US DEPARTMENT OF COMMERCE

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The Advanced Technology Program: Reform with a Purpose

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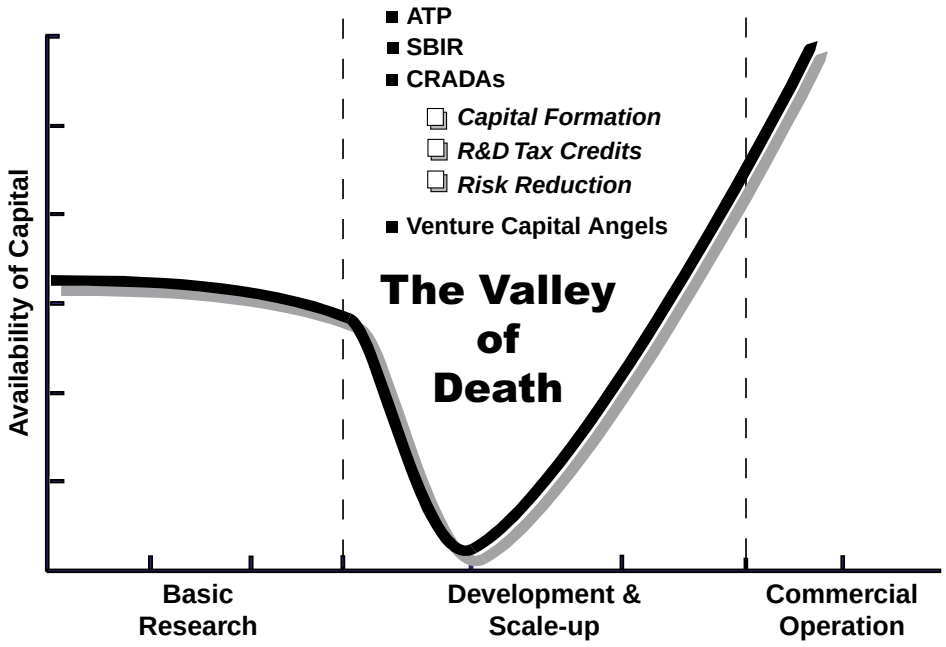
1. Introduction and Overview

The Department of Commerce's Advanced Technology Program[1] (ATP) was authorized in 1988 and first funded in 1990. Its goal is to fund early-stage, high-risk research that would likely be deferred if not for government support—research with the potential to engender broad economic benefit, not simply to benefit individual award recipients. By assisting in the funding of this kind of research, ATP helps propel promising technologies through the "Valley of Death"[2] that many argue is encountered by entities attempting to move new technologies out of the laboratory and into the marketplace.



Throughout its history, ATP has remained controversial. Some critics have suggested that the Program is an example of "corporate welfare," in that it funds firms, especially large firms, that seem to have the resources to engage in the research independently. Others have suggested that the Program funds research tasks that are too close to product development. Late-stage research is

[1] The ATP is part of the Department's Technology Administration and is housed at the National Institute of Standards and Technology (NIST). It was established by the Omnibus Trade and Competitiveness Act of 1988 (P.L. 100-418, 15 U.S.C. Sec. 278n).

[2] The so-called "Valley of Death" refers to the time period prior to the demonstration of technical and economic feasibility of a new technological concept, when the risks are very high due to uncertainty or complexity. It is believed that transcending the "valley" in the shortest time is crucial for success in exploiting the new technology in the market place. Independent studies have found that the ATP has successfully reduced this lead time by at least half, via direct industry partnerships that broaden the base of technical and business expertise and through direct technical assistance by NIST, universities and Independent Research Organizations (IROs).

an activity the Administration believes should be left to the private sector. Ongoing debates over the Program's aims and policies have hindered its stability.

Perhaps the most comprehensive study[3] of the Program to date was released by the National Research Council (NRC). The NRC study, which addresses these controversies, found that the Program is effective, supports research that is unlikely to be funded by the private sector alone, and credibly assesses its record of achievements in order to evaluate its impact.

ATP funding has had a beneficial impact, and basic research continues to be a priority for federal investment in science and technology. The ATP Program, with appropriate reforms, can play a useful role in the Federal science and technology portfolio. The National Venture Capital Association reports that per annum venture capital spending in the United States grew from approximately $2 billion during ATP's first year of funding to $103 billion in 2000, and corporate R&D spending has risen over the past several years. Yet, this corporate R&D spending has been mostly on evolutionary R&D. In fact, in his research[4] at Harvard University, Professor Lewis M. Branscomb makes a compelling case that industry spending on early-stage technology development—the research that ATP funds—remains very low relative to overall spending.

Furthermore**,** since the Program's inception, the role of the university has evolved. Although increasingly recognized as hotbeds of innovative activity leading to commercial ventures, universities are not allowed, under current law, to lead ATP joint ventures or to hold rights in the intellectual property (IP) that results from ATP-funded research.

Accordingly, it is necessary for ATP to become more responsive to the changing research and business environments. It is important to build on the Program's record while acknowledging valid criticism. The Program needs to be periodically reviewed and modified, and be given a greater degree of stability[5] in order to fully achieve its promise.

Below are six changes that, if implemented, would serve to stabilize and strengthen the Program. Each of the proposed reforms is discussed in detail in the following pages.

[3] National Research Council, *The Advanced Technology Program: Assessing Outcomes*, Charles W. Wessner, editor, Washington, D.C.: National Academy Press, 2001. In addition, many evaluations of ATP have been undertaken by a variety of investigators, including academics working with the National Bureau of Economic Research (NBER), "think tanks" such as the American Enterprise Institute, and independent or congressional bodies, including the General Accounting Office (GAO).

[4] Lewis M. Branscomb, *Between Invention and Innovation: An Analysis of the Funding for Early Stage Technology Development*. A project of the Kennedy School of Government's Science, Technology and Public Policy Programs. To be released Spring 2002.

[5] Greater stability for R&D funding is one of the key recommendations to emerge from the National Research Council's *The Advanced Technology Program: Assessing Outcomes*.

Proposed reforms:

- Recognize the significant value of the resources that institutions of higher education offer by allowing universities to lead ATP joint ventures.

- Offer universities increased incentive to participate in developing commercially relevant technologies by allowing them to negotiate with joint venture partners over the rights to hold the intellectual property that results from research.

- Limit large companies' participation in ATP to joint ventures. ATP support for large companies in the Fortune 500 as single applicants is inappropriate. However, in recognition of the economic value of the diffusion of knowledge—as well as other national benefits that arise from large firm participation in joint ventures—large companies should be permitted to receive ATP awards, although only as part of a joint venture.

- Reinvest a percentage of revenues derived from awards back into ATP to fund additional high-risk research and help stabilize the Program. To accomplish this, ATP-funded companies that achieve successful commercialization should pay an annual royalty to the government of 5%, up to 500% of the amount of the original award.

- Modify ATP project management activities and selection criteria to ensure that the Program does not fund product development and marketing. Later-stage research efforts, specifically product development and marketing, are not the proper domain for government funding.

- Determine, where appropriate, whether additional private-sector, non-proprietary input would improve the ability of ATP's selection boards to assess funding requests. Although ATP uses a competitive peer-review process in selecting research projects for funding, its selection panels sometimes consider funding requests without complete information on planned or ongoing private-industry research in the technological areas under consideration.

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2. Proposed Reforms

Reform #1: University Leadership of ATP Joint Ventures

Proposed Change:

ATP's statute should be changed to allow institutions of higher education to lead ATP joint ventures. Given their increased capabilities—and given their investment in the infrastructure needed to take research from the lab to the marketplace—qualified universities are as capable as Independent Research Organizations (IROs) of leading ATP joint ventures. As long as corporate entities remain substantially involved in R&D, programmatically advise projects, and facilitate definition of research agendas, universities could provide excellent leadership of ATP joint venture awards.

Enabling a greater role for universities in ATP projects is consistent with the Administration's interest in ensuring that the Program supports projects toward the basic research end of the research-to-product development spectrum. Universities have a key role in basic research, and are also involved in applied research that moves basic findings toward applications with commercial potential.

Background and Analysis:

The role of the university has changed

During the past 20 years, the role of U.S. universities as a driver of economic growth and productivity has changed drastically. Fueled in part by the Bayh-Dole Act (1980), American universities have become increasingly active in undertaking sophisticated commercially-focused, high-risk research. Today, university-supported research makes its way to the market through such mechanisms as incubation programs, spin-off companies, technology transfer efforts, and sponsored research.

In turn, U.S. industry has been able to effectively leverage the new capabilities provided by universities. As technology has become more complex and multi-disciplinary, and as short-term competitive pressures have forced companies to focus more on near-term returns, U.S. industry has turned to universities to undertake the kind of pioneering research they once performed. Universities place great value on this synergy. According to the University of Wisconsin (UW):

> "(I)ndustry can and does provide universities with important intellectual stimulation, as well as interpretations and reinterpretations of academic research results from a different and valuable perspective. In fact, one of the primary assets of the UW is its interactive relationship with industry, which keeps it informed of industrial needs and interests, and provides important feedback on the results of our research." [6]

[6] *Policies Concerning Research Sponsored by Industry: University of Wisconsin-Madison Graduate School*, p.1 http://www.rsp.wisc.edu/indres.htm

Likewise, major research universities have increased their reliance on corporate partnerships. They have responded, in part, by creating entire administrative departments to create and manage "sponsored" research funded by industrial clients. As a result of these trends, corporate-sponsored university research, which can provide universities with additional funding from licensing successful technologies, increased from $236 million in 1980 to more than $1.3 billion in 1992. Today, more than 200 universities are licensing technology to industry, an 800% increase since 1980. In 1993, universities received over $320 million in royalty income from licensing their inventions, and a substantial fraction of these revenues is reinvested in R&D that supports existing licenses. Universities move their inventions into the marketplace not only through corporate partnerships, but by setting up their own "startup" or "spinoff" companies as well. Furthermore, many universities have set up or are closely associated with technology "incubators" specifically designed to help such startups.

The evolving role of universities is further reflected in "industry" association trends. Associations that represent research contracting and research management professionals in universities have experienced significant growth in recent years. These associations include:

- the National Council of University Research Administrators (www.ncura.edu),
- the Society of Research Administrators (www.srainternational.org), and
- the Association of University Technology Managers (www.autm.net).

NCURA membership has grown from 1,400 members in 1980 to 3,600 today. Between 1993 and 1999, SRA membership grew from about 2,500 to more than 3,200. In addition, the Association of University Technology Managers has grown from 133 members in 1980 to about 2,800 in 2001. The top-notch continuing education opportunities these professional associations provide at both the national and regional level are a strong testimonial to the infrastructure that universities have built for developing commercially-oriented technologies and for moving these technologies into the marketplace.

In short, there has been a major evolution in the role of U.S. research universities. Today, many universities are well qualified to transfer technology into the commercial marketplace and effectively compete. They often have the staff and infrastructure needed to effectively bridge the "valley of death." For example, the Executive Director of Research Administration and Technology Transfer at the University of California System "directs a staff of 78 employees in the Office of the President and is responsible for system-wide administration of technology licensing activities carried out at UCOP and six campus-based licensing offices."[7]

ATP can better capitalize on these capabilities

Given this evolution at the nation's universities, the Administration recognizes that ATP's mission of bringing about broad-based benefits via technology development may be consistent with the mission of leading research institutions. In fact, significant synergistic developments are likely to

[7] *2000 Annual Report: University of California Technology Transfer Program*, p 5.

stem from an enhanced relationship with university technology transfer centers. One school boasts:

> "At Columbia, we not only have world-class teachers and researchers, but we also are determined to make their technologies and breakthrough inventions available to the American people and the world."[8]

ATP should leverage the growing capabilities that universities now offer. By allowing qualified universities to lead joint ventures, ATP could effectively capitalize on the capabilities that are recognized by the states as "more than an asset for producing a skilled workforce—they are also an important economic development tool."[9] The Program could take advantage of the effective infrastructure that large universities (see Table 1) have built for leading commercially-oriented research—research that may be steered in part by the universities' corporate partners. Such a change would likely increase university-industry partnerships, and could only be beneficial:

Table 1 - **Most Involved Universities Incidents in Active and Completed Project**

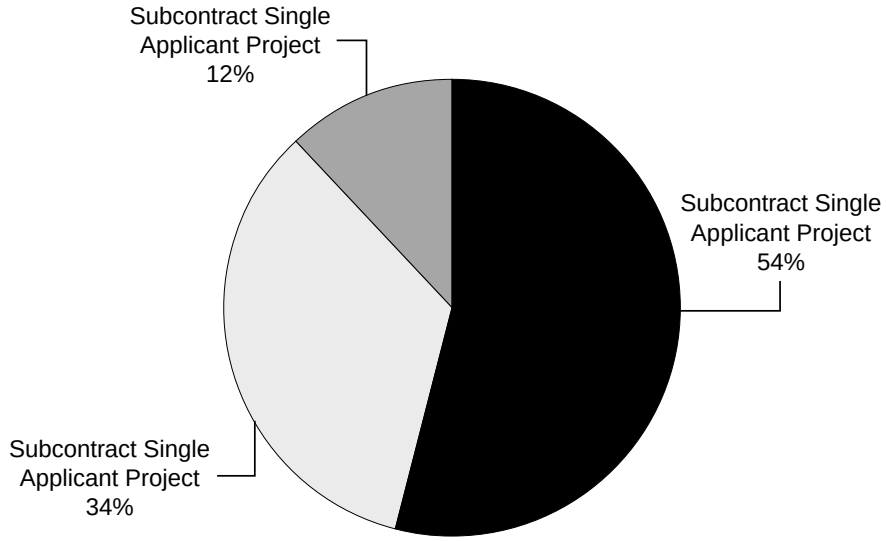
Organization	As Subcontractor	As JV Partner	TOTAL	Tech Transfer/Licensing Office?
Stanford	14	4	18	Office of Technology Licensing Stanford University 900 Welch Road, Suite 350 Palo Alto, CA 94305-1850
University of Michigan	15	1	16	Office of Technology Transfer 2071 Wolverine Tower 3003 S. State Street Ann Arbor, MI 48109-1280
Massachusetts Institute of Technology (MIT)	15	1	16	Technology Licensing Office MIT 5 Cambridge Center Kendall Square, Room NE-230 Cambridge, MA 02142-1493
Carnegie Mellon	9	5	14	Carnegie Mellon University Technology Transfer Office 4615 Forbes Avenue, Suite 302 Pittsburgh, PA 15213
Pennsylvania State	13	1	14	Director of Technology Transfer 304 Old Main University Park, PA 16802
Ohio State	11	2	13	The Office for Technology Licensing 202 Research Foundation Building The Ohio State University 1960 Kenny Road Columbus, OH 43210
Cornell	12	1	13	Cornell Research Foundation 20 Thornwood Drive, Suite 105 Ithaca, NY 14850
University of Minnesota	11	2	13	University of Minnesota Patents and Technology Marketing 450 McNamara Alumni Center 200 Oak Street, SE Minneapolis, MN 55455-2070
Johns Hopkins	10	2	12	Office of Technology Transfer The Johns Hopkins University Applied Physics Laboratory 1100 Johns Hopkins Road Suite 1-W146 Laurel, MD 20723-6099
University of California, Berkeley	8	3	11	Office of Technology Licensing University of California, Berkeley 2150 Shattuck Avenue, Suite 510 Berkeley, CA 94720-1620

[8] *Annual Report: Columbia Innovation Enterprise*, p.1, http://www.columbia.edu/cu/cie/Annual_Report/ar9900_letter.htm
[9] T. Rubel and S. Palladino, "Nurturing Entrepreneurial Growth in State Economies," National Governors' Association, 2000, p.17.

"University-industry partnerships are helping to move new discoveries from the laboratory to the marketplace faster and more efficiently than ever before—ensuring that products and services reach the public more quickly and often. The partnership enables a researcher — who made the initial discovery — to participate in the further development of a product or process, which in turn, significantly reduces the time to eventual commercialization."[10]

University Participation in 533*
ATP Projects
42 Competitions: 1990-September 2001

Types of Participation



Note: Each instance of participation is counted where a university participates in more than one award.

* Study based on Active and Completed Projects.

University-led joint ventures would acknowledge those institutions' important contributions

Universities have played an important role in ATP-funded projects since the Program's inception. Even in the ATP's early years, there was university participation in about half of the Program's projects. In fact, many ATP-funded projects involve participation by more than one university. The reason a for-profit firm seeks university participation is apparent: universities often provide ATP

[10] *Surveys—Common Questions and Answers About Technology Transfer*, Association of University Technology Managers (AUTM), p 1-2, http://www.autm.net/pubs/survey/qa.htm.

projects with access to eminent researchers, multi-disciplinary excellence, and established research expertise. Furthermore, universities also have extensive experience in government contracting that many small companies lack. Allowing universities to lead ATP projects would clearly acknowledge these important contributions.

University-led joint ventures enhance the equity of the Program

The existing ATP Rule allows non-profit independent research organizations (IROs) to submit a proposal to ATP on behalf of a joint venture and to administer an ATP project provided that the following two conditions are met:

(1) The joint venture includes at least two separately-owned for-profit companies, both of which are substantially involved in the R&D and both contributing towards the cost-sharing requirement, and
(2) The joint venture is industry-led, i.e., the industry partners must be substantially involved in the R&D, with a leadership role in programmatically steering the project and facilitating definition of the research agenda. The industry partners must also be committed to the commercialization plans if the technology is successfully developed.

Examples of IROs include Battelle Labs and the National Center for Manufacturing Sciences.

Furthermore, ATP's current policy of restricting universities from leading projects is inconsistent with the policies of many other Federal programs. Numerous other programs recognize the ability of universities to lead industry/university collaboration for technology development. Examples include the National Science Foundation's Industry/University Cooperative Research Centers (www.eng.nsf.gov/iucrc); State/Industry/University Cooperative Research Centers (www.eng.nsf.gov/eec/siurc_intro.htm) and Engineering Research Centers (www.eng.nsf.gov/eec/erc.htm); the Small Business Technology Transfer Program (STTR) www.sba.gov/sbir/indexsbir-sttr.html; DARPA (Defense Advanced Research Agency; www.darpa.mil); and NASA's Centers for the Commercial Development of Space.

In sum, while universities currently do not qualify as IROs and are thus precluded from leading ATP joint ventures, they are often as well qualified as IROs in helping to get technologies to the marketplace. Should universities be permitted to lead ATP-funded joint ventures, however, it would be appropriate for them to be held to the same rigorous standards of leadership as are IROs**.**

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Reform #2: University and other Non-Profit Organization Ownership of ATP-Funded Patents

Proposed change:

Amend the statute to permit universities and other non-profit members of ATP joint ventures to negotiate for rights in intellectual property resulting from these ventures.

Background:

The passage in 1980 of the Bayh-Dole Act, which gives universities title to inventions arising from the research funded by the Federal government, sparked a revolution in university research. This statute recognized that imagination and creativity were a national resource that was best encouraged by offering the financial rewards of inventorship to those who do the actual inventing**.** The legislation has been successful and its impact significant. Between 1980 and 1993, the number of U.S. patents issued to universities each year has grown from less than 250 to more than 1,600. Almost 4,300 products now on the market came out of research that was performed in universities. Today, products that arose from work done at universities, other non-profits and patent management firms contribute approximately $40 billion to the U.S. economy and support over 260,000 jobs. These trends continue to accelerate. Between 1991 and 1999, annual invention disclosures by university researchers increased 63% (to 12,324), patent filings increased 77% (to 5,545) and new licenses/options increased 129% (to 3,914).[11] Examples of new products that have resulted from university research work include DVD players, Lycos® and Google®, the CyberMark Smart card®, the Cohn Cardiac Stabilizer and 8Mbps modems.

These trends reflect the reality that universities are adept at managing intellectual property (IP) and have been negotiating the right to hold such property in their industry partnerships for more than 20 years. They also reflect universities' ability to undertake technology transfer effectively.[12] According to Dr. Mary L. Good, past President of the American Association for the Advancement of Science and former Under Secretary of Commerce for Technology:

> "The whole issue of intellectual property residing with universities has worked out extremely well. It has a proven track record and universities have handled it in an ethical and appropriate manner."[13]

Current ATP legislation restricts how intellectual property can be shared with universities participating as subcontractors or in joint venture arrangements. The Bayh-Dole Act, which allows universities to retain intellectual property rights for research performed with Federal funds, does not apply to ATP. Because of this, the Program may be disadvantaged in attracting well-qualified

[11] *Surveys: Common Questions and Answers About Technology Transfer*, Association of University Technology Managers (AUTM), http://www.autm.net/pubs/survey/qa.htm.
[12] Technology transfer refers to the movement of discoveries and innovations resulting from scientific research conducted at universities into the commercial sector. One way that universities transfer technology is through the patenting and licensing of innovations. (AUTM Survey).
[13] Telephone Interview, January 10, 2002.

researchers from top universities. In fact, universities often see this feature of ATP as putting them at a competitive disadvantage. Patent rights are important to universities. According to Dr. Good:

> "Intellectual property rights allow universities to work with industry in a way they would not be able to without them. They give universities something to bargain with."[14]

Universities have demonstrated their ability to manage IP effectively and perform technology transfer activities. Thus, the Administration believes that universities participating in ATP should be allowed to retain intellectual property rights and concurs with the ATP Advisory Committee recommendation:

> "ATP authorizing legislation (should) be rewritten such that companies applying to ATP can decide for themselves how they wish to share intellectual property ownership with university partners if they wish to share it. This change would be welcomed by universities throughout the United States and would likely increase university participation in ATP projects" [15]

While ATP has not performed a comprehensive survey of universities regarding its IP provisions, anecdotal evidence suggests that universities' inability to take title to IP is a point of contention and may reduce their participation in the Program. In fact, Dr. Steven Price, Director of University-Industry Relations at the University of Wisconsin-Madison, stated that he does not encourage members of his community to apply to ATP, due to the restrictive IP provisions.[16]

The Administration finds that ATP's IP provisions place universities in a subordinate position and believes they should be able to negotiate for these valuable assets. It is clear that universities derive great value from the IP generated by their faculty and clear that they know how to get the technology into the marketplace. For example, in 1999/2000, Columbia University was the nation's largest generator of technology transfer revenue, with revenues of $166.3 million from transfer activities. Similarly, the University of California System generated $77.7 million from royalty, fee, and patent/legal reimbursements in the fiscal year ending June 2000.

Often, a substantial portion of the revenue a university receives from patent licensing is reinvested in the system to further advance its mission. For example, according to Columbia's Science and Technology Venture Annual Report:

> "Our mission at S&TV is to work with the faculty to achieve [breakthrough inventions] while reinvesting any financial returns in more University research to continue pushing back the frontiers of knowledge."[17]

[14] Telephone Interview, January 10, 2002.
[15] *2000 Report of the ATP Advisory Committee*, p.6.
[16] Comment made during National Academy of Science's Government-University-Industry Research Roundtable Meeting, March 15, 2000.
[17] *Columbia University Science and Technology Ventures Annual Report*.

Eliminating the IP restriction would not only serve to increase university participation in the program but also to acknowledge the important role that universities play in ATP joint ventures. It would increase equity by empowering universities to negotiate for appropriate intellectual property rights with their commercial ATP partners. Finally, increased university participation would go far in promoting technology transfer for broad national benefits, consistent with ATP's mandate as well as the stated objectives of many leading research institutions:

> "Patentable discoveries … are to be used and controlled in a fashion that maximizes their benefit to the public." [18]

[18] Texas A&M University System: *Technology Licensing Office, System Policy 17.02*, Revised December 7, 2001.

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Reform #3: Retain Large-Firm Participation in ATP Joint Ventures

Proposed Change:

The ATP statute should be amended to provide that a company of Fortune-500 size (generating more than $2.5 billion annually) may participate only as a part of a joint venture. This would enhance the Program's ability to ensure broad diffusion of results, and would thereby improve the Program's long-term effectiveness. By partnering with large firms, universities and small- and medium-sized firms also would benefit from the larger firms' marketing and technological insights.

Background and Analysis:

ATP is an industry-driven program whose mission is to accelerate the development of innovative technologies for broad national benefit through partnerships with the private sector. The private sector encompasses firms and organizations from small two-person start-up companies operating on shoe-string budgets, to universities, Independent Research Organizations (IROs), and members of the *Fortune 500*. ATP draws from this diverse pool to seek out the best opportunities for taxpayer investment in new enabling technologies. The rich diversity of participation from organizations of all sizes and types is reflected in ATP program statistics: 60% of all ATP projects are led by small businesses, more than 150 universities participate, and 88% of all joint venture projects with large firm participation also include a smaller company.

Throughout the Program's life, there has been a debate as to who are the most appropriate participants. Some have suggested that ATP funding be restricted to small businesses, the argument being that small businesses are singularly qualified, due to their low-overhead innovation capability.[19] Yet this contention ignores the critical niche ATP fills in the Federal R&D portfolio:

> "ATP is not the same as the SBIR (Small Business Innovative Research) Program…SBIR's selection criteria are different, and ATP's ability to support joint ventures involving companies of all sizes is important for broader diffusion of results."[20]

The participation of firms of all sizes is a critical aspect of ATP-funded joint ventures.[21] Projects should continue to include a mix of large and small firms. Having both advances the Program's

[19] D. B. Audretsch and R. Thurik, *Innovation, Industry, Evolution, and Employment*, New York: Cambridge University Press, 1999.

[20] *2000 Advisory Committee Report*, p.6.

[21] In ATP, firms may either be funded as single applicants or as joint ventures. While the Program does not exclude participants by size or by organizational type (firm, university or other non-profit) or by the form of application (joint venture versus single applicant), there are different rules that apply. Under current rules, any award granted to a single applicant is subject to a three-year time limit and a $2M cap. Furthermore, single applicant awards are only granted to for-profit companies. In joint ventures, participants are afforded slightly different incentives: a joint venture must have at least two for-profit companies, and the industry cost-share must be greater than 50% of total project costs. However, there is no limit on award amount and joint ventures are given up to five years to pursue the technology development. More details on this may be found in the *ATP Proposal Preparation Kit*, http://www.atp.nist.gov.

mission of accelerating technology development and thus yields larger benefits. Indeed, joint ventures create many important synergies. Involving firms of all sizes in joint ventures creates a powerful mechanism for the development of future enabling technologies by providing their technical resources. Of particular importance is the role that large firms play in these arrangements. Large firms bring value to joint ventures from their experience in managing complex projects. They also contribute stability, skills, technology, and potential customers. The NRC warns of the dangers of limiting ATP joint ventures to small businesses:

> "The participation of large companies is a unique and valuable characteristic of ATP. 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. The participation of larger companies can also ensure better access to downstream markets with the small firms with which they collaborate under this Program. Accordingly, awards to joint ventures involving large companies should be retained."[22]

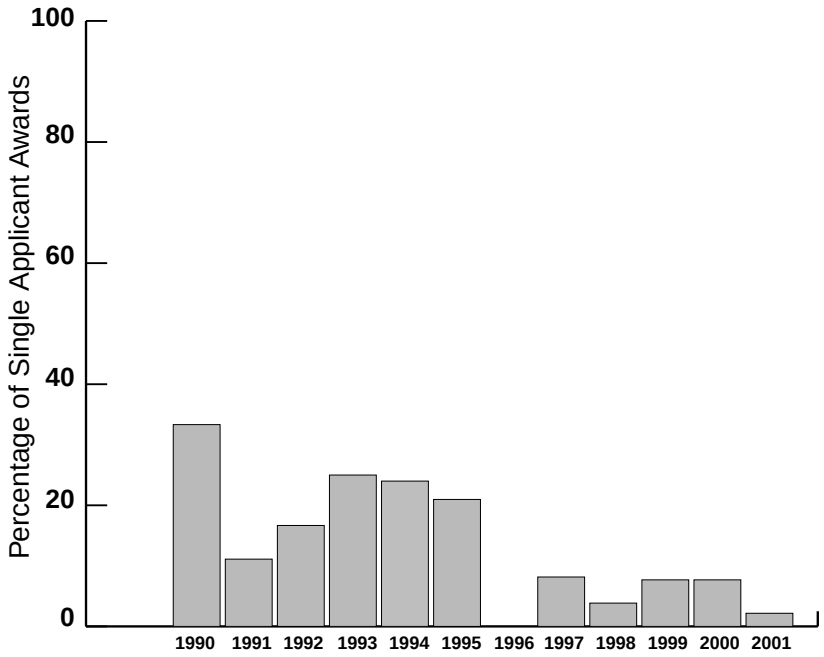
Given these facts, the Administration recognizes the unique role played by ATP in catalyzing these arrangements, and that the Program draws its strength from participation by firms of all sizes. Furthermore, if ATP is truly industry-driven, it must accurately reflect industrial trends in technology development, such as:

> "(A) [the] trend in industrial R&D today…for large companies increasingly to team with tiers of small business suppliers or end-users." [23]

While the Administration believes that large firms should be encouraged to continue to participate in the Program as members of joint ventures, it believes their role as single applicants should be discontinued. Eliminating the current provision that allows large firms to participate as single applicants should not have a significant impact on advancing the Program's objectives. Rather, it simply makes operational a trend that started in 1997. On December 9, 1997, a rule change required large firms applying as single applicants to ATP to pay 60% of all project costs. This rule change was intended to place greater emphasis on joint ventures and consortia with a broad range of participants. This emphasis must be retained. As evident from Program statistics, this rule change had a profound effect on the percentage of large firms receiving single applicant awards. Between 1990-1997, the percentage of single-applicant awards received by large firms was over 18%. Between 1998-2000, i.e., after the rule change, fewer than 6% of single applicant awards went to large firms, or between two and three awards per year. In fact, only one large firm received funding as a single applicant during FY 2001. Thus, the codification of what has already been made operational should not substantially impact the contributions that such firms make to the Program and the nation in viable joint ventures.

[22] National Research Council, *The Advanced Technology Program: Assessing Outcomes*, Charles W. Wessner, editor, Washington, D.C.,: National Academy Press, 2001. p. 96.
[23] *2000 Advisory Committee Report*, p. 6.

Trends in Large Firm Participation as Single Applicants
(as a percentage of Single Applicant awards)



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Reform #4: Royalties on Government Investments in Profitable ATP Ventures

Proposed Change:

ATP's statute should be modified to require recipients of ATP awards to pay an annual royalty to the Federal government of 5 percent of any gross revenues derived from a product or invention supported by or created as a result of ATP funding. The Federal government's recovery would be up to 500 percent of the amount of the original funding received by the award recipient. The financial recovery to the Federal government would be reinvested in the ATP Program.

Background and Analysis:

To enhance stability, increase equity, and boost the efficiency of the Program, companies receiving ATP awards should be required to pay back a reasonable[24] amount of revenues from successful projects. Such a payback, or recoupment, by the Federal government could allow the Program to replenish its operating funds from revenues derived from successful projects. Recoupment of the taxpayer investment in enabling technologies funded under ATP would serve to augment the Program for the national good.

For most of the Program's history, funding stability has been a major concern. Over the past several years, the Program was unable to enjoy a stable level of funding. This, in turn, has caused a great deal of trepidation among potential applicants. If the Federal government, acting through ATP, is not perceived as a reliable long-term partner, some companies that invest considerable resources in co-funded projects may not pursue critical enabling technology development.

The need for stability in the Program has also been recognized in several independent academic and policy-related studies. In 1998, for example, it was recognized that one opportunity to improve relations with industry would be through stabilizing the Program's budget. According to Christopher Hill:

> "The ups and downs of ATP's budget and continual challenges to the program's legitimacy have not contributed constructively to building a solid program with a sound fiscal administration and a secure image among its industrial constituency."[25]

Most recently, the NRC made a compelling case for increasing the stability for ATP's R&D funding. The 2001 Report finds that:

[24] Given the fact that the technologies funded under ATP are "enabling" and likely to have many different applications and uses, and thus be incorporated into a variety of product lines, a maximum recoupment of 500% of the original award is appropriate.

[25] C. Hill, "The Advanced Technology Program," p. 163, in *Investing in Innovation: Creating a Research and Innovation Policy that Works*, edited by Lewis M. Branscomb and James H. Keller.

> " 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."[26]

Given changing national priorities that have resulted from the tragic events of September 11, 2001, the stability of any program, not just ATP, becomes even more of a question. For the nation to remain competitive, it is important for industry and universities to continue to develop pre-competitive technologies. To this end, it is also critical for the Federal government to be perceived as a reliable partner.

Recoupment of the Federal R&D funds expended on high-risk enabling technology developed with ATP support would also serve to address the equity concerns that stem from the fact that since the Program's inception—and through September 2000[27]—168 technologies have been commercialized. Some of these technologies resulted in profitable inventions generating substantial cost savings for the affected industries. Among many examples, the Auto Body Consortium developed a suite of process-monitoring and control technologies that are cutting costs throughout much of U.S. auto industry. The Diamond Semiconductor Group developed a flexible new technology that implants desired impurities reliably into silicon wafers, thereby saving the industry money and increasing yields.

The Administration believes that the equity issue remains a valid criticism. But it will dissipate when the repayment of the Federal share of funded projects takes a direct route. Under certain terms and conditions, and not in an effort to penalize success, it is fair and reasonable to require a direct repayment based on the initial Federal share if a company is profitable and nets considerable gains from a technology developed under ATP. In contrast, it is inappropriate to recoup if the proposed technology fails or if the company does not profit from the technology developed.

Finally, recoupment would promote the efficiency of the Federal government, i.e., it would allow the Program to make best possible use of all resources. The Administration concurs with the following *Principle to Guide Federal R&D Policy and Funding* designed to optimize Federal R&D investment. According to the American Institute of Chemical Engineers:

> "Congress and R&D agencies should explore expanded use of industry royalty payments, or 'recoupment,' on technologies that are eventually commercialized by industry based on Federal R&D support. While such recoupment comes with administrative difficulties, it is currently used in select program areas."[28]

[26] *The Advanced Technology Program: Assessing Outcomes*, pp 94-95.
[27] *ATP Performance Measures 2000*.
[28] "Optimizing Federal R&D Funding: Principles and Criteria: an AIChE Position Paper," June 1998.

ATP was conceived with recoupment in mind. In fact, projects funded between 1990-1991 were subject to recoupment. The original recoupment legislation applied only to licensing fees and royalty payments from patents (or equivalent IP). While there were only 39 projects to which this provision applied, this requirement was removed in 1992, before most financial gains were realized.

Furthermore, ATP would not be the only Federal program that has a recoupment clause. For example, Department of Energy's Clean Coal Technology Program has included cost-recovery provisions in each of the five separate funding solicitations conducted from 1986 to the present. Also, the Department of Defense historically required recoupment of a proportionate amount of the non-recurring costs of research, development and production for major defense equipment exports. In 1995, these recoupment charges, intended to reimburse the U.S. government for a proportionate share of its investment in weapons sold, became subject to a statutory waiver on a case-by-case basis.

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Reform #5: Ensuring that ATP Funding is Used Only to Support Removal of Scientific or Technological Barriers to Product Development

Proposed change:

Amend the "contracts or awards; criteria; restrictions" section of the ATP enabling statute to explicitly restrict project support of later-stage commercial projects. The change should be made operational by enhancing ATP project selection and management procedures.

Background and Analysis:

Some claim that the ATP application review process has at times permitted an inappropriate focus on funding later-stage, rather than pre-commercial, technologies. The former chairman of the House Science Committee expressed "concern that the Program 'may have funded research that was similar to research already being funded by the private sector.'"[29] Such later-stage efforts are not a proper function of government. ATP's project selection criteria and operational procedures should be strengthened to ensure that the Program only supports projects that can be expected to remove scientific or technological barriers to product development to the point at which product development begins.

A recently completed multi-year study of ATP by Professor Lewis M. Branscomb, former Director of NIST and Professor at the Kennedy School of Government at Harvard University, draws upon venture capitalists, R&D managers, entrepreneurs, government officials, and scholars to identify the boundaries of ATP's niche in the innovation system.[30] Branscomb concludes that government support of a technology is appropriate up to the point where a reasonable business case could be made that a technology's development could proceed without that government support. This view was widely shared by the private sector participants in the project. Parallels may be drawn to the conclusions drawn by Dr. Claude Barfield of the American Enterprise Institute, who states, "the more clearly one can identify the commercial benefits of the Program … the more the question of why the government is supporting such activity in the first place comes into play."[31]

Clearly, ATP was not established to fund product development projects. ATP examines applications and makes awards with this restriction firmly in mind. However, given the fact that the Program's selection boards sometimes operate with incomplete information, the ability of ATP to make the best possible judgments when selecting award recipients remains a concern.

As the recent NRC study states:

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[29] *The Advanced Technology Program: Assessing Outcomes*, National Research Council, 2001, p. 47.
[30] L. Branscomb, *Between Invention and Innovation: An Analysis of the Funding for Early Stage Technology Development.* A Project of the Kennedy School of Government's Science, Technology and Public Policy Program, To be released Spring 2002.
[31] *The Advanced Technology Program: Challenges and Opportunities*, National Research Council, 1999, p. 46.

> "One of the most recent studies undertaken by GAO, released in 2000, focused on factors in the ATP selection process that could limit its ability to identify similar research elsewhere.… ATP's (current) award process is unlikely to avoid funding similar research insofar as access to proprietary information and ATP conflict of interest requirements limit the Program's ability to identify similar research."[32]

There is no bright line between appropriate government involvement and inappropriate support of product development. There will continue to be some uncertainty as to what is product development in various industry sectors. Although experts can usually come to a general consensus on whether any particular project crosses the line into product development, the issue is complicated. The initiation of the product development phase of a technology has different characteristics in different industries, and these characteristics change over time. Thus it is incumbent upon ATP to go to the lengths necessary to ensure that is has made every effort to avoid funding projects that would cross that line and to evaluate proposals on this point. Current ATP procedures do a good job overall. Given the importance of the issue, however, improvements should be made.

ATP should undertake the following tasks in order to strengthen its ability to differentiate proposals that clearly do not cross the line into product development and that are deserving of government support, and those proposals which could be seen to cross the line into product development:

- In deliberations on funding decisions, ATP should explicitly identify the scientific or technological barrier to product development and explain why the removal of that barrier will allow the technology to move forward without further government support.

- ATP should, within one year, evaluate recommendations to assist in the identification of projects during the selection process that may enter into product development. These recommendations could be developed with input from private sector experts, including venture capitalists, R&D managers, entrepreneurs, and scholars. They should identify—with as much specificity as possible—the characteristics of technology projects that are indicative of product development. Each selection board could use a set of such recommendations adapted to the characteristics of the technology/industry area under that board's responsibility.

- For all future awards, ATP should decline to fund those projects that do not meet these guidelines, or seek modifications to the proposal in order to meet the guidelines, as appropriate. Proposed task or budget changes to ongoing projects should be reviewed so as to ensure conformity with these guidelines. Furthermore, ongoing projects that are engaging in unallowable activities, as defined by the guidelines, should be modified or terminated for cause.

[32] *The Advanced Technology Program: Assessing Outcomes*, National Research Council, 2001, p. 47.

By explicitly identifying the scientific or technological hurdle that is blocking progress on an important technology, and by developing and enforcing clear guidelines on what is permissible for government to fund and what is not permissible for government to fund, this reform strengthens the ability of ATP to select those research projects which will not be supported by the private sector in the absence of ATP support. While no bright line is possible between research and product development, this reform raises the standard so that policymakers can be confident that ATP is doing the best job possible at making that distinction.

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Reform #6: ATP Project Review and Evaluation Process

Proposed Change

ATP will conduct a study of its evaluation boards to determine if additional non-proprietary input from non-governmental sources would assist the Program in better assessing whether a specific technology is being adequately supported by the private sector.

Background and Analysis

One of the great strengths of ATP's project selection process is the quality of the people on its selection panels. These panels are each made up of two groups, one possessing technical expertise (scientists and engineers), and the other possessing business expertise (economists, industry experts, and former business executives). Working as a team, these groups carefully review each proposal, applying well-developed criteria in order to identify those research and development projects that might properly be funded by the Federal government. The peer-review process is at the heart of how ATP selects projects for funding, and is the primary factor in the program's demonstrated ability to meet its objectives.

Yet there is room for further improvement of the process, especially in the area of obtaining private sector input on whether a technology is already being adequately addressed from non-governmental sources. However, it is not clear which prescriptions for improvement are most likely to succeed without further study.

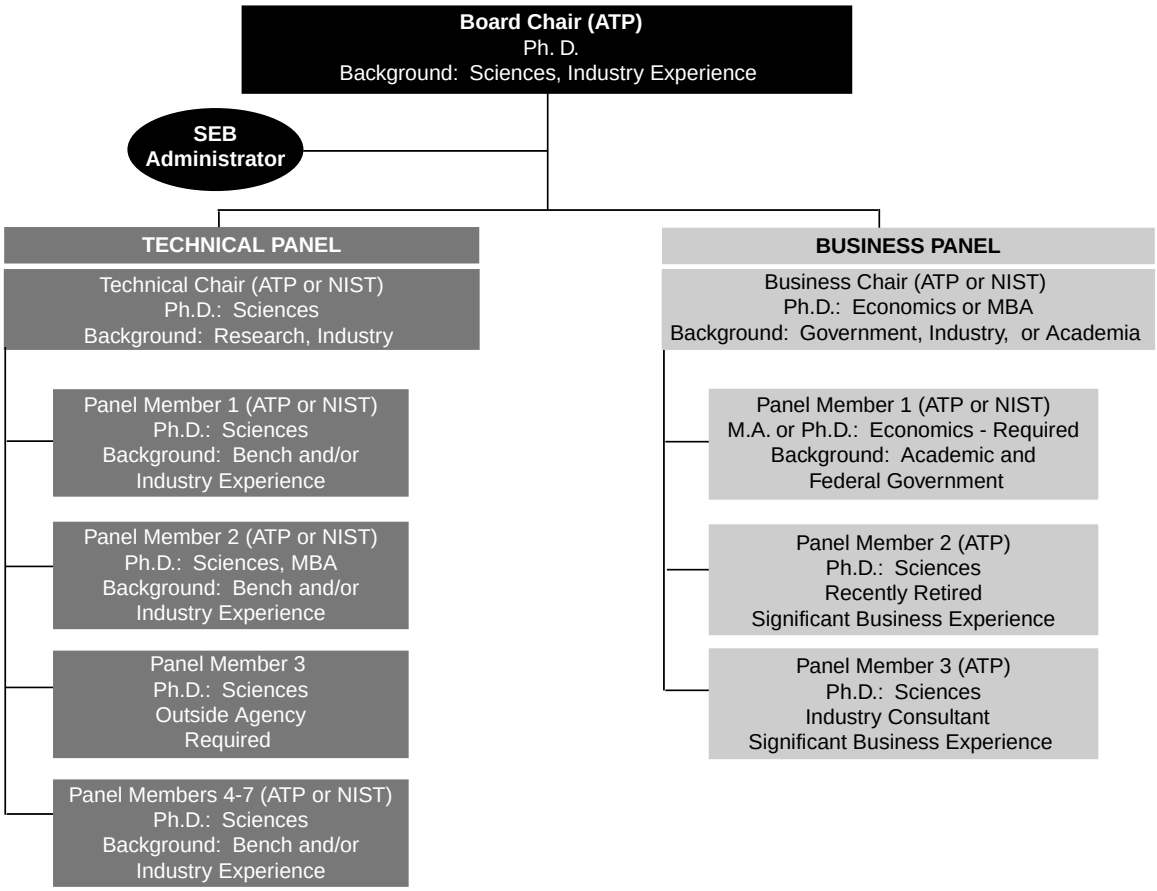
On the technical side of the selection panels, ATP already has access to highly skilled scientists and engineers at the National Institute of Standards and Technology, as well as other technical personnel within the national labs. With the large and often unique resource base represented by these talented individuals, ATP can evaluate a technology to a degree that is generally considered unmatched in the Federal government, possibly even surpassing the standard of due diligence performed in the private investor community, including by venture capitalists.

On the business side of its selection panels, ATP faces a difficult problem. The ATP does not have a large or well-developed resource of people expert in the various markets in which applicants are operating. The technical people have a familiarity with the markets related to their technology specialization, but their level of expertise is generally not sufficient. Ideally, the business side of the selection panel would include people with detailed knowledge of the markets in question, as well as a rich understanding of the players, the strategies, and of the research directions of key firms. Unfortunately, these "ideal" individuals cannot be used on selection panels. Doing so would raise conflict of interest issues, since these experts are direct participants in those markets.

ATP has long recognized the problem of attracting qualified business people for its selection panels and has addressed this problem in a number of ways. First, ATP includes on its selection panels members of its economic evaluation staff, who are well-versed in the specialized area of economics

that involves technology, the R&D process, and the public role in supporting research. Second, ATP draws upon its technical staff, identifying those with strong business backgrounds (often individuals with MBAs) for membership on its selection panels. Third, ATP contracts with individuals in the private sector to join these selection panels. These individuals are often consultants, retired business executives, and others with significant personal experience in the business world who can bring to bear a wealth of real-world knowledge.

Representative Source Evaluation Board (SEB) Makeup



This solution to the problem of evaluating the business issues of a given research proposal is admirable and has served ATP well. The Administration believes there are steps that can be taken to improve the business-side evaluation, however. Certain suggestions could result in meaningful improvements in determining whether ATP is funding research that the private sector is already undertaking. Those suggestions include:

- Purchasing market analysis reports from consulting firms, or subscribing to specialized technology-oriented newsletters.
- Contracting with one or more consulting firms to supply as-needed analysis to inform the ATP selection process.
- Identifying and contracting with scholars who specialize in a given technology area, to obtain their insights and opinions.

A study will be undertaken to explore this issue and to determine if any of these suggestions, or perhaps other suggestions, would be of use in raising even higher the standard by which ATP evaluates proposals. We envision that this study will be accomplished within one year and will involve consultation with the private sector. The final report will list proposed improvements, and analyze and discuss their implementation.

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3. Selected References

Adams, Brooke. 1999. "Colleges Cash In on Brainpower." The Salt Lake Tribune; Salt Lake City. December 26

American Institute of Chemical Engineers. 1998. "Optimizing Federal R&D Funding: Principles and Criteria: an AIChE Position Paper." http://www.aiche.org/government/pdfdocs/98rdpap.pdf

Association of University Technology Managers. 2001. "Surveys—Common Questions and Answers About Technology Transfer." http://www.autm.net/index_n4.html

Audretsch, D.B. and R. Thurik. 1999. *Innovation, Industry, Evolution, and Employment*, New York: Cambridge University Press, 1999

Branscomb, L. M. (forthcoming) *Between Invention and Innovation: An Analysis of the Funding for Early Stage Technology Devlopment*. A Project of the Kennedy School of Government's Science, Technology and Public Policy Program, To be released Spring 2002

Branscomb, L.M. and J. Keller, editors. 1998. *Investing in Innovation: Creating a Research and Innovation Policy.* Cambridge, MA: MIT Press

Brody, H. September 2001. "The TR University Research Scorecard." *Technology Review*; Cambridge, MA.

Cleare, Michael. Executive Director. 2001 *Annual Report, Columbia Innovation Enterprise*. http://www.columbia.edu/cu/cie/index2.html

Hill, C. 1998. "The Advanced Technology Program: Opportunities for Enhancement," in *Investing in Innovation: Creating a Research and Innovation Policy.* L.M. Branscomb and J. Keller, editors. Cambridge, MA: MIT Press. pp 143-173

National Institute of Standards and Technology. 2001. *2000 Annual Report of the Advanced Technology Program Advisory Committee.* Gaithersburg, MD

National Institute of Standards and Technology. 2001. "ATP Program Measures" Gaithersburg, MD.

National Institute of Standards and Technology. ATP Website. http://www.atp.nist.gov

National Institute of Standards and Technology. December 19, 2001. *Business Reporting System*. Gaithersburg, MD.

National Institute of Standards and Technology. November 2000. *The Advanced Technology Program Proposal Preparation Kit.* http://www.atp.nist.gov/atp/kit-00/kit-1100.htm

National Research Council. 1999. *The Advanced Technology Program: Challenges and Opportunities.* Charles W. Wessner, editor. Washington, D.C.: National Academy Press

National Research Council. 2001. *The Advanced Technology Program: Assessing Outcomes.* Charles W. Wessner, editor. Washington, D.C.: National Academy Press

Noll, R. and L. R. Cohen. 1991. *The Technology Pork Barrel.* Washington, D.C.: The Brookings Institution

Rubel, T. and Palladino, S. 2000 "Nurturing Entrepreneurial Growth in State Economies." National Governor's Association, Washington, D.C. http://www.nga.org/center/divisions/1,1188,C_ISSUE_BRIEF D_588,00.html

Technology Licensing Office, Texas A&M University System. 2000. *Annual Report to the Board of Regents.* College Station, TX.

Technology Licensing Office, Texas A&M University System. Rev. December 7, 2001. "System Policy 17.02" http://tlo.tamu.edu

University of California. 2000. *Annual Report: University of California Technology Transfer Program*. Oakland, CA.

University of Wisconsin – Madison. 2002. "Policies Concerning Research Sponsored by Industry." http://www.rsp.wisc.edu/indres.htm