The Case for Innovation Policy: Key Principles for National Success

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The United States economy cannot grow without continued innovation. By boosting productivity and creating higher paying jobs, innovation supplies the X-factor that facilitates economic prosperity. Although innovation is fundamental to economic growth, other economic concerns often overshadow innovation policy. At present, we struggle with the twin macroeconomic needs of preventing a new recession and creating fiscal stability through long-term deficit reduction, making it difficult to focus on innovation policy.

In the best of times, innovation policy must overcome two related blind spots. First, the federal budget fails to distinguish between long-term investments and current consumption. This commonsense distinction is used by companies when they invest in research and development (R&D), by families when they save for college, and by states, like Illinois and Montana, when they dedicate long-term funding for capital expenditures.[1] But this distinction is not built into federal budget policy. Second, focusing on long-term investments is difficult when today's job crisis creates pressure for measures with the biggest possible immediate impact. Consequently, the claims of tomorrow's industries, which promise to create robust economic growth and job creation, are harder to address. In the past, catalyzing forces like the space race captivated the public and justified long-term investments that enabled innovation; today, by contrast, public opinion has yet to coalesce around policies that will make us more nationally competitive.

Even if innovation is, by its nature, hard to predict, we know how to spur it on. Successful U.S. innovation policy spans centuries, with historical examples ranging from President Lincoln's investments in infrastructure (the transcontinental railroad) to Congress's support for Samuel Morse's first telegraph line. In the more modern era, the commercial success of important technologies like GPS, speech translation technology, and CAD tools[2] were made possible by federal programs. Perhaps the most noteworthy success is the Internet, which enjoyed robust federal support from its origins as ARPANET in 1969 to full-fledged commercialization in 1995. This policy—planting seed corn and encouraging the private sector to commercialize the harvest—has changed the everyday lives of Americans through travel (commercial airlines),[3] information (Google),[4] at home cooking (microwave oven),[5] and much more.

Innovation policy can be made more effective and, in a time of scarce dollars, it must become so. Innovation policy should provide needed resources where markets fail to do so, leverage dollars

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[1] CAPITAL BUDGETING IN THE STATES, NATIONAL ASSOCIATION OF STATE BUDGET OFFICERS (1999).

[2] *See History*, DARPA, http://www.darpa.mil/About/History/First_50_Years.aspx (last visited Sept. 21, 2011) (follow "50 Years Timeline" hyperlink).

[3] Boeing's 707 plane, used commercially starting in the 1950s, had origins in a military tanker designed for the Air Force. History: 707/720 Commercial Transport, Boeing, http://www.boeing.com/history/boeing/707.html (last visited Sept. 21, 2011).

[4] Google developed partly out of work that Larry Page did on the Stanford Digital Library Project, which was funded by the NSF and DARPA. *See Sponsors & Partners*, STANFORD DIGITAL LIBRARY TECHNOLOGIES, http://ilpubs.stanford.edu:8091/diglib/pub/SponsorsAndPartners.shtml (last visited Sept. 21, 2011) (follow "People" hyperlink).

[5] When Raytheon Company developed shipboard radars for PT boats for the United States during World War II, it discovered that microwave radio signals could be used to cook food. In 1947, Raytheon unveiled the world's first microwave oven. *Technology Leadership*, RAYTHEON, http://www.raytheon.com/ourcompany/history/leadership/ (last visited Sept. 21, 2011).

to incentivize private investment, and ensure that dollars go where they are most likely to spur job creation and business growth. In this paper, we will briefly describe (1) the role of innovation in economic and employment growth, (2) the fruitful legacy of federal support for innovation, and (3) the core attributes of an innovation policy for fiscally constrained times.

The scope of this paper will not permit a review of all of the actions that government can take to incent innovation. Indeed, a wealth of literature exists on the foundations of national competitiveness, including education at all levels, the availability of capital and smart trade policies. Rather, our focus will be on innovation policies that may be overlooked in tough fiscal, and uncertain economic, times. Those include: basic research (which supplies the fundamental building-blocks for growth), immigration reform for highly skilled workers (which brings much-needed talent to our shores), encouragement of bottom-up regional economic strategies (which build on the dynamics of entrepreneurial communities), and the Department of Energy's ARPA-E program (a solution for critical market failures in the energy sector). By fully supporting these initiatives, the federal government can plant the seed corn for our nation's future.

Part I: Jobs

Today, the national unemployment rate is stubbornly high. In fact, some predict that the United States will not return to full employment in the near future.[6] As we consider long-term solutions, it is important to appreciate that support for innovation means supporting jobs.

First, innovation spurs job growth and the creation of high-paying jobs. The OECD has found that, as a historical matter, the income-generating effects of new technologies have proven more powerful than their labor-displacing effects: "technological progress has been accompanied not only by higher output and productivity, but also by higher overall employment."[7] Think of the now non-existent buggy manufacturers of the 19th century or the ubiquitous hometown telephone operator of the 20th century. Although the automobile and digital revolution eliminated these jobs, they created new ones. In other words, innovation fuels productivity growth, which eliminates some jobs, the ultimate outcome is greater economic prosperity and higher paying jobs. To be sure, there is an adjustment period whereby workers develop and acquire new skills to find opportunities in the industries of the future, but an educated workforce and entrepreneurial country can take advantage of such opportunities.

Second, the creation of new businesses is centered on the transformation of ideas into new forms of economic value. Introduction of new and innovative products and services drives consumer consumption, which in turn spurs economic growth. In fact, startup companies are the highest job-producing companies each year. To be exact, about half of all jobs are at firms with less than 500 employees. And those numbers represent growth; the average net growth rate of firms under 100 employees is 2.27 percent, whereas the average net growth rate for firms larger than 500 is 1.95 percent.[8] As a recent study has shown, the top performing 1 percent of successful high

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[6] *See* MCKINSEY GLOBAL INSTITUTE, AN ECONOMY THAT WORKS: JOB CREATION AND AMERICA'S FUTURE, MCKINSEY & CO. 1 (2011).

[7] Stephen Ezell, *Technology and Innovation Create, Not Destroy, Jobs*, INNOVATION POLICY BLOG (June 15, 2011) http://www.innovationpolicy.org/technology-and-automation-create-not-destroy.

[8] John Haltiwanger, *Entrepreneurship and Job Growth* 9 (Working Paper Series 2006) *available at* http://ssrn.com/abstract=1244668.

growth startup firms offers the most significant job opportunities by contributing eighty-eight jobs per year, with each company eventually hiring between twenty and 249 employees.[9]

Third, the success of the U.S. economy, including that of its larger firms, depends upon innovation. In a globally connected world, innovation is not optional. The most successful U.S. companies both add jobs directly (e.g., eBay grew to more than 17,700 employees over fifteen years[10]) and also increase demand for critical components in their supply chains that, in turn, foster growth and employment opportunities for related, smaller companies, including startups. For example, manufacturing facilities have an important spillover effect. One study of manufacturing in New York found that the jobs multiplier for cutting-edge biotechnology and nanotechnology firms is 9.20. "This means that for every job in these firms, [about] ten additional jobs are supported."[11]

As the next section demonstrates, there is a rich history of government-supported innovation in the U.S., which further illustrates the important connection between innovation policy and job creation. A lesson of industrial history is that change is a certainty and it will disrupt established industries. As such, a core public policy objective should not be focused on protecting industries of today, but rather that the United States maintains its competitive position on the cutting-edge of the industries and technologies of the future.

Part II: Government Innovation Policy: A Fruitful History

Throughout the 20th century and into the 21st, governmental policy has been an important, and successful, input into innovation. Many innovative technologies have roots in government support. Such government-supported innovation often is not simply "innovative" in the sense that it produces scientific and technological novelty, but also "innovative" in the sense that it unlocks the commercial potential of developments in science and technology.

Perhaps the hallmark of immensely productive, government-supported innovation is DARPA, the Defense Advanced Research Projects Agency, which operates under the Department of Defense (DOD). DARPA supported the creation of the Internet's predecessor, ARPANET, despite lack of private sector interest.[12]

Over the years, "DARPA's innovative research has created entirely new capabilities for the U.S. military such as stealth aircraft, GPS, the M-16 assault rifle, and night vision goggles."[13] DARPA's research and funding support has also "provided the foundation for industries like optical networking, supercomputers, and design tools for computer chips."[14]

Government-spurred innovation is not merely an artifact of past defense policy; it is part of an ongoing effort to expand scientific and technological capabilities in ways that enhance our

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[9] *See* Dane Stangler, *High-Growth Firms and the Future of the American Economy*, EWING MARION KAUFFMAN FOUNDATION 5-6 (2010).
[10] *See* Investor FAQs, *How Many Employees Does eBay Have*, EBAY INC., http://investor.ebayinc.com/faq.cfm (last visited Sept. 21, 2011).
[11] THE PUBLIC POLICY INSTITUTE OF NEW YORK STATE, INC., LET'S MAKE IT HERE: KEYS TO MANUFACTURING A RESURGENCE IN NEW YORK 8 (2011).
[12] *See* NATIONAL ECONOMIC COUNCIL, *A Strategy for American Innovation: Driving Toward Sustainable Growth and Quality Jobs*, THE WHITE HOUSE (Sept. 2009), http://www.whitehouse.gov/administration/eop/nec/StrategyforAmericanInnovation/.
[13] *Id.*
[14] *Id.*

national competitiveness and economic health. Even Google, one of the new economy titans, developed out of work that Larry Page did on the Stanford Digital Library Project, which was funded by government organizations including the NSF and DARPA.[15] Such examples highlight that federal spending on both research and procurement can accelerate technological development in many industries, including software, airframes, semiconductors, and computer hardware.[16]

Many government agencies have been deeply involved in spurring innovation across a variety of industries, including Agricultural Research Services at the Department of Agriculture,[17] the Research and Innovative Technology Administration at the U.S. Department of Transportation,[18] the twenty-seven research institutes and centers operating under the National Institutes of Health,[19] and the National Institute of Standards and Technology[20] to name a few. To appreciate their impact, consider the impressive legacy of government's role in innovation that has persisted into the present day: of the eighty-eight U.S. entities that received "R&D 100 Awards" for the nation's best innovations in 2006, seventy-seven relied on some government support.[21] Moreover, as Robert Atkinson has noted, "in 2006 over two-thirds of firms producing award-winning innovations benefited from federal funding."[22]

Part III: Recommendations

We know that innovation is a, perhaps "the," critical component to sustained economic growth and job creation, a conclusion amply demonstrated by the legacy of successful U.S. innovation policy. But these are tough times and it is tempting to defer addressing long-term needs in favor of short-term pressures. That is why it is so important for the "constituency of the future"—business and community leaders, academicians, officials from all levels of government—to support an innovation policy that will facilitate long-term economic growth.

As noted before, an exhaustive review of desirable innovation policy positions is beyond the scope of this paper. Rather, four key areas merit particular attention and support: (1) support for basic research, (2) immigration reform to ensure that talented technologists and entrepreneurs can stay in the U.S., (3) encouragement of regional economic strategies created and led by

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[15] *See supra* note 4.

[16] *See* David C. Mowery & Richard N. Langlois, *Spinning Off and Spinning On(?): The Federal Government Role in the Development of the US Computer Software Industry*, 25 RES. POL'Y 947 (1996).

[17] For example, ARS-supported research led to innovations in things like sterilization for agricultural pest control and the creation of new breeds of plants that make pasture management easier, to name only two. *See Careers: Science Hall of Fame*, AGRIC. RES. SERV., http://www.ars.usda.gov/careers/hof/ (last visited Sept. 21, 2011) (follow "Browse the Hall" hyperlink).

[18] A RITA-affiliated research organization, the John A. Volpe National Transportation Systems Center, has supported developments in vehicle crash safety ratings, fuel economy standards, rail flaw detection for railroads, navigation aids for water travel, and many other developments. *See Timeline*, NAT'L TRANS. SYS. CTR., http://www.volpe.dot.gov/about/history/timeline/timeline_508.html (last visited Sept. 21, 2011).

[19] "[M]ore than 130 Nobel Prize winners have received support from NIH. Their studies have led to the development of MRI, understanding of how viruses can cause cancer, insights into cholesterol control, and knowledge of how our brain processes visual information, among dozens of other advances." *See About NIH*, NAT'L INST. OF HEALTH, http://www.nih.gov/about/ (last visited Sept. 21, 2011).

[20] "In a typical year, NIST's scientists and engineers publish about 2,200 professional journal articles and technical reports. NIST also offers more than 1,300 Standard Reference Materials (SRMs) that are used to check the accuracy of instruments and test procedures. In 2010, it distributed more than 30,000 SRMs to customers in U.S. industry and around the world." *See Advancing Innovation and Industrial Competitiveness*, NAT'L INST. OF STDS. AND TECH., http://www.nist.gov/public_affairs/factsheet/overview-brochure.cfm (last visited Sept. 21, 2011).

[21] *See* NATIONAL ECONOMIC COUNCIL, *supra* note 12.

[22] Robert D. Atkinson et al., *One from Column A, B, and C: Finding a New Bipartisan Consensus on U.S. Competitiveness and Innovation Policy*, ITIF (Mar. 2011).

communities, businesses, and universities, and (4) support for catalyzing innovation to support national priorities—such as supporting the Department of Energy's ARPA-E program. As a group, these four priorities illustrate the key tenets of an overall approach to innovation: They are also important because, taken together, they set forth the parameters of innovation policy as a whole: Empower talent and the foundation of basic research, then put them to work supporting bottom-up strategies and commercialization of technologies that will boost regional growth and work to solve national priorities.

Basic Research

Basic research and development—research merely to learn unknowns—is essential to enabling innovation. Unlike applied research, which produces shorter-term economic value, basic research has long-term and fundamental economic implications because it "advance[s] the scientific knowledge base of the country . . . contribut[ing] practical advances that can help people and create economic opportunity."[23] As Federal Reserve Chairman Ben Bernanke explained early this year, basic research provides long-term economic growth and is the source of much innovation.[24] If federal policies do not prioritize basic research, the United States will be left without an important fundamental building-block for innovation.

Unfortunately, market failure is a real barrier to basic research initiatives. Reluctance by the private sector to invest in this type of research when immediate returns are unavailable necessitates federal government attention in the field. Unfortunately, industry focus on basic research is stagnant or declining.[25] Industry publications in peer review journals—an indicator of industry focus on basic research—have decreased over the past decade, with substantial decreases in physical and biomedical sciences.[26] With competitive pressures in a range of industries, the private sector is no longer able to support major basic research initiatives—unlike in the days when Bell Labs or Xerox PARC supported a range of technological developments and breakthroughs, from the laser and UNIX to the mouse and graphical user interface. Recognizing this trend, President Obama has called for increased federal research funding, addressing the challenge that "federal funding for R&D spending as a percentage of gross domestic product (GDP) has been decreasing almost continuously since the peak in the mid 1960s — the years of the 'space race.'"[27] After all, "if history is [a guide], long-term economic growth will be fuelled by waves of technologies that may very well originate from ideas that are driven by curiosity rather than profit."[28]

Immigration

Talented, high-skilled individuals wish to come to the United States to help build our economy and we say "No, thanks." That must change. U.S. labor market demand for individuals skilled in science, technology, engineering, and medicine (STEM) is great. The Bureau of Labor

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[23] Ed Silverman, *Who Discovers Innovative Meds? The Public Sector*, Pharmalot (Feb. 10, 20100, 10:31 AM) http://www.pharmalot.com/2011/02/who-discovers-innovative-meds-the-public-sector/.

[24] Am. Psychological Assoc., *Fed Chief Bernanke Endorses Government Support of Basic Research* (June 2011), http://www.apa.org/science/about/psa/2011/06/government-support.aspx.

[25] Nat'l Sci. Bd., A, *Research and Development: Essential Foundation for U.S. Competitiveness in a Global Economy*, Nat'l Sci. Foundation, http://www.nsf.gov/statistics/nsb0803/start.htm#research (last visited Sept. 14, 2011).

[26] *Id.*

[27] *Budgeting for the Long Run*, 10 Nature Materials 407 (2011), *available at* http://www.nature.com/nmat/journal/v10/n6/full/nmat3044.html.

[28] *Id.*

Statistics projects the growth rate in the science and engineering sector to be twice that of total job growth between 2006 and 2016.[29] "During times like the 1950s and 1960s, a rising level of educational attainment kept up with [the] rising demand for skill."[30] "[S]ince the late 1970s and early 1980s," however, "U.S. education levels [have] not kept up with the [need] for skilled workers."[31] Despite the demand, high-skilled immigrants with domestic and foreign educations have difficulty obtaining the limited number of available temporary and permanent visas.[32]

Those foreign-born highly skilled immigrants that make it to the U.S. are both highly inventive and highly educated, making them an important key to the success of the United States economy. High rates of patenting activity are associated with "foreign-born inventors relative to their presence in the population as a whole."[33] In fact, highly skilled foreign professionals "have been integrally involved with founding about one-quarter of the technology and engineering companies started between 1995 and 2005 that comprise the Dunn & Bradstreet Million Dollar database."[34] In 2006, these companies "employed 450,000 workers and generated $52 billion in revenue in 2006."[35]

The StartUp Visa Act of 2011 and related efforts provide a powerful example of an immigration reform measure that can catalyze entrepreneurship.[36] In its current form, this bill broadens opportunities for startups, as well as their founders and investors, to receive permanent visas for their entrepreneurial initiatives.[37] Stated simply, allowing high-skilled immigrants to start firms in the U.S. "benefits native-born workers and the broader population by helping achieve critical mass in researching specialized areas, providing skills that complement native-born researchers, and contributing to increased output, commercialization, or usefulness of the patents[.]"[38] Enacting this bill can thus catalyze innovation and job growth with no cost to the federal budget.

Regional Economic Strategies[39]

Research has demonstrated that industries in a geographic cluster create new sectors, register higher employment, higher growth of wages, more businesses, and more patents.[40] In fact, productivity in regions with successful clusters is 12 percent greater than in other regions.[41]

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[29] *See* NAT'L SCI. FOUND., NSB 10-01, SCIENCE AND ENGINEERING INDICATORS 2010, at fig.3-A.

[30] David Autor, *The Polarization of Job Opportunities in the U.S. Labor Market: Implications for Employment and Earnings*, THE HAMILTON PROJECT 1 (Apr. 2010), http://www.brookings.edu/papers/2010/04_jobs_autor.aspx.

[31] *Id.*

[32] Peter Schuck & John Tyler, III, *Making the Case for Chancing U.S. Policy Regarding Highly Skilled Immigrants*, 38 FORDHAM URB. L.J. 327, 342-43 (2010).

[33] *Id.* at 330-31.

[34] *Id.* at 333.

[35] Vivek Wadhwa, Presentation at the NBER-Sloan Workshop on Career Patterns of Foreign-Born Scientists and Engineers Trained and/or Working in the U.S., Cambridge, MA: Immigrants and Returnees (Nov. 7, 2007).

[36] Catherine Clifford, *Need Jobs? Bring the Foreign Entrepreneurs*, CNN MONEY (July 19, 2011, 1:21 PM ET), http://money.cnn.com/2011/07/19/smallbusiness/visas_for_entrepreneurs/.

[37] Press Release, John Kerry, Kerry-Lugar-Udall Visa Bill Will Create Jobs in America (Mar. 14, 2011), *available at* http://kerry.senate.gov/press/release/?id=4e6a51f6-fb2b-4212-b299-b0c46c7e6b58.

[38] Schuck & Tyler, *supra* note 32, at 332; *see also* RULES FOR GROWTH: PROMOTING INNOVATION AND GROWTH THROUGH LEGAL REFORM, THE EWING MARION KAUFFMAN FOUNDATION (2011).

[39] This discussion draws upon an earlier analysis presented in Jonathan Sallet, *Innovation Policy in Tough Times on Tight Budgets: The Case for Regional Innovation Clusters*, Sci. Progress (Oct. 8, 2010).

[40] Mercedes Delgado, Michael E. Porter, & Scott Stern, *Clusters, Convergence, and Economic Performance*, CAMBRIDGE: INSTITUTE FOR STRATEGY AND COMPETITIVENESS (2010).

[41] Michael Greenstone, Richard Hornbeck, & Enrico Moretti, *Identifying Agglomeration Spillovers: Evidence from Million Dollar Plants* (MIT Department of Economics, Working Paper No. 07-31, 2007).

Such engines of economic growth must be empowered—their strengths enhanced through federal support of "regional innovation clusters," a phrase encompassing three critical concepts:

(1) Clusters are geographic places that generate positive externalities that flow from the natural interchanges between businesses; those positive externalities come from proximity—say, the ability of new businesses to connect with angel investors or venture capitalists—which creates an environment that is conducive for the next business to connect with its own sources of capital.

(2) Innovation. We tend to think of innovation as breakthroughs in information technology or biotechnology or nanotechnology, but it also can come from better business practices, novel uses of resources, or smarter design.

(3) Regions explain the geography of economic activity—and thus where leadership needs to be located. In the United States, for example, most clusters cross state lines, not to mention municipal and other local borders. That means it is within economic, not political, borders where growth strategies need to be created in the first instance.

Cluster initiatives do not require substantial public sums to be successful. Notably, cluster initiatives rely on a bottom-up approach, thereby improving the likelihood of success and the efficacy of public policies that support such activities. A guidepost for such support is taking action that supports already vital connections between entrepreneurs, mentors, and research universities. Building on local strengths, public policy can remove friction to success in such communities, incent the implementation of strategies that build on comparative advantages, and look for opportunities to support key elements of a vibrant ecosystem (whether it be a university hub, providing support for startups in a region through access to shared resources, etc.).

Support For National Priorities Using Innovation—The Case Study of ARPA-E

The National Academy of Sciences[42] conceived ARPA-E to achieve four objectives: attract the best and brightest minds to energy research, focus on creative "out-of-the-box" transformational and risky energy research that industry by itself cannot or will not support, "use an ARPA-like organization that is flat, nimble, and sparse, . . . and create a new tool to bridge the gap between basic energy research and development/industrial innovation."[43]

To understand the role of ARPA-E, it is important to recognize the threat posed by what is known as the "valley of death"—the gap between the discovery of a breakthrough technology and its mainstream adoption. "ARPA-E is intended to bridge that valley of death," Norm Augustine, the former CEO of Lockheed Martin, has explained.[44] After all, late-stage funding by the venture capital community is limited and cannot fill this need by itself.[45] For example, "[t]he International Energy Agency (IEA) estimates that global investment will need to increase by 400 percent over the next two decades to address our energy challenges."[46]

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[42] NAT'L ACAD. OF SCIS., NAT'L ACAD. OF ENG'G, & INST. OF MED., RISING ABOVE THE GATHERING STORM, REVISITED: RAPIDLY APPROACHING CATEGORY 5 (2010).

[43] Steven Chu, *The Case for ARPA-E*, 4 INNOVATION: AM.'S J. OF TECH. COMMERCIALIZATION (2006).

[44] Coral Davenport, *ARPA-E Makes a Tempting Target for GOP Budget Cutters*, NAT'L J., Feb. 19, 2011.

[45] Matt Hourihan & Matthew Stepp, *A Model for Innovation: ARPA-E Merits Full Funding*, ITIF 2 (July 2011) http://www.itif.org/publications/model-innovation-arpa-e-merits-full-funding.

[46] *Id.*

Of course, innovation is a chancy business, and it is likely that a large proportion of ARPA-E's experimental energy ideas—like many of DARPA's ideas—won't make it out of the lab. "But if just a few of them pay off," as MIT's Donald Sadoway put it, "the impact [will be] enormous."[47] "With the right energy breakthroughs, he suggests, the program could lead to a national-security victory over the nation's dependence on oil [and] turn sources like solar and wind power into" real energy solutions.[48] In short, supporting ARPA-E is good public policy.

Matt Hourihan and Matthew Stepp have argued that "Congress should substantially increase ARPA-E's current funding levels for [fiscal year] 2012 to at least $300 million in order to continue accelerating technological innovation and spurring economic growth."[49] Some of the proposed funding sources for ARPA-E include the repeal of oil industry tax (and other) incentives; a gasoline tax; an oil company profit tax; and support from federal oil and gas royalties.[50]

Despite the considerable innovative value that ARPA-E could have for our national economy, fiscal constraints present a significant obstacle to innovation. Budget levels proposed by the House in July 2011 for fiscal year 2012 "could very well set ARPA-E on the wrong long-term trajectory, reducing America's capacity for public-private energy innovation exactly when [it should be accelerated]."[51] In short, cutting off funding for ARPA-E, or reducing it to paralyzing levels, is the wrong move to make when healthy funding could produce dramatic economic gains for our nation's future prosperity and preeminence.

Conclusion

It is a frequent observation that good governmental policy today is important to the workers of tomorrow. As we have explained, it is the critical path toward sustained economic growth, job creation, and American economic success in the 21st century. Going forward, we must evaluate how innovation policy can do better in tough fiscal times. The four areas emphasized—basic research, immigration reform for highly skilled workers, regional innovation clusters, and ARPA-E—are all important on their own. If properly supported, they promise to boost long-term job creation and economic growth. They are also important because, taken together, they set forth the parameters of innovation policy as a whole: Empower talent and the foundation of basic research, then put them to work supporting bottom-up strategies and commercialization of technologies that will boost regional growth and work to solve national priorities.

[47] Tom Clynes, *The Power Broker*, 278 POPULAR SCI. 54 (Feb. 2011).
[48] *Id.*
[49] Hourihan & Stepp, *supra* note 45, at 1.
[50] DEBORAH D. STINE, ADVANCED RESEARCH PROJECTS AGENCY – ENERGY (ARPA-E): BACKGROUND, STATUS, AND SELECTED ISSUES FOR CONGRESS, CONG. RES. SERV. (Aug. 12, 2008).
[51] Hourihan & Stepp, *supra* note 45, at 2.