procedures and the size of the joint venture. A post-project survey showed persistent collaborative links with 46 percent continuing with their partners on non-ATP technology and 14 percent with their subcontractors. Over half of the participants continued in R&D because of their positive ATP experience. Strategic effects on behavior emerged with 77 percent saying that their project reflected a new direction for their company and 83 percent saying that their project reflects a new R&D direction for their industry. For ATP, the concept of behavior additionality provides another dimension for evaluating outcomes from ATP-funded projects and broadens the concept of success to include both the direct and indirect effects of government funding of high-risk projects.

POLICY ANALYSIS STUDIES

1. *Evaluation Best Practices and Results: The Advanced Technology Program. NISTIR 05-7174.* May 2005. Stephanie Shipp, Connie Chang, and Lorel Wisniewski.

ATP's evaluation efforts were instituted to meet external requests for ATP program results, to use evaluation as a management tool to meet program goals and improve program effectiveness, to understand ATP's contributions to the U.S. innovation system, and to develop innovative methodologies to measure impact of the public R&D investment. The program's economists track progress of ATP projects throughout project life and post-project using a variety of tools including surveys, compiling data, producing statistical analyses, undertaking economic studies, and commissioning studies by outside consultants and research economists. The authors describe the evolution of ATP's evaluation activities, its evaluation best practices based on ATP's experience since 1990, and findings from ATP studies.

2. *Understanding Private-Sector Decisionmaking for Early Stage Technology Development. A "Between Invention and Innovation Project" Report. NIST GCR 02-841A.* September 2005. Philip E. Auerswald, Lewis M. Branscomb, Nicholas Demos, and Brian K. Min.

The authors' research illuminates the varying levels of support for early stage development activities across industries and firms. This report is based upon research and analysis performed by Booz Allen Hamilton, who conducted 39 detailed interviews with senior executives and investors from 31 large corporations across 8 industry sectors, and 8 venture capital firms. The authors drew on the interviews and examined trends in management of corporate R&D and how new market realities are affecting the ways corporations manage early stage development activities. Findings point out that emerging corporate strategies include an increasing formalization of portfolio management approaches to corporate R&D and a growing reliance on acquisitions, alliances, and contracting out to obtain access to and exploit earlier stage technologies, especially where internal barriers are blocking progress. Case studies suggest that government funding may be effective, and even essential, in helping larger firms pursue in-core radical innovations that bring economic and social benefits that would otherwise be lost.

CLUSTER STUDIES

Photonics Technologies: Applications in Petroleum Refining, Building Controls, Emergency Medicine,and Industrial Materials Analysis. NIST GCR 05-879. September 2005. Thomas M. Pelsoci.

ATP has provided cost-sharing funding to more than 120 photonics projects since 1991. To access the economic benefits from a portion of these projects, the author adopted a cluster study approach to combine the methodological advantages of detailed case studies and of higher level overview studies. The following five projects were selected for analysis: Capillary Optics for X-Ray focusing and Collimating; MEMS-Based Infrared Micro-Sensor for Gas Detection; Infrared Cavity Ring-Down Spectroscopy; Optical Maximum Entropy Verification; and Integrated Micro-Optical Systems. Findings from the study indicate that U.S. industry and consumers, and the nation, will enjoy at least $33 of benefits for every dollar of ATP's $7.47 million investment in the cluster of five projects.

ATP technology translates into $1.90 already realized benefits generated for every dollar of ATP's investment in the five projects.

WORKING PAPER

Factors Affecting U.S. Production Decisions: Why are There No Volume Lithium-Ion Battery Manufacturers in the United States? ATP Working Paper Series, Working Paper 05-01. June 2005. Ralph J. Brodd.

In the area of advanced rechargeable batteries and other areas as well, ATP has funded projects that were technically successful, but where the outlook for U.S. companies becoming major commercial players in high-volume applications is not promising at present. This study uses the case of lithium-ion batteries to seek a better understanding of industry factors that affect the introduction of new rechargeable batteries and similar types of technologies into the marketplace. Some findings from the report include:

- That U.S. battery companies "opted out" of volume manufacturing of lithium-ion batteries, primarily because of a low return on investment compared with existing business, the significant time and investment required from conception through commercialization, and the time and expense required to establish a sales organization in Japan to access product design opportunities and take advantage of them.

- Structural differences of the Japanese electronics products industry compared to its U.S. counterpart create barriers for U.S. firms seeking to market rechargeable batteries or battery materials in Japan. In markets for rechargeable batteries, customers are large, high technology electronics companies with their own battery manufacturing capability.

- Developing a product requires close contact with portable electronics device designers, which is more easily accomplished within the vertically integrated Asian companies than in the U.S. system, where battery companies have little access to device designers.

SURVEY DATA RESULTS

1. *Survey of ATP Applicants, 2002. NIST GCR-05-876. June 2005*. (Six factsheets on customer satisfaction and time and cost for proposal preparation; ten factsheets on Funding Sources for Innovative R&D, What Happens to Non-funded Projects?, ATP Helps Companies Work With Universities, and seven other topics.)

This survey was administered to all applicants in the 2002 competition year in order to compare the company and project characteristics of awardee and nonawardee companies soon after the awards were announced. It addresses the counterfactual question—what happens when a project does not receive ATP funding. The survey results found that 39 percent of those projects were not pursued, 44 were pursued on a smaller scale. Of those pursued on a smaller scale, more than four out of five reported that their project scope was reduced to below 40 percent of the proposed ATP project.

Proposed ATP projects for both awardees and nonawardees are higher risk and have a longer time horizon than their typical R&D projects. ATP awardees reported a greater contrast between their proposed ATP projects and their typical R&D projects, compared to nonawardees. A key finding is that ATP awardees attracted additional funding since submitting their ATP proposal. This phenomenon is referred to as the halo effect.

2. *Customer Satisfaction Findings from the Advanced Technology Program's Survey of ATP Applicants 2002. NIST, GCR 05-873*. February 2005. Jeffrey Kerwin, Andrew Wang, and Stephen Campbell.

From January through July, 2004, ATP conducted a *Survey of ATP Applicants* to its 2002 competition. One section of the survey focused on customer satisfaction. Overall, respondents viewed ATP review and decision process as fair; found ATP processes, information, tools, and materials to be useful; and were satisfied with ATP staff. In general, awardees rated ATP higher on customer satisfaction questions than did nonawardees, although most nonawardees offered favorable ratings as well. Responses to customer satisfaction questions given by both 2000 and 2002 applicants were very similar.

CONFERENCE PROCEEDINGS

1. *From Lab to Market: Understanding the Role of Mergers, Acquisitions, and Technology Transfer in the Innovation Process.* Paper presented at the Meeting of the American Statistical Association, Minneapolis, MN. August 2005. Gary Anderson.

The author combines proprietary ATP longitudinal data with other publicly available data to trace and characterize ownership of ATP funded technologies. The paper then explores the role that changes in ownership of these technologies play in their ultimate dissemination and commercialization.

2. *Measuring Societal Benefits: The Use of Case Studies in the Advanced Technology Program.* Paper published in Proceedings of the American Statistical Association, Minneapolis, Minnesota. August 2005. Stephanie Shipp and Jeanne Powell (NIST/ATP), and Thomas Pelsoci (Delta Research Company).

This paper summarizes the experience of ATP in using quantitative case studies that build on a statistical foundation to evaluate program impacts. It

bridges the gulf between statistics and program evaluation by describing how benefit-cost studies use methods from both fields to estimate the impact of funding high risk R&D in the private sector. The authors illustrate the combination of techniques with an in-depth example of one of ATP's recent benefit-cost studies, an analysis of five photonics projects funded by ATP (see cluster study above).

3. *Outcomes from Multiple Award Competitions in the Advanced Technology Program.* Paper presented at the Meeting of American Statistical Association. Minneapolis, MN. August 2005. Stephen L. Campbell and Andrew J. Wang.

This paper presents the analysis the authors conducted using data from the 2000 and 2002 ATP award competitions. The analysis covered the characteristics of proposed projects and applicant companies, factors that explain award selection, and subsequent research funding outcomes for awardee and nonawardee companies, and the impact of ATP selection boards on the funding decision. The authors used several regression methods and summary results are reported in table format.

OTHER PUBLICATIONS

1. *A Profile of ATP Manufacturing Investments, Inspiring Innovations in Industry. Brochure.* February, 2005.

There are risks to pursuing early-stage manufacturing technology development, although a body of evidence suggests that in terms of innovation in manufacturing, the returns to the nation far exceed the costs. This brochure highlights a few recent manufacturing projects that received ATP awards.

2. *Measuring ATP Impact, 2004 Report on Economic Progress. Statistical Abstract.* September 2004.

This report presents findings from ATP's economic and policy studies and provides data about ATP-funded project outputs, outcomes, and impacts on the U.S. economy and society. Award statistics from

all ATP's competitions present an aggregate view of the program, and short case studies provide snapshots of a few completed projects.

ADVANCED TECHNOLOGY PROGRAM

Appendix 2

ATP "Gems" and Success Stories

The Advanced Technology Program evaluates carefully each of the projects for which it provides cost shared funds. The rigorous economic evaluation methods utilized by the ATP quantify the degree of success or lack thereof of each project. The projects listed below have been deemed by ATP to be particularly successful. Check the website: *http://www.atp.nist.gov/gems/listgems.htm* for details.

American Auto Companies Form Consortium to Develop Structural Composites for Large Parts
***Automotive Composites Consortium* (ACC)**, Dearborn, MI

World's First Commercial Production Facility for High-Temperature Superconducting Wire
American Superconductor Corporation, Westborough, MA

Balancer Saves Industry Time and Money
BalaDyne Corporation, Ann Arbor, MI

Coating-Enabled Component Design: Technology Tools for Nanostructures Coatings
Caterpillar, Inc., Peoria, IL; ***United Technologies Corp.***, East Hartford, CT; and ***J.A. Woollam Co.***, Lincoln, NE

Advanced Optimization Technology to Enhance Business Decision Making
CombineNet, Inc., Pittsburgh, PA

Palm Pilot Uses Partially ATP-Enabled Handwriting Recognition Technology
Communication Intelligence Corporation, Redwood Shore, CA

ATP Helps Process to Manufacture the Next Generation Liquid Crystal Display (LCD) Chips
Displaytech, Inc., Longmont, CO

One-step Purification of Natural Gas
Engelhard Corporation, Iselin, NJ

Highly Efficient Solar Cells
Evergreen Solar, Inc., Marlboro, MA

Start-up Company Commercializes Novel Plastics Technology
Ford Motor Company, Dearborn, MI and ***General Electric Research and Development***, Schenectady, NY

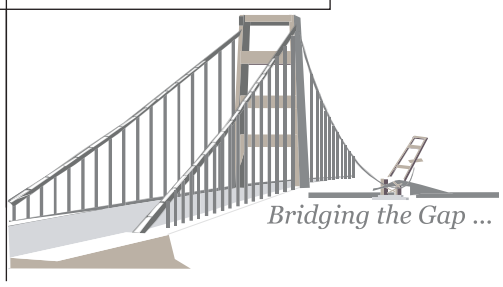
Low-Cost Amorphous Silicon Manufacturing for Digital Mamography and Other Uses
General Electric Global Research, Schenectady, NY and ***Perkin Elmer***, Boxborough, MA

High-Performance NanoMaterials
Hybrid Plastics, Inc., Hattiesburg, MS

Kent SeaTech Increases Fish Farm Yield and Recycles Water for Neighboring Agricultural Irrigation
Kent SeaTech Corporation, San Diego, CA

Software to Develop Cognitive Skills
Lexia Learning Systems, Inc., Lincoln, MA

World's First Corn-to-Plastics Plant Opens
NatureWorks LLC, Wayzata, MN



Web-Based Technologies that Drastically Change Industrial Product Design
Ohio Aerospace Institute (project lead)
Cleveland, OH

Integrated Microfabricated Devices for DNA Typing
***Orchid Biosciences*, Inc.**, Princeton , NJ

Holographic Diffusers that Can Efficiently and Cost Effectively Distribute Light
Physical Optics Corporation, Torrance CA

Model Driven Intelligent Control of Manufacturing
STEP Tools, Inc., Albany, NY

Generic Technologies for the Targeted Detection and Cleavage of DNA and RNA
Third Wave Technologies, Inc., Madison, WI

First Commercial Heterogeneous Catalyst Developed Using High Throughput Discovery Techniques
UOP LLC, Des Plaines, IL and
Novodynamics, Inc., Ann Arbor MI

Innovative Optics Technology to Focus X-Rays and Neutrons
X-ray Optical Systems, Albany, NY

Appendix 3

Status Reports Completed in Fiscal Year 2005

ADVANCED MATERIALS & CHEMISTRY	
COMPANY	PROJECT TITLE
ABB Lummus Global, Inc. (formerly ABB Lummus Crest)	Thin-Film Solid Acid Catalyst for Refinery Alkylation
Advanced Refractory Tech	Diamond-Like Nanocomposite Technology
Air Products and Chemicals, Inc.	Energy-Efficient Oxygen Production Using Novel Ion-Transport Membranes
Automotive Composites Consortium (a partnership of DaimlerChrysler [formerly Chrysler], Ford and General Motors)	Automotive Composite Structures: Development of High-Volume Manufacturing Technology
Bosch (formerly Allied Signal)	Low-Cost, Near Net-Shape Aluminum Casting Processes for Automotive and Truck Components
BP Amoco	Facilitated Transport Process for Low-Cost Olefin-Paraffin Separations
Catalytica Energy Systems (formerly Catalytica, Inc.)	Development of Improved Catalysts Using Nanometer-Scale Technology
Crucible Materials Corporation, (formerly Catalytica, Inc.)	Rapid Solidification Powder Metallurgy for High-Nitrogen Stainless Steels
General Electric Corporation R&D	Intelligent Processing of Materials for Thermal Barrier Coatings
GM Thermoplastic Engineering Design (Engineering Design with Thermoplastics)	Engineering Design With Injection-Molded Thermoplastics
Homeywell (formerly Allied Signal)	Ceramic Technology for Broad-Based Manufacturing
Honeywell (formerly Allied Signal)	Aqueous Injection Molding for Low-Cost Fabrication of Silicon Nitride Components

ADVANCED TECHNOLOGY PROGRAM

Bridging the Gap ...

Status Reports Completed in Fiscal Year 2005 (cont'd)

Advanced Materials & Chemistry (cont'd)

COMPANY	PROJECT TITLE
IBM T.J. Watson Reseearch Center	Conducting Polymers: Three Dimensional Engineering for Advanced Applications
PCC Structurals	Development of Casting Technology to Produce Large Superalloy Castings for Industrial Applications
Praxair, Inc.	Advanced Sorbents for Reducing the Cost of Oxygen
Texas Instruments, Inc.	Ultra-Low k Dielectric Materials for High-Performance Interconnects
United Technologies Research Center	Novel Leak Detection Technology Development
Wyman-Gordon	Cost-Effective, Near-Net-Shape, Superalloy Forgins for Power Generation Gas Turbines
York International	York Coil Technology Project

Biotechnology

COMPANY	PROJECT TITLE
Aphios Corporation	Marine Microorganisms and Saline Fermentation: A New Industrial Resource
Cengent Therapeutics, Inc. (formerly Moldyn, Inc.)	Enhanced Molecular Dynamics Simulation Technology for Biootechnology Applications
Dow AgroSciences (Mycogen Corporation)	Oleaginous Yeast Fermentation as a Production Method for Squalene and Other Isoprenoids
DuPont Qualicon (formerly Dupont FQMS Group)	Automated DNA Amplification and Fragment Size Analysis
Genosensor Consortium (c/o Houston Advanced Research Center)	Genosensor Technology Development

Status Reports Completed in Fiscal Year 2005 (cont'd)

BIOTECHNOLOGY (CONT'D)	
COMPANY	PROJECT TITLE
Incyte Corporation (formerly Combion, Inc.)	DNA Diagnostic Systems Based on Novel Chem-jet Techniques
JDS Uniphase (formerly The Uniphase Corporation)	Compact Blue Laser for Diagnostics
Large Scale Biology Corporation (formerly Large Scale Proteomics Corporation)	Standardization of 2-D Protein Analysis Using Manufacturable Gel Media
Medical Analysis Systems (formerly NAVIX)	DNA Diagnostics Using Self-Detected Target-Cycling Reaction (SD-TCR)
Monsanto (formerly Agrecetus)	Transgenic Cotton Fiber With Polyester Qualities *via* Biopolymer Genes
Orchid BioSciences (formerly Molecular Tool, Inc. Alpha Center)	Integrated Microfabricated Devices for DNA Typing
The Dow chemical Company	Breakthrough Process for Direct Oxidation of Propylene to Propylene Oxid
Valentis, Inc. (formerly Progenitor, Inc., a subsidiary of Interneuron Pharmaceuticals)	Application of Gene Therapy to Treatment of Cardiovascular Diseases

ELECTRONICS/PHOTONICS	
COMPANY	PROJECT TITLE
eMagin Corporation (formerly FED Corporation)	Large Area Digital HDTV Field Emitter Display Development
INSIC (formerly NSIC) - Short Wavelength	Short-Wavelength Sources for Optical Recording

ADVANCED TECHNOLOGY PROGRAM

Bridging the Gap ...

Status Reports Completed in Fiscal Year 2005 (cont'd)

ELECTRONICS/PHOTONICS (CONT'D)	
COMPANY	PROJECT TITLE
Kopin Corporation	High Information Content display Technology
Planar Systems, Inc. (American Display Consortium)	Patterning Technology for Color Flat-Panel Displays
SDL, Inc. and Xerox Corporation	Monolithic Multiwavelength Laser Diode Array Spanning 430 to 1100nm
Superconductor Technologies, Inc. (formerly Conductus)	Hybrid Superconducting Digital System

INFORMATION TECHNOLOGY	
COMPANY	PROJECT TITLE
Abrasive Technology Aerospace, Inc.	Rapid Fabrication of Superabrasive Grinding Tools
Accenture (formerly Andersen Consulting Center for Stragetic Resarch)	Component Integration: An Architecture-Driven Approach
Cerner Corporation	Methodologies for Automating Clinical Practice Guidelines
Cerner Corporation (formerly DataMedic - Clinical Information Advantages, Inc.	"MEDencode" - A Technology to Populate a Clinical Data Repository as a By-product of Producing the Clinical Note
Cincinatti Lamb, UNOVA (Lamb Technicon)	Agile Precision Line Boring
IBM Corporation	A Product-Family-Based Framework for Computer Inetegrated Manufacturing
InStream	Development of a Seamless Clinical Management System for Behavioral Health Organizations

Status Reports Completed in Fiscal Year 2005 (cont'd)

INFORMATION TECHNOLOGY (CONT'D)	
COMPANY	PROJECT TITLE
Lucent Technologies (formerly AT&T Bell Laboratories)	Automation of Dependable software Generation with Reusable Components
Montronix	Machine Tool Process Monitoring Diagnostic System
SciComp, Inc.	Automatic Generation of athematical Modeling Components
Titan Systems (formerly Intermetics)	Enterprise Tools for the Continously Available Medical Care (CAMC) Home Healthcare System
Xerox Palo Alto Research Center	Reusable Performance-Critical Software Components Using Separation of Implementation Issues

ADVANCED TECHNOLOGY PROGRAM

Bridging the Gap ...

About the Advanced Technology Program

The Advanced Technology Program (ATP) bridges the gap between the laboratory and the market place through research partnerships with the private sector. ATP's early stage investments accelerate the innovation of new products and processes that contain enabling technologies that private investors consider too risky. ATP changes the way U.S. industries approach high-risk research by providing a mechanism for industry to extend its technological reach and push out the envelope of what can be attempted.

ATP views R&D projects from a broad perspective. In sharing the relatively high risks of developing technologies that could enable a broad range of new commercial opportunities, ATP fosters projects with a high pay-off for the nation as a whole in addition to a direct return to the innovators.

ATP has several features that set it apart from other government R&D programs:

- For-profit companies conceive, propose, and execute ATP projects, often in alliance with other companies, academia, not-for-profit organizations, and federal labs. All industries and all fields of science and technology are eligible for funding. For-profit companies retain rights to all intellectual property developed in a project.
- The ATP award is a cost-share agreement. Joint Ventures (two or more for-profit companies working together) pay at least half of all project costs. Large, *Fortune* 500 companies participating as single firms must pay at least 60 percent of total project costs. Small and medium-sized companies working on single-company ATP projects must pay a minimum of all indirect costs associated with the project.
- ATP does not fund basic research or product development.
- ATP awards are made strictly on the basis of rigorous peer-reviewed competitions. Selection is based on scientific and technological merit, and strong potential for broad-based economic benefits to the nation. All proposals are assured a confidential, technically competent review even if they involve a broad, multi-disciplinary mix of technologies.
- ATP's support does not become a perpetual subsidy or entitlement.
- Each project has goals, specific funding allocations, and completion dates established at the start. Projects are monitored and can be terminated for cause before completion.

More than 60% of ATP awards have gone to small businesses or to joint ventures led by a small business. Of the projects selected for awards since ATP's inception in 1990, well over half of the projects include one or more universities as either subcontractors or joint-venture members. More than 165 universities have participated in ATP projects.

For more information, or to be put on the ATP mailing list:

Hotline:	1-800-ATP-FUND (1-800-287-3863)
Email:	*atp@nist.gov*
Fax:	(301) 926-9524
Web site:	*http://www.atp.nist.gov*
By writing:	**Advanced Technology Program** National Institute of Standards and Technology 100 Bureau Drive, Stop 4701 Gaithersburg, MD 20899-4701