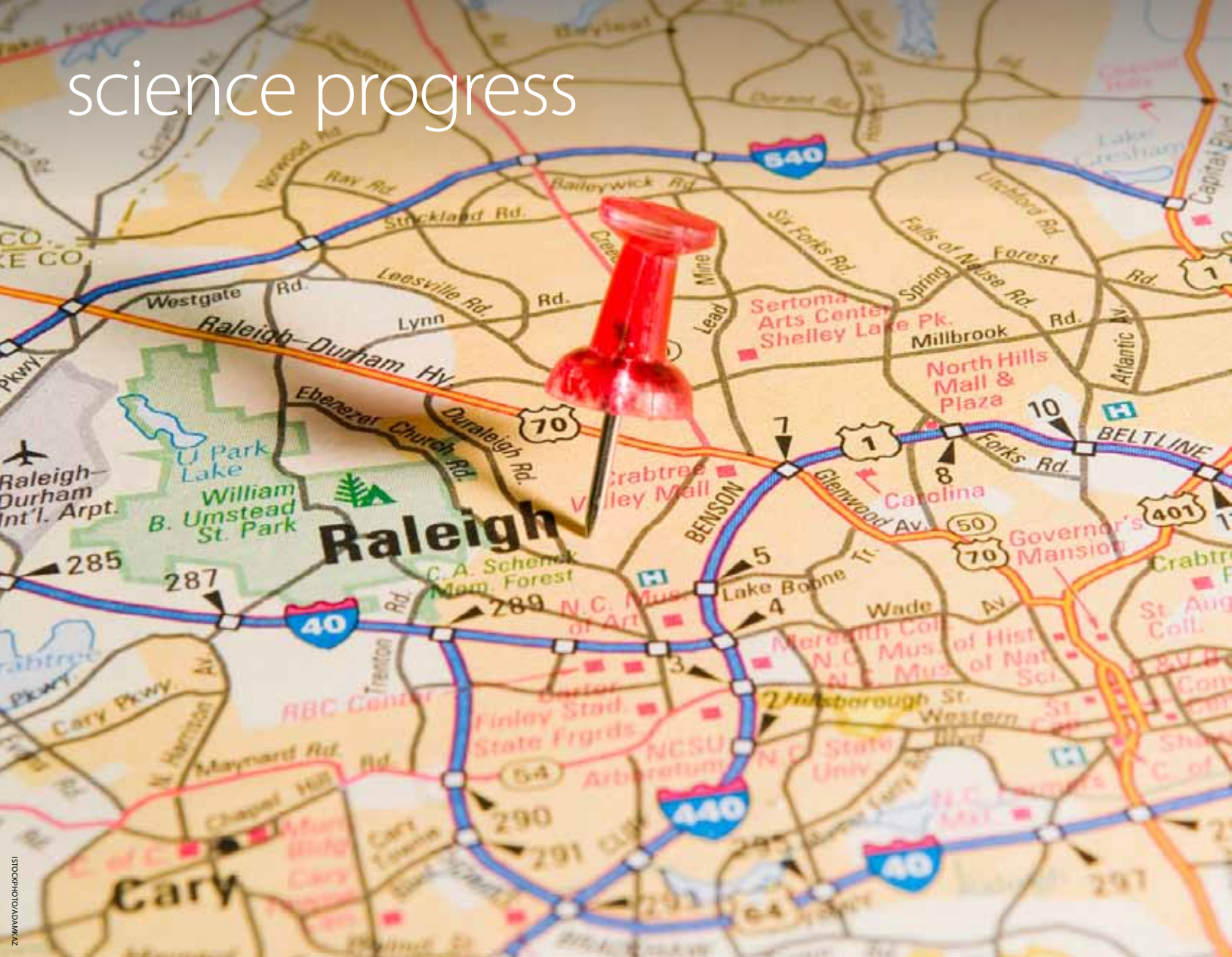


science progress



The Geography of Innovation

The Federal Government and the Growth of Regional Innovation Clusters

Jonathan Sallet, Ed Paisley, and Justin Masterman September 2009

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Introduction and summary

Innovation is the critical component of long-term economic prosperity, driving productivity growth and (if spread across key sectors of the economy) ensuring broad-based economic growth. Sparking innovation, however, requires capital (which is threatened by the current economic downturn), skilled-labor, scientific and technological advances, and creative collaboration between government and the private sector. Innovation cannot be dictated, but it can be cultivated.

In this paper, we focus on the importance of President Barack Obama's call for a new federal effort to support regional innovation clusters. We know now—from a solid record of state and local achievements and academic research—that regional innovation clusters are a critical component of national competitiveness. Geographic regions that are bound together by a network of shared advantages create virtuous cycles of innovation that succeed by emphasizing the key strengths of the local businesses, universities and other research and development institutions, and non-profit organizations. Think information technology in Silicon Valley, music in Nashville, manufacturing in the Pacific Northwest, or life sciences in Massachusetts.

The United States, we argue in this paper, requires innovation policies for which responsibility is shared between regional leaders and the federal government. Leadership must begin in the clusters themselves—with local understanding of competitive strengths and strategies to increase the shared advantages that economists recognize as “positive externalities.” The federal government, however, can and should assume a vital role in which it frames critical national challenges, facilitates the flow of information and expertise to and between regions, and helps finance, in a competitive and leveraged fashion, valuable activities that clusters would otherwise be unable to undertake.

To that end, President Obama has requested that \$100 million be appropriated in fiscal year 2010 for the Economic Development Administration of the Department of Commerce to support regional innovation clusters and associated business incubators.¹ That request is, by itself, a very small portion of the federal innovation budget. The U.S. government each year spends about \$150 billion on basic scientific research and development. The EDA funding would help scientific breakthroughs resulting from this research find their way into new products and services that, in turn, could help foster broad-based economic growth.

We believe it is vitally important for Congress to appropriate this \$100 million. After all, we devote less than 1 percent of our nation's basic R&D budget to programs that support regional clusters, unlike our most aggressive international competitors (see box on page 2). As this paper will demonstrate, a relatively small federal initiative can be managed so that it yields significant economic advantages.

Such support could help create the next powerhouse information technology company like Google or the next pioneering biotechnology company like Genentech—and these are only two of the thousands of new companies, large and small, that spawned their groundbreaking tech-

INTERNATIONAL CLUSTER INITIATIVES

Some of our strongest international competitors, including Japan, South Korea, and many European countries, have invested in significant national cluster initiatives, directing great amounts of money and resources toward making innovation clusters the main focus of their economic and innovation policies.² The irony is obvious—foreign innovation policymakers have come to the United States to study our successes and consult with our experts and yet the United States has conspicuously failed to embrace cluster initiatives as an explicit part of its own innovation policy.

France, for example, has a €1.5 billion program called *Pôles de Compétitivité* that is focused entirely on creating, supporting, and encouraging the growth of innovation clusters throughout the country.³ In fact, 26 of 31 European Union countries have cluster initiative programs in place.⁴ Japan has made similarly large investments in two cluster programs called the Knowledge Cluster Initiative and the Industrial Cluster Program, while

South Korea has made innovation clusters the central organizing concept of its industrial policy. Numerous other countries in Europe and Asia, especially China, boast nation programs dedicated explicitly to promoting the development of specific regional innovation clusters.

The lesson is clear. As Harvard University economist Michael Porter, whose scholarship has been instrumental in our understanding of the nature and impact of regional clusters, explains it, strategic thinking “happens in other countries—Denmark and South Korea are just two where I have participated in serious efforts by national leaders, both public and private, to come together and chart a long-term plan.”⁵

No reason exists for the United States government not to do the same. Our nation also needs to improve the economic competitiveness of our regional innovation clusters.

nologies on university campuses in Silicon Valley before becoming Fortune 500 companies. New businesses, in turn, create new jobs, bolstering the overall economic well-being of the nation.

This \$100 million would be money well spent. The reason: Never before has the U.S. government devoted a single penny to a comprehensive national program *specifically* dedicated to supporting regional innovation clusters and business incubators that fuse the geographically shared resources of universities and other research organizations, companies, research centers, governments, and workers.

Federal involvement is needed. Although the United States boasts a series of successful clusters, their true potential has not been fully realized. Cluster initiatives, according to a recent Brookings Institution report, are “too few” and they are “thin and uneven in levels of geographic and industry coverage, level and consistency of effort, and organizational capacity.”⁶ Moreover, traditional clusters are under terrible stress. The automobile cluster in the Midwest is suffering not just from the perspective of the automobile manufacturers and their direct workers, but also with regard to the impact on the supply-chain, including specialized suppliers and local communities. Automobile parts manufacturers told the Treasury Department earlier this year that 130,000 jobs had been lost in eighteen months.⁷

Federal support to help innovation clusters improve their competitive strengths makes good economic sense. Begin by considering what regional economic clusters are and how they work. A simple, working definition is this: Clusters are geographic concentrations of companies, suppliers, support services, financiers, specialized infrastructure, producers of related products, and specialized institutions (such as training programs) whose competitive strengths are improved through the existence of shared advantages. So, for example, a successful cluster connects companies with academic institutions, research labs, and other nonprofit organizations in order to create the kind of virtuous cycle of competitiveness that creates jobs, stimulates business formation, and improves productivity.

What are the kinds of advantages shared by the participants in clusters? They could be a set of workers who boast particular skills, such as building boats in Maine. Or community colleges that offer training to manufacturing workers in places where advanced manufacturers are located. Or

companies that decide to locate somewhere because of the presence of well-trained employees. Or research centers that conduct basic research into biotechnology close to start-up biotechnology companies. Anything, really, that creates what an economist would call a “positive externality,” a benefit that is captured not just by a single company, but by entire communities.

Positive externalities are nothing new. Nor are high-tech innovation clusters. Some, like Silicon Valley or the Route 128 corridor outside Boston, boast world-class universities and research institutions anchoring fervent communities of networked high-tech information technology and biotechnology companies served by a critical mass of commercial, legal, and financial talent. And some, like Akron, Ohio, have leveraged historical expertise; Akron’s rubber industry has spawned an innovation cluster anchored by companies committed to polymer science and advanced manufacturing innovation.

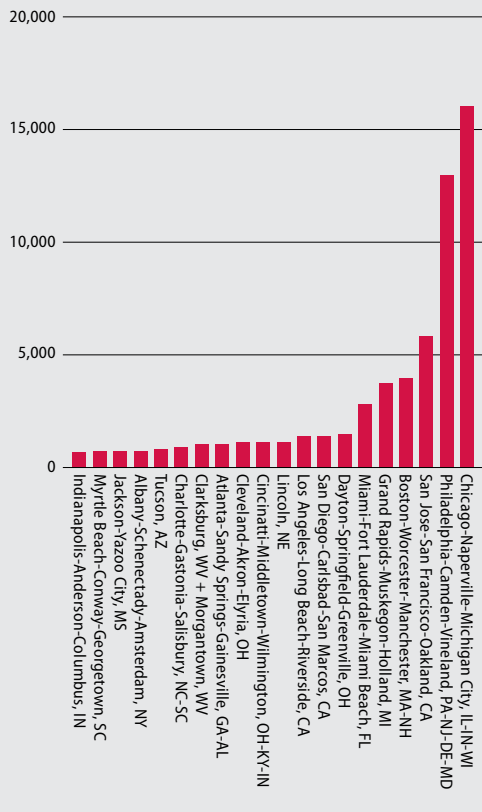
Here is what is new: The notion that regions can work closely with the federal government to consciously focus on the creation of shared advantages within clusters to create jobs, create businesses and, of course, stimulate long-term economic growth.

INNOVATION CLUSTERS GROWING APACE

A snapshot of three representative technology clusters in the United States

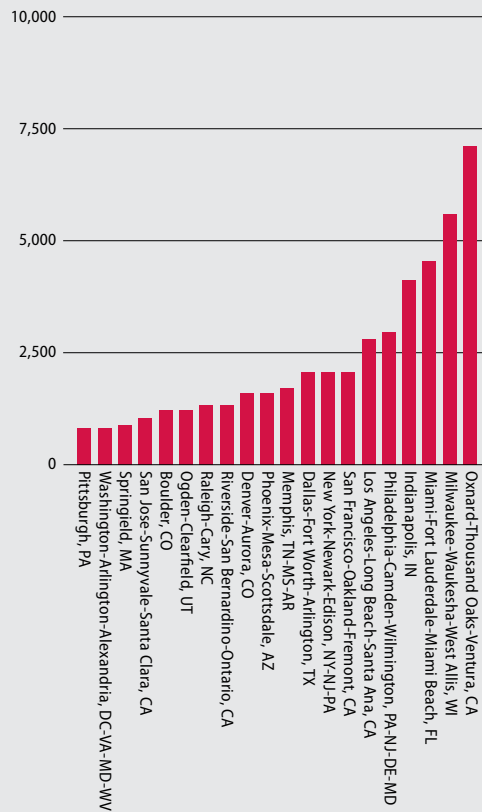
Biopharmaceuticals cluster

Cluster job creation by economic area, 1998–2006



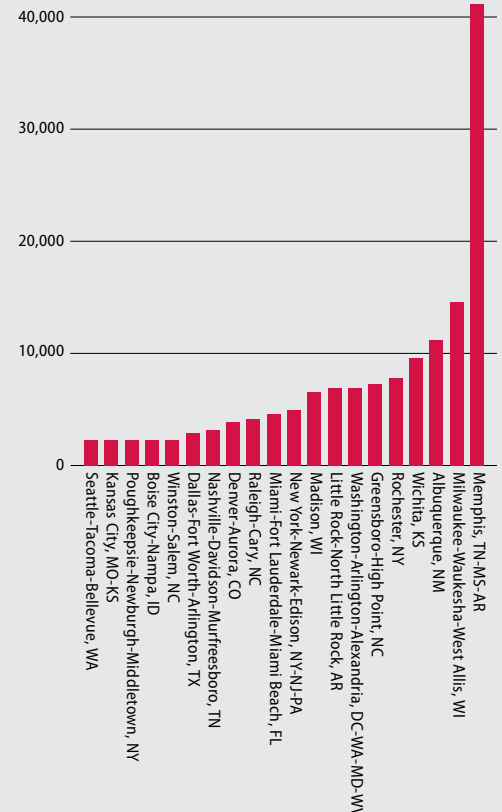
Information technology cluster

Cluster job creation by economic area, 1998–2006



Medical devices cluster

Cluster job creation by economic area, 1998–2006



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School. Copyright © 2005 President and Fellows of Harvard College. All rights reserved.

Job creation and business creation, the main economic benefits coming from innovative clusters, mostly spring from so called “high impact” companies (high-tech startups and established companies alike) that sell goods and services outside their clusters to both national and international markets, drawing revenue back into the cluster.⁸ These “traded” services boost regional economic growth and national economic competitiveness. As measured by patent rates, productivity rates, and other innovation metrics, an innovation cluster creates new companies and new jobs in a helter-skelter but overall positive direction.

The federal government, of course, does spend money on a variety of innovation programs designed to help communities across our country create some of the ingredients necessary to replicate the success of thriving high-tech innovation clusters, such as the San Diego biotech cluster, the medical devices cluster around Minneapolis, and Research Triangle Park in North Carolina. These programs help fund the early commercialization of innovative products and services as well as regional workforce development and economic development efforts to provide the infrastructure necessary for innovative companies to flourish.

But these programs fall short of their true potential precisely because they are not organized in a systematic fashion to reap the advantages of an innovation cluster. The programs often fail to coordinate their work and leverage their unique strengths toward innovation cluster development as their central mission. That’s why a modest federal investment in a national cluster development program would multiply the benefits of our existing federal innovation programs, coordinate these efforts, and match federal expertise to the weaknesses and needs of regional clusters.

Policymakers must absolutely ensure they maintain the serendipity, competition, and ad hoc collaboration that have characterized successful clusters in the United States. The importance of regional clusters to competitiveness, however, raises three interrelated policy questions:

- Do federal programs that fail to focus on *all of the ingredients* needed to create a successful innovation cluster lack the direction and heft to make a difference?
- Can a government program dedicated specifically to the creation of new innovation clusters make a difference?
- And are there other factors that account for the unique innovative qualities that make Silicon Valley and Route 128 a success yet doom efforts in other regions of the country to failure?

The answer is “yes” on all three counts, which presents policymakers with a troubling dilemma: how best to invest limited federal resources?

This paper offers policymakers a guide through this dilemma. In the first part of the paper, we will explore briefly the lessons learned by those who have both led and researched innovation clusters over the past several decades. We will reconfirm the observation that, first and foremost, “place matters.”⁹ Successful regional innovation clusters are not fungible—success rests upon differentiated competitive advantages that exist for different reasons in different parts of the country.

We will then demonstrate that access to finance matters, too. The greatest challenge that clusters need to bridge is the so-called “valley of death” financing gap that leaves young innovative companies with good ideas unable to fund the commercialization of those ideas due to the lack of seed-stage and early-stage financing. The current financial crisis has widened this valley, not

just for young companies, but also for established companies that once could turn to more liquid debt and equity markets or to local or regional lenders and investors to fund their new ideas. Strategies to attract new private capital to regional innovation clusters are critically important.

There's also a similar dearth of human capital—both managerial and workforce—in many regions of the country that wish to create or expand vibrant innovation clusters. American workers are very productive and much of our nation's manufacturing sector could operate profitably in the United States if we took advantage of our global leadership in research and development, innovation, and process technologies to forge more competitive regional economies. The problem is we don't do that today in any nationally systematic way involving clusters. The result is a growing structural unemployment problem with seemingly few solutions to match our productive workforce to the needs of innovative regional businesses.

Overcoming all of these connected hurdles requires us to rethink how we go about supporting clusters. So, also in the first part of this paper, we will examine how forward-thinking state and metropolitan governments have adopted practices that foster strong clusters, creating jobs, helping established companies grow and, of course, providing opportunities for new businesses. The key lesson for regional governments: Patience and leadership are necessary in the creation of all clusters.

Cases in point: North Carolina's Research Triangle Park and San Diego's CONNECT cluster—two regions that focused on all the ingredients needed for success, including federal funding—took several decades to reach their current prominence among U.S. clusters and were piloted there by a coterie of forward-thinking government, university, and business leaders. Newer clusters that recognize the importance of patience, such as those budding around the Arizona State University in Tempe, the Washington, D.C. metropolitan region's many universities, and in rust belt cities in the Midwest such as Pittsburgh, are making headway.¹⁰

In the second part of the paper, we will discuss the reasons why Congress should support, and how the Obama administration should effectively implement, the president's proposal that the Economic Development Administration be appropriated \$100 million to support regional innovation clusters and associated business incubators. We will demonstrate that the Obama proposal is the answer to the failures of federal support identified in our earlier discussion of federal efforts. And we will show how this new effort—alongside dedicated White House leadership—can simultaneously increase the effectiveness of other federal programs, such as Small Business Innovation Research and Small Business Technology Transfer programs, which are administered by a variety of government agencies in coordination with the Small Business Administration, and the efforts of other Commerce programs, including those housed at the National Institute of Standards and Technology and the National Science Foundation. (See Appendix for a summary of the main federal programs that could measurably increase the impact of a clusters approach).

Support for clusters through the Department of Commerce's EDA must be targeted at what matters most to innovation: The shared advantages that accrue to businesses, workers, and communities alike when the success of a cluster spawns a virtuous cycle of economic growth. Operating at the micro-economic level, the EDA must show a keen understanding of the ecosystem of innovation to ensure that its targeted innovation investments go where they can make a difference building cluster infrastructure and thereby do the most good for the longest time.

Specifically, we will explain how the Obama proposal provides the missing elements that are needed to support state and regional leadership. The federal government should leave leadership to the regional community, which knows best its own competitive advantages. But a bottom-up approach can reach the top level of government, with EDA supplying necessary funds to allow clusters to create shared resources, and with universities, community colleges, and research centers supplying a national framework against which the importance and success of clusters can be measured. Funding should be tightly connected to effective information exchanges, which will strengthen the ability of clusters to plot their own competitive strategy, and aligned with other federal programs through, for example, so-called “one-stop shops.”

We conclude this paper by sketching out the critical program-design elements that should be endorsed in the appropriations process for the proposed \$100 million for EDA to implement a federal clusters strategy. Specifically, in this paper we propose that EDA should:

- Administer a competitive matching-grants program, with established criteria used to ensure the greatest impact of federal funding, among them an emphasis on local leadership from the private and public sectors, including universities and other research institutions.
- Align the cluster selection process with national priorities such as energy-efficiency, advanced manufacturing, and new technologies when administering this matching grants program.
- Assist economically distressed areas of the country by pooling regional resources from within and outside of distressed areas in order to bring together a critical mass of university savvy, business acumen, and productive workers.

No single grant application should have to meet all these criteria, but having these three principal guidelines in place will help ensure transparency and effectiveness. Funding should be focused on building the common infrastructure of innovation in a region, which effectively lowers the cost of business growth and creation. Examples include program development plans for business incubators and research centers, worker-training programs, and technology-transfer efforts focused on small- and medium-sized companies. Where regions have no effective clusters, smaller planning grants should also be available for the creation of strategies based on comparative advantages.

Time to act

Support for regional innovation clusters and business incubators is good public policy—and good political leadership. Successful cluster policies have been implemented at the regional level by both Republican and Democratic officials alike because clusters represent a pragmatic approach that requires collaboration with the business community and that, when successfully implemented, benefits communities as a whole.

Similarly, pioneering research into the role of clusters by policy advisors to both Democrats and Republicans has created a bipartisan foundation that increases the chances that, once initiated, federal cluster efforts will be supported for a long time by members of both parties. This is important because, as we have noted before, patience matters and, therefore, federal clusters efforts must be able to garner long-term political support.

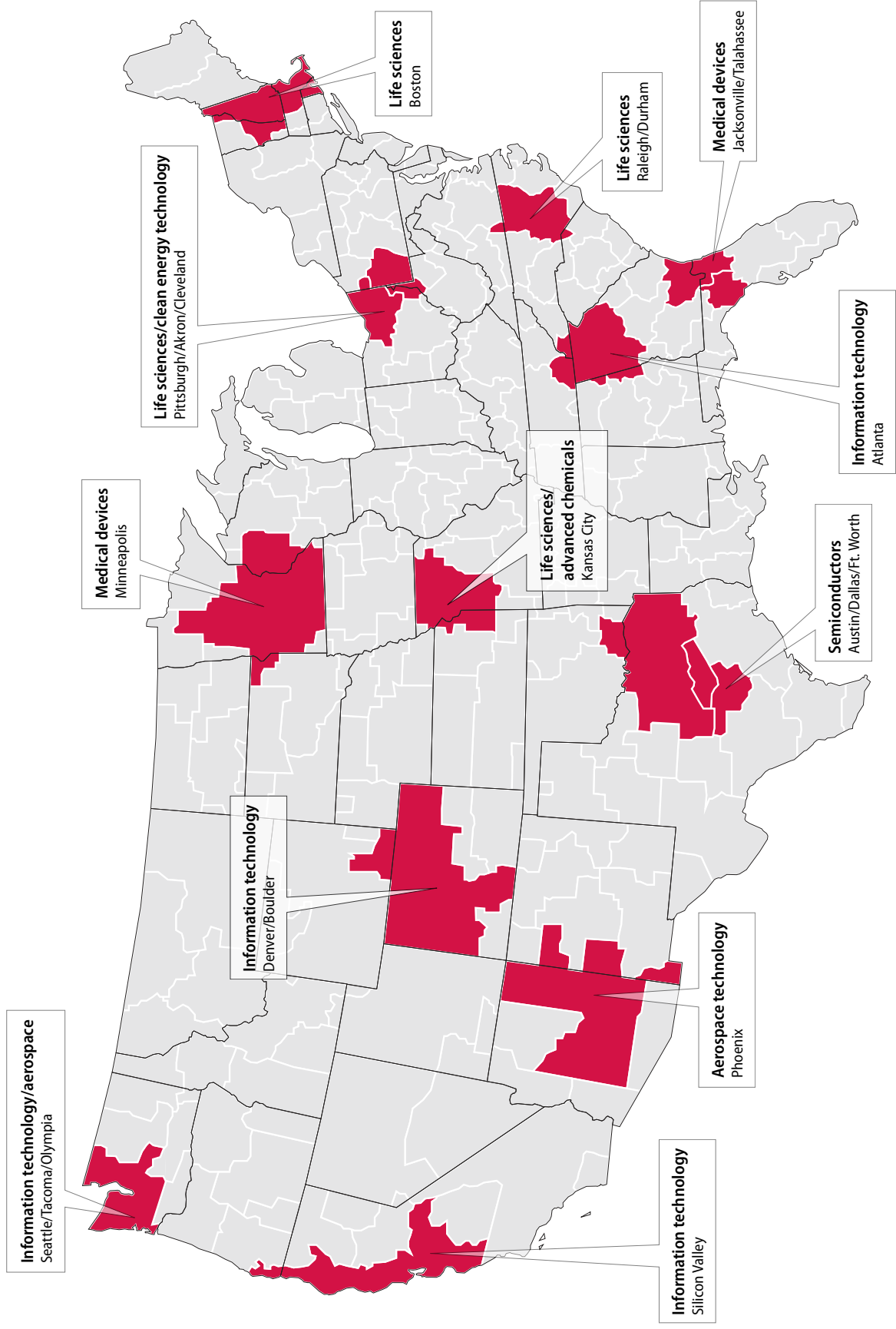
Moreover, in a coming time of budget austerity, the regional cluster initiative does not require large sums of funding. That's because federal support will be leveraged, providing resources that are not otherwise available but always contingent on regional governmental and private resources to amplify the impact of federal dollars. In fact, federal support in fiscal year 2010 budgets would come at an important time for state governments, which are under tremendous fiscal pressures. States including Ohio, Kansas, Connecticut, and Pennsylvania have either reduced economic development spending or encouraged large reorganizations of programs to control it.

Over time, the implementation of regional cluster strategies can increase the effectiveness of other federal spending. Just within the Department of Commerce itself, for example, export promotion and technology outreach programs at the International Trade Administration and NIST, respectively, would be strengthened by their links to effective cluster strategies, which in turn could supply valuable expertise to increase EDA's own effectiveness. Even more importantly, federal support for regional innovation clusters presents an important opportunity for EDA to forge a close partnership with the Small Business Administration, whose own programs reach deep into local communities.

In the pages that follow we will present our analysis, conclusions, and recommendations in greater detail. In the end, we hope the case is made that Congress needs to appropriate that first \$100 million toward a national program for regional innovation clusters. We are confident this step will help ensure that the \$150 billion taxpayers invest annually in basic scientific research and development can better deliver on the promise of more and better jobs, new businesses, and transformative technologies across our nation.

A SNAPSHOT OF U.S. INNOVATION CLUSTERS

A selection of high-tech clusters in different parts of our country



Lessons learned about successful cluster creation

Let's consider first how businesses in clusters come into being. For a life sciences company like Genentech, for example, building a young company out of university-based research depends first on the university's willingness to invest in the concept of startup-based commercialization. That requires a sophisticated technology-transfer operation at universities and other basic research laboratories. Then the startup must find the early cash needed to start a new company to commercialize its yet-untested intellectual property, as well as gain some early business know-how from economic development agencies and solicit additional donations from federal research grants just to stay alive.

Such companies then need to attract angel investors, venture capitalists, and corporate strategic partners—themselves key developers of innovation—to build their businesses. If all goes well—no mean feat as the technology the company is commercializing has to prove to be not just safe and efficacious but also marketable—perhaps the company can make an initial public offering on a stock exchange, becoming a public company.

This process can take more than a decade, and chances are the company will still not yet be profitable. And along the way, the company needs to attract an array of business, marketing, and financial talent, especially expertise from business executives who have done it all before and succeeded or more likely failed a few times first before succeeding.

Each of these factors is also critical to creating new communities of regional innovation where startup companies succeed in traversing this difficult financing path. Yet the breadth of workforce skills and management skills needed to build these clusters are often missing in these communities, which are just starting to understand the power of their own competitive advantages.

This same dynamic is true for information technology companies like Google as well as for other startups in nanotechnology, alternative energy and green technologies, new materials, and other cutting-edge industrial and services technologies. The innovation growth cycle for these types of companies is not as lengthy as it is for biotech companies, but the problems are the same:

- Lack of commercialization expertise at many research universities
- Lack of access to enough seed-stage and early-stage venture capital
- Lack of management talent, workforce talent and industry-specific talent to create new local companies
- Lack of a “critical mass” of supportive individuals and businesses in these tech arenas in most university towns and cities

Without regional support for innovation, two threats dominate the landscape. First—and this is difficult to measure—some companies will simply fail to come into being or, if launched, fail to find fertile soil for their efforts. Second, innovative new companies may have to move to find

success—perhaps far from the universities and federally funded labs where the innovations themselves were developed. And that, of course, means that regions are deprived of the new successful companies whose presence may improve regional competitiveness by clustering. Regional economies require vibrant business communities, but when the most innovative talent alights for other cities to build their businesses regional economies suffer.

In contrast, where clusters are supported by local businesses, universities and other educational institutions, and communities, advantages accrue to both established and new businesses—and their workers. Established businesses that sell their goods and services across a broader region or around the globe bring new dollars and employment opportunities that then expand the local economy. Fostering innovation among startup companies and established companies in clusters has a multiplier effect for both types of companies and purely local businesses, too, such as restaurants, dry cleaners, and other small retail businesses, all of which provide “non-traded” services that are created and consumed within the cluster.

In short, success in a sector creates spillover effects in the regional economy, as specialists look to the area for next generation of information technology, life sciences, or other form of innovation.

There are two sets of lessons that are crucial to remember when considering the creation of a successful cluster. The first set teaches us about the on-the-ground conditions that make a cluster successful—what inherent regional characteristics enhance the chance of cluster success. The second set identifies the governmental actions that improve the chances of cluster success—what the government can do to leverage endemic regional strengths to encourage success. For innovation policy to be fruitful it is vitally important to recognize the difference between these two sets of lessons as well as to consider how they can be combined to boost regional innovation across the country.

The on-the-ground conditions that make a cluster successful are first and foremost intrinsic to the cluster itself. Place matters. But the other key conditions are a pro-innovation environment (including the presence of research institutions and committed government, research and business leadership), management and workforce talent, risk capital and debt financing, and a regional innovation network of similar companies competing—especially in pre-competitive research—cooperating with each other. And even when all these ingredients are present, a final lesson learned about successful clusters is that patience is crucial. Clusters take time. Regional leaders need to understand this and work equally patiently at the development process.

Ideal government innovation policies should encourage local strengths, stimulate shared advantages, encourage the creation and development of human networks, and always galvanize public education and research institutions. Through these steps, governmental policy will base economic development on existing and nascent strengths, build regional infrastructure, convene businesses, finance, nonprofits and workforce participants, and encourage universities, research centers, federal labs and community colleges to develop their own long-term policies to help cluster stakeholders more effectively join together. Government action that improves the chances of a cluster becoming successful must be carefully attuned to conditions on the ground, and must complement these existing conditions rather than force the cluster into artificial strategies ill-suited to local strengths.

There is a crucial difference, however, between these two sets of lessons. The first—the ways that local advantage turn into self-sustaining forces of competitiveness—have been well enunciated through academic research, much of this based on Harvard Business School professor Michael

Success in a cluster creates spillover effects in the regional economy, as specialists look to the area for next generation of information technology, life sciences, or other form of innovation.

Porter's pioneering work in the field,¹¹ as well as new research demonstrating that areas with strong clusters have higher rates of innovation and entrepreneurship and better wages.¹² Recent studies¹³ have established the real advantages of “clusters” for a growing economy, including strong correlations between:

- Per-capita GDP and cluster concentration
- Cluster strength and higher wages¹⁴

But the second set of lessons—which forms of governmental action can increase the chances for cluster success—have yet to be fully integrated into the theory of economic development that guides national and regional governments. In this section of the paper we will identify both sets of lessons through the examination of four principles for cluster success: Place matters, networks are critical, patience is necessary, and leadership is essential.

Place matters

Regional efforts to develop and encourage the growth of innovation clusters consistently run up against one inexorable fact: Place matters. Clusters cannot be instantaneously generated out of whole cloth. Many of the necessary regional ingredients need to be present stretching back decades.

Silicon Valley cannot be replicated in every location without regard for regional character, strengths and weaknesses, and stakeholders. Santa Fe cannot develop a world-class hydroelectric cluster, and it shouldn't try. But New Mexico is developing its advantages in solar, wind, and geothermal energy, as it should. Clusters develop depending on the unique mixture of local and regional strengths and stakeholders, including universities (and other knowledge-generating research institutions), businesses, government programs, and workforce skills.

In short, different regions have fundamentally different strengths that policymakers must recognize. Boston, Palo Alto, Omaha, Atlanta, and Phoenix each has very different indigenous businesses, universities and other research institutions, workers, and histories, all of which determines the viability of innovation cluster development and the flavor of any potential industrial agglomeration. Specifically, regions have:

- Distinct R&D institutions, including universities, federal labs, and industrial research centers, determining the degree to which, and the nature of, ideas that “spillover” into the local community, encouraging small business formation and commercialization.
- Workforces and management pools with varying skills and education levels, determining the ease and speed with which new companies can develop, hire employees, and produce new products.
- Different amounts and types of capital available for investment in new businesses and nascent industries, affecting the success that R&D spillover has in the creation of innovative companies.

Boston and Silicon Valley, of course, have powerful research universities, highly competitive local companies that make large annual R&D investments, a well-educated and highly skilled workforce, significant venture capital expertise and financing, and plenty of people with a range of critical business skills. The soil in these places was properly fertilized decades ago—including with federal research and development money and key support for such pioneering companies as

chipmaker Fairchild Industries—just waiting for a seed or two to set off a chain reaction that led to the emergence of world-class centers of high-tech industrial agglomeration.

Now, this doesn't mean that regions without all the inherent pro-innovation characteristics of Silicon Valley can't develop into successful innovation clusters. Quite the contrary. Look no further than North Carolina's Research Triangle Park's now-thriving biotechnology cluster, the Dallas-Austin-San Antonio computer chip and computer software corridor, Seattle's booming software cluster, or the budding nanotechnology cluster in upstate New York. All four of these clusters had some but not all of the ingredients needed, such as strong research institutions, major industrial companies, nearby financial centers and key workforce and management talent. And they all required local leadership to coalesce the inherent cluster capabilities and attract the other ingredients that were lacking.

These clusters and others developed relatively successfully by building on their own inherent strengths. They took advantage of the makeup of their own soil, developing successful clusters of competing companies with distinctively local character. This is the takeaway message for policy-makers: Regions are different and an embrace of these local differences is the key to encouraging the development of innovation clusters on the scale and in the image of the local environment. Effective regional cluster policy must, therefore, leverage existing strengths, competitive advantages, and local stakeholders to encourage development that fits the place. Ineffective regional cluster policy would attempt, for example, to build a biotech cluster in a region with little or no indigenous life sciences companies, research universities, or established technical workforce.

So what are some of the local ingredients that contribute to the development of a successful innovation cluster? We've already highlighted the need for institutions of knowledge creation, at least the beginnings of groups of similar businesses, industry-specific managerial and technical talent, a skilled workforce, and a budding network of ancillary businesses and legal and financial services to help the cluster grow. Then patience and leadership are required to bring this all together into an effective cluster. Let's briefly consider each of these ingredients in more detail.

The existence of institutions of knowledge creation

Innovative companies were once innovative ideas, many of which came from the scientists, professors, and engineers that work at universities, corporate R&D facilities, and government laboratories. The "spillover" of ideas from these knowledge-creation institutions (and their intellectual property practices) to the local community and network of entrepreneurs is the central process that takes place in fertile innovation clusters. As more and more ideas move from labs to eager individuals and their business partners, scores of innovative businesses are started, feeding an auspicious cycle.

Celebrated are the roles played by Stanford University in Silicon Valley and the Massachusetts Institute of Technology in Boston in knowledge creation. Less well-known but no less important are the roles played by the Rensselaer Polytechnic Institute in Albany, the University of Pittsburgh and Carnegie Mellon University in Pittsburgh, Columbia University in New York City, and the University of Texas in Austin.

These and other research universities boast technology-transfer operations that help create startups in their local and regional communities.¹⁵ But other universities and research institutions

"Gazelle" jobs

Jobs in gazelle companies (firms with annual sales revenue that has grown 20 percent or more for four straight years) as a share of total employment

The top five	Jobs in fast-growing companies as a percentage of total employment
1. Nebraska	20.8%
2. New York	12.3%
3. New Jersey	11.0%
4. Washington	10.2%
5. Minnesota	9.9%
U.S. Average	8.0%

Source: Robert Fairlie, 2007 data.

The top five movers	2002 rank*	2008 rank	Change '02-'08
1. Nebraska	36	1	135
2. Alaska	46	20	126
3. Arkansas	41	18	123
4. Nevada	33	13	120
5. Delaware	25	6	19

* 2002 state ranks have been revised for data comparability.

Source: Information Technology and Innovation Foundation. All data from ITIF drawn from its "The 2008 New Economy Index."

have not yet developed their tech-transfer capabilities in ways that enrich the regions they inhabit, depriving their communities of the innovation spillovers necessary to build vibrant clusters.

The availability of capital

A good idea doesn't guarantee the development of a profitable company. Without significant, consistent, and affordable capital, the spillover of ideas from knowledge-creating institutions isn't enough to make innovative companies. Venture capital, angel investment, and public financing are integral to the creation and growth of the small companies that are the bedrock of innovation clusters.

The lack of seed-stage and early-stage capital financing, the so-called "valley of death," poses a significant challenge to growing companies and an exciting target for cluster policymakers. This valley of death has only been widened and deepened by the recent economic turmoil.

Angel investment dropped 28 percent in 2008, indicating a severe contraction in the availability of capital to help young companies get their start in business.¹⁶ And the average investment by venture capital firms in 2008 was \$8.3 million, with only about 4 percent of the capital going to early-stage companies.¹⁷ In the first quarter of 2009, investment activity was down 47 percent in dollars and 37 percent in deals from the fourth quarter of 2008, which was itself a down quarter. These numbers represent the lowest venture capital investment levels since 1997.¹⁸

We must also remember that new companies aren't the only innovative companies in a cluster. A recent Small Business Administration study¹⁹ showed that innovative companies are not just startup companies. There are about 375,000 so-called "high-impact" companies spread across the country, defined as those having "sales of which have at least doubled over the most recent four-year period and which have an employment growth quantifier of two or greater over the same period." Interestingly, these companies, which include high-tech startups, account for almost all of the private sector employment and revenue growth in the economy, even though they only constitute 2 to 3 percent of all companies. Yet only 2.8 percent of these companies are 10 years old or younger. These established businesses sometimes lead the innovation activities of a particular region, and are integral components in a region's economic geography.

The economic downturn of the past year or so has made credit exceedingly hard to come by for even these larger, more established companies. Banks have cut their lending to even the most strong and well-established innovative companies in response to tough economic conditions. All of these extraordinary credit difficulties have forced even large, deep-rooted companies to cut back on their innovation activities and product development. Finding ways to help established businesses overcome these financing hurdles will be critically important to the development of young innovation clusters.

Moreover, state financing is more difficult to come by. State governments, many of which have significant grant programs designed to encourage technology-based economic development by lending to innovative companies, are dealing with budget crises and have had to cut back drastically on their lending. As we noted above, states including Ohio, Kansas, Connecticut, and Pennsylvania, have either reduced economic development spending or encouraged large reorganizations of programs to control it.²⁰

Fastest growing firms

The number of Deloitte Technology Fast 500 and Inc. 500 firms as a share of total firms

The top five	Percentage of firms that are fast growing
1. Massachusetts	0.037%
2. Virginia	0.035%
3. Utah	0.027%
4. Maryland	0.023%
5. New Jersey	0.021%
U.S. Average	0.013%

Source: Deloitte Fast 500, 2006 and 2007 data and Inc. 500, 2007 and 2008 data.

The top five movers	2007 rank	2008 rank	Change '07-'08
1. West Virginia	49	29	↑20
2. North Dakota	47	33	↑14
3. Wisconsin	38	27	↑11
4. Kansas	36	26	↑10
4. Rhode Island	42	32	↑10

Source: Information Technology and Innovation Foundation.

Venture capital

Venture capital invested as a share of worker earnings

The top five	Venture capital as a percentage of worker earnings
1. California	1.5%
2. Massachusetts	1.4%
3. Washington	0.8%
4. Colorado	0.6%
5. Maryland	0.4%
U.S. Average	0.4%

Source: PricewaterhouseCoopers/Venture Economics/NVCA, 2007–2008 data.

The top five movers	2002 rank*	2008 rank	Change '02-'08
1. New Mexico	44	8	↑36
2. Vermont	29	15	↑14
3. Tennessee	37	25	↑12
4. Mississippi	43	33	↑10
5. Oklahoma	39	30	↑9

* 2002 state ranks have been revised for data comparability.

Source: Information Technology and Innovation Foundation.

The presence of high-skill labor alongside programs to spur talent generation

Without employees with the skills necessary to do innovative, often high-tech work, new and expanded businesses could never get off the ground. That is why a region that is to become a more successful cluster must not only have lots of entrepreneurs who can start companies, but the availability of eager, dedicated, and talented workers who have the energy and skills to bring innovative ideas to life. Workforce development programs are crucial to the development and maintenance of a highly skilled workforce, and a smart policy choice for regions hoping to grow new companies.

These new companies in turn help boost job growth. Between 1994 and 2006, for example, high-impact companies with fewer than 500 employees created 58 percent of all new jobs.²¹ Of course, many of these new companies failed or were acquired by others, resulting in plenty of jobs lost. But that “churn” represents a dynamic innovation economy in action. That’s why states struggling with the downturn of the American manufacturing sector, especially the rust belt states of the Midwest, have begun to embrace workforce development programs to boost high-tech job growth.

Michigan, for example, awards startup grants and provides training to fill job vacancies in high-demand fields that will bolster further economic growth to more than 20 “regional skills alliances.” Or consider Pennsylvania, which has an Industry Partnerships program that brings together employers and workers in the same industry cluster to discuss overlapping labor issues, encouraging hiring and the development of skilled workers. The Pennsylvania program has trained more than 70,000 employees since 2005, growing high-skill jobs in innovative companies.²²

Highly skilled labor is essential to the growth of new companies and innovation clusters—workforce programs that encourage the development of highly skilled labor represent a prescient recognition of the importance of training and retraining our labor force for a new generation of American ingenuity.

Networks

Networks, physical and virtual, are integral to spurring the development of industry clusters. When companies, universities, workers, policymakers, and sources of capital are in close and frequent contact, clusters are strengthened. In the absence of these networks, clusters struggle to develop to their full potential.

Networks are important because collaboration is important. The first to comment on the relational networks between companies and entire industries was economist Alfred Marshall, who in his 1890 *Principles of Economics* highlighted the agglomeration of certain industries into districts across England. The impact of his ideas waxed and waned until the early 1990s, when Michael Porter and others gave birth to a wave of scholarship on the role of clustering in economic development, specifically examining the collaboration and exchange of ideas between companies with complementary and overlapping professional interests.

Scholars, policymakers, and others who study the origination and development of industry clusters have highlighted the importance of networks, of regional, multi-stakeholder relationships, on the success of a cluster. University of North Carolina professor Maryann Feldman, for example, notes that “as technology allows greater communication at long distance, we experiment with

Entrepreneurial activity

The adjusted number of entrepreneurs starting new businesses

The top five	Adjusted number of entrepreneurs as a percentage of population
1. Montana	0.47%
2. Georgia	0.43%
3. Vermont	0.42%
4. Mississippi	0.42%
5. Louisiana	0.39%
U.S. Average	0.30%

Source: Robert Fairlie, 2007 data.

The top five movers	2007 rank	2008 rank	Change '07-'08
1. Tennessee	41	12	129
2. Massachusetts	43	16	127
3. Louisiana	30	5	125
4. Kentucky	42	25	117
4. South Dakota	27	10	117

Source: Information Technology and Innovation Foundation.

distant collaboration and knowledge sharing [because] there is simply no substitute for just being there—being at the place where exciting work is taking place, where high-content unstructured conversations take place, and where the unexpected may be explored and spark something new.²³

Case in point: The state of New York, the city of Albany, the State University of New York, local and regional businesses, and labor leaders have networked together over the past 10 years or so to create the College of Nanoscale Science and Engineering and the Albany Nanotech complex, investing billions of dollars, attracting hundreds of high-tech companies from around the world to set up shop in their \$5 billion nanotech complex, and spurring the creation of new products and new businesses. This has all been done through a collaborative web of staggering scale, with government, business, and university leaders; high school, college, and graduate students; labor leaders and venture capital and angel investment professionals utilizing each other’s unique strengths and expertise to put Albany back on the cutting edge.²⁴

Austin, Texas has also developed a remarkable regional economic stakeholder network, resulting in the area’s dominance as a computer chip cluster. The city’s leadership worked hard in the 1980s to land SEMATECH, the public-private non-profit consortium of semiconductor manufacturers formed to boost innovation in the U.S. chip industry, then under siege from Asian competitors. This critical network of companies spawned new start-up companies as SEMATECH developed.

In addition, Austin Ventures, a \$3 billion venture capital firm, as well as several other financing firms, partnered with a regional policymakers, local entrepreneurs, and most prominently, the University of Texas’ researchers and university leaders to build a cluster of profound success, commercializing university technology and forming companies. Networking Austin’s stakeholders turned the city from a college town into an international chip hub.

As we consider regional innovation strategies to spur economic development and the growth of regional centers of innovation, we would be wise to make supporting the development and strengthening of regional networks a central focus. Targeted federal support has worked in the past and can work again.

Patience in the Creation of Clusters

Patience really does make perfect. Regional and national policymakers must realize that it takes time and a sustained effort to create innovation clusters. Policymakers who expect initiatives to sprout full-fledged industry clusters overnight will be disappointed and are likely to give up before their efforts actually yield promising results. The existing research shows that the evolution of clusters can take many years, often decades.

The experience of the North Carolina Research Triangle is a very useful case study, providing a hint to the significant investment of time and money that is required to create or strengthen an innovation cluster. In North Carolina, the explicit decision was made in the 1960s to invest heavily in universities and research infrastructure to develop a relatively rural area into a life sciences innovation cluster. Of particular importance: local leaders drew two key national labs, one from the Environmental Protection Agency and one from the National Institutes of Health, to locate near their universities.²⁵

Patents

The number of patents issued to companies or individuals per 1,000 workers

The top five	Adjusted number of entrepreneurs as a percentage of population
1. Idaho	2.66
2. Washington	1.71
3. California	1.35
4. Colorado	1.26
5. Delaware	1.22
U.S. Average	0.74

Source: Robert Fairlie, 2007 data.

The top five movers	2002 rank*	2008 rank	Change '02-'08
1. Massachusetts	17	7	↑10
2. Maine	42	32	↑10
3. Washington	8	10	↑2
4. South Dakota	48	41	↑7
4. Kansas	38	29	↑9

* 2002 state ranks have been revised for data comparability.

Source: Information Technology and Innovation Foundation.

Today the Research Triangle employs thousands of people, houses more than 170 high-tech and high-paying companies, and has spurred over 1,500 startups since 1970. It can be argued that a cluster has successfully been created—but the process has taken a very long time, and required sustained levels of investment. And it was launched at a time when few other regions were aiming for the same position.²⁶

So what can policymakers learn from the obvious success of the North Carolina Research Triangle? Namely, that a sustained and large investment of time, money, expertise and leadership is not only desirable but fundamentally necessary to the creation of research clusters across the nation. An analysis of biotechnology clusters across the United States by Joseph Cortright found that “the profile of the three metropolitan areas that have successfully developed a significant biotech presence in the past decade (Raleigh-Durham, San Diego, and Seattle) suggest the level of effort required. Each of these areas has had an average of \$500 million annually in funding from the National Institutes of Health (in 2001 dollars) for more than a decade, and \$750 million in new venture capital investment during the past six years. And each area also has one or more of the nation’s 20 top-ranked medical research universities, and two or more of the nations’ 50 principal biotechnology venture capital investment firms.”²⁷

Another example of a region taking this lesson to heart is the Greater Phoenix region, where the Arizona state government and Arizona State University have prepared a variety of educational, R&D, financing, business development, and workforce development programs centered around the state’s comparative economic advantages.²⁸ Other examples include Pittsburgh and Philadelphia, where life sciences clusters are growing after state and local officials, businesses, and university leaders teamed up to develop comprehensive clusters policies.²⁹

In all of these places, policymakers had to overcome the short-term political obstacles to investing in long-term innovation cluster development programs. Often times, local politicians don’t see benefits of their investment during their terms in office, which leads them to look for more quick-fix solutions to economic development, such as tax breaks and other incentives to draw big employers to their communities.³⁰ This can result in state and local political leaders competing hard to attract new businesses with immediate job payoffs but with little long-term economic benefit to the region.

Cluster investment, lacking immediate payoffs for politically powerful constituencies, thus has historically had limited appeal compared to the alternative “locational” strategy of attracting large investments from elsewhere. This political reality presents a significant challenge to overcome, and is another piece of evidence that patience and thoughtful leadership is fundamental to cluster success. Yet the more academics and policymakers alike learn about clusters, the more it becomes apparent that growing existing clusters doesn’t require the same timeline. Once a cluster’s comparative advantages are understood, and all the potential players in a cluster connect in one or several different ways, providing the last necessary ingredients to foster success is an easier proposition economically, but also politically.

Leadership

Inherent in the concept of clusters is the notion of shared advantage—the regional co-location of positive externalities. It’s not surprising, therefore, that collaboration is an important ingredient of cluster success. But collaboration and shared advantages do not spring full-bloom into being. Conscious leadership plays an important role.

Once a cluster’s comparative advantages are understood, providing the last necessary ingredients to foster success is an easier proposition economically and politically.

Sometimes leadership can seem to be inherent in the local institutions themselves, as clusters develop on their own over decades without any particular set of individuals or institutions consciously thinking about their development. All that was needed were basic research and development money, strong research institutions and a comparative advantage in particular industries. Silicon Valley and the Route 128 corridor fall into this category, though over the years Stanford University and the Massachusetts Institute of Technology increasingly provided the intellectual leadership to champion the commercialization of technologies brewing on campus.

Other innovation clusters, however, required decisive local leadership to begin to flourish. Consider San Diego's CONNECT program. A number of business, educational, and political leaders in San Diego in the late 1980s, among them University of California, San Diego Chancellor Richard Atkinson, Daniel Pegg, chairman of the San Diego Regional Economic Development Corporation, the CEO of communications chip software pioneer QUALCOMM, Inc. Irwin Jacobs, and venture capitalist Buzz Woolley of Girard Capital, came together with the express purpose of refashioning San Diego to compete in the new "knowledge economy." Their hard work and leadership spurred the creation of the multi-dimensional CONNECT program that has supported the creation and development of over 1,200 companies, many new jobs, and led San Diego to be ranked as one of the top biotech innovation clusters in the country.³¹

Or consider Toledo, Ohio. The University of Toledo, recognizing its strong engineering and manufacturing science programs and the city's highly skilled workforce and economic infrastructure, led a 20-year effort to create a new photovoltaics and clean-energy cluster. UT has assembled a team of world-class faculty in photovoltaics and has built laboratories and support centers that have spun off dozens of businesses and reinvigorated the city. In partnership, the state of Ohio committed \$18.6 million to UT in 2007 to spur the continued development of the photovoltaics cluster, generate new high-tech jobs, and to increase industry revenue.³² From this university and government leadership, the Wright Center for Photovoltaics Innovation and Commercialization is now an internationally recognized photovoltaics research and development center with infrastructure attractive to companies incubating the future generations of photovoltaic technologies.

These stories of leadership have played out all across the country, from the optoelectronics cluster in Boulder, spurred by the leadership of the University of Colorado, the National Science Foundation, and local business leaders, to the Minneapolis medical devices cluster, sparked by the leadership of officials at the University of Minnesota. The development of innovation clusters often results from the strong, decisive action of local institutions and their leaders.

So the upshot: Geographic differentiation, a critical mass of business and finance skills, innovation networks both physical and virtual, patience and leadership can combine to create competitive regional innovation clusters across the country. How do federal policies help catalyze the creation of these clusters? Or more accurately, how can federal policies be improved to catalyze the creation and growth of clusters? We now turn to these questions.

Federal innovation policy: The missing link to cluster success

Now, for the first time, the federal government is poised to implement a nationwide regional clusters strategy. The Obama administration is seeking \$100 million in funding for regional innovation clusters and business incubators in the fiscal year 2010 budget of the Economic Development Administration. And that comes none too soon. Much of the response to the current economic crisis has been, rightly, on implementing immediate steps designed to ensure the functioning of our nation's financial system and immediate job growth. At the same time, however, the Obama administration has correctly called upon the nation to take actions now that will rebuild the foundation of sustainable economic growth for the long-term.

The specific, but limited role of the federal government in innovation policy is to frame, facilitate, and fund innovative activities and initiatives at the local and regional level that otherwise could not be implemented. Regional innovation is a local, bottom-up process, but the federal government has an important role to play: providing resources, coordinating development and innovation efforts, and stimulating communication between levels of government and among regions. In this role, the federal government can be an invaluable resource for the future growth of regional innovation clusters—filling a missing link in U.S. innovation development chain.

Currently, the United States spends over \$150 billion annually on research and development,³³ but only about \$651 million is spent on programs that can be described as indirectly supporting regional innovation clusters—though none with the explicit focus of the proposed EDA efforts. These activities include, on an annual basis, the National Science Foundation's \$25 million for its Partnerships for Innovation, Advanced Technology Education and Industry/University Cooperative Research Partnership programs; the Department of Commerce's National Institute of Standards and Technology's \$110 million for its Manufacturing Extension Partnership program and \$65 million on its Technology Innovation Program; and the Department of Labor's \$125 million Community-Based Job Training program, as well as additional funds through its Workforce Innovation in Regional Economic Development, or WIRED program.³⁴

In addition, there is the multi-agency Small Business Innovation Research program and the Small Business Technology Transfer program, which provide competitive small-business grants to encourage and foster commercialization and innovation through a program coordinated by the SBA as part of its development mandate. Most recently, the Secretary of Energy, Dr. Steven Chu, has proposed the creation of eight new Energy Innovation Hubs to further energy innovation by pulling “scientists from different disciplines in collaborative efforts” to solve common problems bedeviling energy research.³⁵ (See Appendix for greater detail on relevant federal programs.)

These federal programs for innovation are unevenly spread throughout the government—at best, their support for regional innovation is indirect and half-hearted, at worst, it is negligible. Not only are the existing programs in their current form uncoordinated with each other, but some suffer

from internal design and execution issues of their own. A federal program explicitly focused on regional innovation clusters and business incubators offers a more successful strategy for innovation by synchronizing existing programs. The bottom line is clear: The federal government must do more if it is to make a real substantial impact on the creation and growth of innovation clusters and, therefore, the success of innovation-focused economic development.

The president's call for the funding of regional innovation clusters is the glue that can hold together—and increase the effectiveness of—long-term economic strategies that are being implemented across the Administration. Relatively inexpensive on its own, built on a solid record of bipartisan achievement at the local level, and backed by thorough scholarship, regional innovation clusters will make government at all levels more effective. Properly conceived, and with critical federal support, regional innovation clusters will boost economic growth through the creation of shared regional advantages that make their business more competitive, their workers more valuable, and their communities more prosperous.

The economic case for the nurturing of regional clusters is persuasive. In this section of our paper, we will address the practical question of governance: How can the Obama proposal to support the development of regional innovation clusters best be implemented as a matter of sound public-policy? Although much attention has been given to the need for a regional innovation clusters system and its benefits, few commentators have addressed *how* the U.S. federal government can actually implement such a system based upon existing agencies and programs.³⁶ And how can the Executive Branch best coordinate the programs discussed above to increase their impact and effectiveness?

The Obama administration's proposal

During his presidential campaign, Barack Obama explicitly called for the federal government to work with regional innovation centers. He explained that the federal government should “identify and build on regional assets to help strengthen not only urban and regional economies, but also bolster America's international competitiveness by helping our entrepreneurs better work collaboratively and synergistically in their fields.”³⁷ The president's proposal for the fiscal year 2010 budget, which begins on October first of this year, follows through on that pledge by seeking \$100 million for the Economic Development Administration to support regional innovation clusters and associated business incubators. As Secretary of Commerce Gary Locke has explained, “the EDA will support economically distressed communities in their efforts to develop strategies for long-term growth with higher-skilled and higher-wage jobs.”³⁸

Renewing the Economic Development Administration

The Economic Development Administration is the right home for this initiative.

Its location in the Department of Commerce provides effective access to a series of related activities that, in addition to the NIST programs discussed above, include the export-assistance programs of the International Trade Administration, the information analysis work of the Economic Statistics Agency, the broadband initiative of the National Telecommunications and Information Agency, and the environmental programs administered by the National Oceanic and Atmospheric Administration.

At the time of the EDA's creation in 1965, the prevailing belief was that economic development depended on investments in physical capital equipment. The agency was intended to provide federal aid in constructing physical assets. As Brookings Institute's Andrew Reamer explained to Congress in 2007, "[o]ver time, additional inputs have been added to EDA's programmatic tool-kit—revolving loan funds, technical assistance—but the basic formulaic approach to economic development has remained."³⁹

This approach to economic development needs to be updated in order to create the most effective economic development strategy possible—especially now when innovation thrives on entrepreneurship, innovation, organizational capacity, and flexibility. Although EDA may indirectly support innovation in existing clusters, in general its projects do not have a comprehensive view of innovation and economic growth as tied to a region's competitive advantage.⁴⁰

Refocusing the agency's mission would not only promote innovation in the United States, but also make EDA a better federal agency in general.⁴¹ It has the existing infrastructure, funding, and expertise in regional economic development to become the federal government's expert for the support of regional innovation clusters.

Indeed, a fresh mission can change the Economic Development Administration into the new *Economic Renewal Administration*—thinking in new ways to best promote the economic development of regions, innovation, efficiency, and the economic well-being of the entire nation. As explained below, the creation of an explicit federal role in supporting regional clusters at EDA can serve as the catalyst for broader federal action, helping to bring together the efforts of all the programs identified above whose innovation policies naturally support regional clusters, including the SBA programs, the WIRED program, particular NSF and NIST efforts, and other activities housed in the Department of Commerce.

Designing the EDA role

A comprehensive and effective regional innovation clusters program should bridge the gap between federal support and bottom-up, local leadership. To effectively accomplish this goal, we detail here three key features that should be implemented as part of the federal effort. The first two would be housed in EDA. The third would be coordinated through the White House and executed by each agency that contributes directly to the success of regional clusters:

- A competitive grants process to foster the commercialization of the best innovative products and services
- Networking to ensure regional clusters have the data they need to chart smart strategies, including through information technology and with the federal government playing the role of “convener,” identifying regional stakeholders, introducing them to each other, and encouraging their interaction
- Coordination across federal efforts, including through the availability of expert assistance through, for example, one-stop shops that would offer advice and help from multiple federal, state, and local programs designed to support the creation of regional clusters

In addition to implementing these three features of a federal innovation clusters program, a set of comprehensive metrics must be developed in order to enable a sophisticated understanding of the impacts of cluster-based strategies. Let's consider each of these features in turn.

Designing and implementing an effective competitive grants process

EDA should dispense federal funds for the support of regional clusters through a competitive grants process that puts a premium on local strategies built to create long-term economic success. A competitive process has the advantage of creating a flexible, effective system that rewards local innovation clusters and incentivizes further growth that would not otherwise occur, while maximizing the likelihood of success.

The competitive grants should be funded, of course, from the \$50 million that the President's budget expressly denotes for regional innovation clusters. Added to that should be the additional \$50 million that the President's budget calls to be used for business incubators. Born of the same campaign pledge as the support for regional innovation clusters, the best use of all of these funds would be to support regional strategies. Although the budget proposal requests separate funding for regional innovation clusters and business incubators, they are mutually reinforcing. The two initiatives will be most effective when they work in conjunction with each other to promote regional economic development.

As this paper went to press, initial action on the President's request had occurred in both the House and Senate. On June 18, 2009, the House approved an allowance of \$255 million for EDA for FY 2010. The report by the House Appropriations Subcommittee on Commerce, Justice, Science and Related Agencies recommended that "[w]ithin funding provided, the Committee supports the efficiency gains of regional innovation clusters for applicants and the agency" although no specific level of funding was designated for support of regional innovation clusters.⁴²

Later in June, the Senate Subcommittee for Appropriations specifically delegated \$90 million for "economic adjustment grants" to include the "President's initiatives within the economic adjustment grants to further develop regional innovation clusters and business incubators, which are intended to leverage emerging technologies and research to bolster U.S. competitiveness."⁴³

The inclusion of the regional innovation cluster program in initial appropriations committee action is, of course, encouraging, but combining these efforts with existing goals of economic adjustment grants risks dilution of the focus on regional innovation clusters. Assuming either this distribution of funding or a similar one passes the Senate, the appropriated funds are a good starting point, but should be expanded upon.

In the future, focused funds specifically for the purpose of developing regional innovation clusters and business incubators should be allocated to EDA. In addition, it will be important for the White House to take a leadership role in ensuring that the separate appropriations for the various other federal innovation programs besides EDA (see Appendix) are channeled through the pertinent congressional committees with a clear strategic eye on overall national innovation goals. Another important political goal will be to keep the cluster strategy free from earmarks or other political designation. The essential strength of successful clusters is competition and that, as well, should be the basis for federal efforts to strengthen clusters.

An important political goal will be to keep the cluster strategy free from earmarks or other political designation.

The design of a competitive grants program

The grant process must have a well-defined, well-thought-out set of criteria to promote the process of local innovation, while encouraging regions to create the strategies that they believe will work best. EDA should establish a peer-review process accordingly, including through the inclusion of outside experts—who would, of course, have no stake in the success of particular applications—in reviewing the applications.⁴⁴

The core of the formal request for proposal should be an invitation for regional clusters to define themselves—including across state lines—and set forth a strategy that builds on local competitive advantages and demonstrates the support of businesses, educational institutions and community resources. It should expressly call for the identification of the economic, not just institutional, outcomes that can be expected with the addition of federal support. And it should include both a mechanism for ongoing evaluation at the regional level and a means of sharing that evaluation with both EDA and with other regions.

Awarding grants on a competitive basis offers several benefits. First, it incentivizes regional innovation clusters to evaluate their own strengths and weaknesses, formulate a plan for moving forward, and design specific benchmarks against which success can be measured. This process is crucial for constant assessment of what is working, and what is not. It not only encourages local innovation, but also *locally-led* local innovation—creating a system of bottom-up innovation and development.

Additionally, the application system allows regional clusters to define the regions and clusters as they see fit. Economic regions are not defined by political boundaries, and attempts to reach economic goals according to political borders undermine the efficacy of development efforts. The application process will allow regions and clusters to define themselves. Going beyond political boundaries and jurisdictions is thus critical to the recognition of the shared advantages that define a cluster. To take just one example, the biopharmaceutical cluster that includes Philadelphia in southeastern Pennsylvania is typically described as encompassing southern New Jersey and northern Delaware as well.

The grants should have time limits of one to three years, after which clusters may reapply for additional support. Preference, although not absolute advantage, should be given in later competitions to clusters that have not previously received a federal award. As a starting point, applicants should explain how federal support for their cluster strategies will:

- Provide funding otherwise not available to the cluster (including from other federal programs available in the same fiscal year).
- Be used quickly so that benefits can begin to flow into the community.
- Enhance the effectiveness of strategies that have been led by the private sector, building on a proven track record of cluster success.
- Integrate distressed communities into a larger regional effort.
- Support activities that would otherwise be unsupported.
- Further the goals of EDA-designated “national challenges” in areas such as energy, health care, manufacturing, and life sciences.⁴⁵

In addition, applicants should be free to include any other content that they feel would demonstrate the importance of their application. This flexibility is particularly important in the first round of rewards, which will serve as a “proving ground” for successive federal grants and which therefore must maximize the ability of the federal government itself learn from the applications process.⁴⁶ The use of these criteria will allow the federal government to prioritize funding for grant applicants according to projects that show the most potential for sustainable innovation.

Finally, it is important to remind ourselves of an innovation cluster’s diversity across industries. A cluster can be established in any industry or sector. At its core, clusters link together disconnected actors within a region by pooling knowledge, resources, and opportunities to seek comparative advantage in any sector. Thus, the United States today hosts a broad range of diverse clusters that are not identified tightly with technology, including the hospitality and tourism cluster in Las Vegas, agriculture in Ohio, and apparel in Los Angeles. Although innovation in areas such as medical research, energy, information technology, and manufacturing is important, federal efforts should recognize that the source of cluster strength lies in its comparative advantages in any set of products and services that can be traded.

The use of federal funding

Once the funding is provided, an effective grants process must be designed and implemented that sends resources to places where they will have the most impact on advancing cluster strategies as defined and proposed by the applicant cluster.

Examples include:

- Business incubators to encourage entrepreneurial activity and provide support for “graduates” of incubators.
- Training programs at local colleges and universities.
- Technology-transfer initiatives for small and medium-sized companies.
- Workforce development programs within the community.
- Financing initiatives that provide otherwise unobtainable capital either to companies or collection of companies, for example, through research consortia such as SEMATECH or other creative ways to draw more angel,⁴⁷ seed-stage and early-stage venture capital to a regional cluster.⁴⁸

Similar uses of federal resources should be considered on a case-by-case basis through the competitive application process. To the extent that applicants wish to demonstrate the utility of implementing a strategy supported by multiple federal resources, as discussed below, they should be encouraged to do so. Not all regions have successful clusters on which to build. Consequently, EDA should also fund smaller planning grants that can be used to create a strategy, for example, by convening businesses, non-profits and educational institutions to assess the region’s comparative advantages. EDA can also direct such communities to other federal resources to supplement and strengthen these planning grants.

The formulation of such strategies is demonstrated by the process employed by Innovation Philadelphia, a public-private partnership created to stimulate economic growth and workforce development in the greater Philadelphia area. In order to identify areas of potential strength, the partnership conducted an analysis of Strengths, Weaknesses, Opportunities, and Threats, or SWOT, of the local economy that focused on biomedical research, nanotechnology, and the creative arts.⁴⁹

Matching requirements

The final component of a successful grant application process is the federal matching of funds. Matching funds can provide invaluable resources and support for the regional cluster after review and approval of its application, and has been a unique feature of similar government programs in the past. While EDA should use a one-to-one ratio as a general rule in matching local funds, we believe that for the first few years, a greater percentage of funding should come from the federal government, in light of current budgetary pressures on the state level.

States, traditionally the primary funder of innovation through education spending and R&D efforts, face unparalleled budget restrictions. A report from the Center on Budget Policy and Priorities in May 2009 showed that 47 out of 50 states face budget shortfalls. Resulting budget cuts negatively impact innovation, cutting back on clusters' main source of funding.

As previously noted, states including Ohio, Kansas, Connecticut, and Pennsylvania, have either reduced economic development spending or encouraged large reorganizations of programs to control it. California, a leader of the biotechnology industry, faces proposed budget cuts of millions of dollars from higher-education institutions, which will directly reduce R&D funding and innovative research in university labs. And in Florida, reduced state funding for the University of Central Florida threatens its medical school, new medical research center, and subsequently, the emerging life-science cluster.

States cannot now support innovation as they have before. Thus, we recommend that for the first three years, a three-to-one ratio be employed for innovation grants. Requiring regional innovation clusters to contribute only 25 percent of the total amount significantly will ease financial pressure at the local level and, thus, boost cluster success in tough economic times. In rare situations where the cluster has little funding to match federal resources with, in-kind matching payments could be considered.

This way, clusters without significant funding are still eligible to apply for federal grants and are qualified for matching of resources. Expertise donated by local businesses or the use of state properties could be considered. It may be appropriate, if even in-kind funding is not sufficient, to consider hardship areas from clusters that include economically-distressed areas. The principle, of course, is to ensure that local resources demonstrate a commitment to an economic strategy that is grounded in real competitive opportunities.

Information networking

Ideas and information about economic development strategies are a public good—and increasing their exchange and flow can create better cluster strategies and connect otherwise discrete parts of a regional economy. The regional innovation cluster program should include an information component to facilitate the exchange and flow of data and learning between the federal government and regional clusters, within each regional cluster, and between regional clusters. Each of these three categories of information transfer offers unique benefits that strengthen economic development on the regional and national level by increasing knowledge of other cluster initiatives, successes and failures, and best practices.

The principle is to ensure that local resources demonstrate a commitment to an economic strategy that is grounded in real competitive opportunities.

Information exchange between the federal government and regional clusters can help in the basic formation and support of clusters. The federal government can provide information to assist with cluster identification, performance and composition. For example, Karen Mills, Elisabeth Reynolds, and Andrew Reamer suggested a “national information center” in their paper, “Clusters and Competitiveness: A New Federal Role for Stimulating Regional Economies.”⁵⁰ This information center would allow the government to collect information about various regional clusters, their strengths and weaknesses, and work to improve them.

As stated in the Obama administration’s fiscal year 2010 budget proposal for EDA, such an information effort “will inform decision-making by businesses, state and local development agencies, and federal policymakers and program managers.”⁵¹ It will also align well with President Obama’s desire to improve transparency of the federal government and could work in conjunction with the new www.data.gov website and similar governmental resources.

Within regional clusters, the information component synchronizes needs and opportunities, allowing the continuous inventory of strengths and tracking opportunities and resources locally. Universities, colleges, research labs, start-up companies, and entrepreneurs will be alerted to other actors within the same region working on similar projects, thus permitting the best analysis of strengths and weaknesses. For instance, better data would aid workforce development, the building of infrastructure, or other opportunities. Ideally, information flow throughout a region fosters the most efficient collaboration.

In addition, improving communication between regional clusters can alert one cluster of the experiences of another cluster and best practices. Clusters can learn from each other’s research and successes and failures, creating development models based on past experiences. Life science companies in the Northeast, for example, could exchange information with those in the Southwest, sharing research efforts and development insights

Collaborative, interactive learning is the primary goal of data exchange and flow. While a “national information center” and other uses of IT can make such information publicly available, another way to boost the learning aspect and transparency of cluster initiatives is through social networking. By using websites, wikis, and other forms of social networking, clusters can share their experiences, research, development initiatives, and best practices with other clusters. All of this should be done in a way that leads to an effective business use of this information.

To further facilitate this new culture of learning and experimentation, we recommend that an innovation summit between key government and business leaders should be convened within the next 12 months. This meeting should identify the best ways for the federal government to support cluster success, identify best practices for effective collaboration, detail specific features and opportunities for clusters, and highlight successful case studies of clusters, as well as identifying the most pressing areas of academic research.

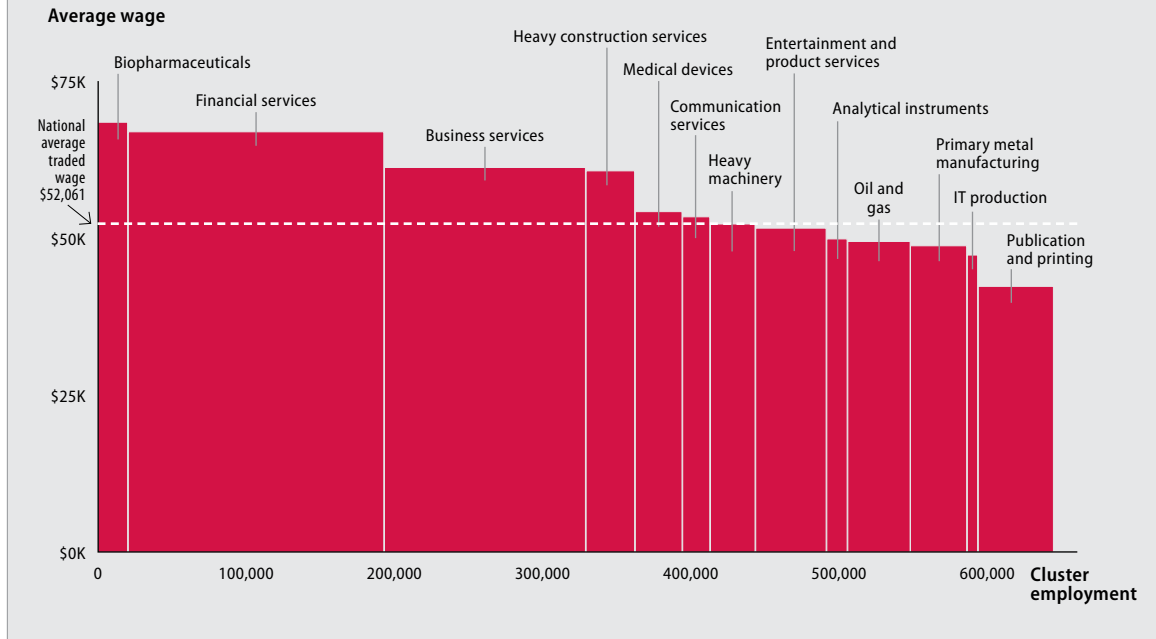
Metrics and measurement

The House Appropriations Subcommittee on Commerce, Justice and Science, in providing funding for regional innovation clusters, made clear its expectation for “proven performance to continue the initiative.”⁵² That is a sound basis on which to define and measure the expected

The best ways for the federal government to support cluster success is to identify best practices for effective collaboration, detail specific features and opportunities for clusters, and highlight successful case studies.

INNOVATION SPARKS HIGHER WAGES

Pennsylvania employment versus average wage, 2006, by cluster



Source: Monitor Global Cluster Mapping Dataset; U.S. Census Bureau.

outcomes of federal funding. Actually measuring the success of clusters, however, is a challenge that should be directly addressed by the new federal effort.

The starting point, of course, is to understand the current status of clusters. A detailed example of the kind of analysis that needs to be done on a nationwide basis is the Monitor Group's analysis of the furniture cluster in Tennessee, which distinguishes between specialties that are highly competitive, such as office furniture; competitive, such as watercraft building; potentially competitive, such as mattress manufacturing, and less well developed, such as health care products. Similarly, the Seattle cluster boasts highly specialized aerospace products and services alongside a highly competitive information technology sector, which often masks the state's other less well-developed industries.⁵³

Similar performance measurements should include jobs created, jobs retained, new company formation, the "churn" rate of similar companies going in and out of business in the same high-tech industries, and the creation of new patented inventions. Our recommendation, therefore, is that EDA, working with the Department of Commerce's Economics and Statistics Administration, should establish a database of cluster strengths against which future outcomes can be measured. To the maximum extent possible, that should draw on existing resources that apply common methodologies across U.S. and foreign clusters.

At the same time, EDA should focus on improving methods of measurement. The Association of Public Land-Grant Universities, for example, is developing a new set of metrics based on involvement from universities in regional innovation that it expects to present later this year. Another

example is the WIRED program, which measures the number of people that have completed workforce education, number of degrees attained, number of patents issued, and employment numbers, among other metrics. Clusters should be evaluated annually according to tiered benchmark metrics in order to assess the impact of the program.

It is worth emphasizing what should *not* be used as definitive measurements are the activities of the federal or regional authorities themselves. The number of businesses to which assistance is provided, meetings convened or data promulgated may be good indications of demand and can serve as interim indications of governmental responsiveness but they are not, by themselves, compelling evidence of economic gains. Rather, they should be used to monitor demand, ensuring that the right resources are being aligned with regional needs, and as a means of building “best practices” that can be used by regional leaders across the nation.

Establishing Executive Branch support for regional innovation clusters

As outlined previously, a series of federal efforts located within multiple agencies are well-equipped to support regional cluster efforts. With the arrival of an explicit federal function at EDA, the time would be right to align those sources of funding with regional cluster strategies as well. EDA would supply, of course, considerable information about the present status and strengths of cluster strategy. The most obvious candidates for initial coordination are other Commerce programs, the WIRED program and other efforts at the Department of Labor, the NSF programs directed at innovation-led growth and, of course, the work of the Small Business Administration.

A number of methods of coordination should be considered. For instance, it might be that a cluster applying for EDA funds could use the same application to seek complementary funding from the other participating programs. An additional step would be for the relevant agencies to agree, consistent with their authorizing legislation and appropriations instructions, to apply consistent criteria to the grant of funds that flow to self-designated cluster initiatives. That might be accomplished, for example, if a percentage of each program were expressly designated for use in clusters.

Such coordination would further the effectiveness of federal funding while simultaneously increasing the efficiency and coordination of federal efforts—an explicit goal of President Obama.⁵⁴ At the beginning, involving too many federal agencies may dilute the effectiveness of a cluster on the ground, and coordination between only two or three agencies—for example, the Departments of Commerce, Energy, and Labor and the Small Business Administration—is a good starting point. As the program develops and applications are submitted, clusters themselves can indicate additional federal agencies they would like to work with and in what capacity.

The White House role in a cross-agency effort is, of course, critical. The president should issue an Executive Order empanelling the core cluster agencies identified above as a coordinating committee, chaired by the National Economic Council, to oversee their joint cluster activities and to report, on an annual basis, how federal efforts could be further improved by, for example, the inclusion of other federal programs.

Much of the groundwork at the local and regional level has already been laid for the collaboration between federal agencies. More specifically, the Department of Commerce already has six established regional offices under EDA, two NIST campuses, and 59 manufacturing extensions

under the MEP program specifically to promote commerce and development across the nation. Additionally, the SBA has 10 centrally located regional offices to support and aid small businesses while the Employment and Training Administration at the Department of Labor has six regional branches to support workforce development on the ground. To the maximum extent possible, there should be a coordination of federal efforts—existing offices and branches can support effective one-stop shops to support and develop regional innovation clusters.

Such efforts must extend beyond local businesses to include a wide array of participants for maximum effectiveness—from business entrepreneurs to research institutions and universities to workforce development programs. Assistance is all the more effective when it empowers multiple constituencies, creating a more robust environment for regional innovation clusters overall. Aligning a variety of efforts with multiple constituencies offers us the best chance to create a comprehensive, coordinated regional innovation cluster, pulling together key federal programs and agencies.

After defining the audience and participating agencies, another issue for consideration is the physical location of these one-stop shops. Some areas of the United States have a concentration of existing federal resources, such as regional offices of the Departments of Labor, Commerce and Energy, in addition to the Small Business Administration, whereas other regions only have access to one or two federal agencies. To understand where one-stop shops work well, there should be pilot programs in test locations—areas with both concentrated resources and sparse resources.

When evaluating how to create “virtual or physical” one-stop shops, the following list of criteria should be considered:

- Initial inventory of need by audience.
- Infusion of local resources.
- Importance of in-person expertise to the regional economy—as opposed to expertise that can be delivered online.
- Existence of a strategy to ensure the delivery of services to all parts of the cluster, including distressed communities.
- Collaboration between the locally active federal programs.
- Integration of distressed areas into larger regions.

The Department of Commerce has already begun a one-stop-shop pilot. This past June, Commerce Secretary Gary Locke announced a one-stop-shop pilot in Detroit, combining the efforts of department programs such as Commercial Services, Export Assistance Center, Minority Business Development Agency, and International Trade Administration, among others.⁵⁵ This is an important first step; future efforts should also be implemented across federal agencies.

Conclusion

The federal government is poised, for the first time, to explicitly support the success of regional innovation centers on a nationwide basis. This is good policy, an important step toward furthering U.S. competitiveness, and a highly feasible political solution. Regional clusters of innovation offer a long-term, pragmatic framework for a federal program dedicated to regional economic policy.

Democratic and Republican governors alike have supported the development of clusters within their state. In New York, former Governor George Pataki, a Republican, established “centers of excellence,” which has led to the successful nanotechnology cluster in Albany today. Among Democratic governors, Pennsylvania’s Edward Rendell has worked to create manufacturing, alternative energy, telecommunications and IT clusters around the state, while Christine Gregoire of Washington has created an entire network of innovation clusters to drive economic development.

In sum, the federal government should seek to develop and implement policies that spur the growth of regional pro-innovation environments by:

- Recognizing and strengthening the crucial role of knowledge-generating institutions.
- Funding and encouraging the development of a pro-entrepreneurship and pro-business culture.
- Incentivizing and supporting credit flow to startups as well as to more established companies.
- Creating and investing in workforce development programs that are the foundation of a high-tech economy.
- Cultivating through structured programs and informal gatherings strong networks of regional cluster stakeholders.

This is a set of complex challenges that can thrive through a new form of cooperation between the federal government and regional authorities—promoting economic growth and innovation through collaboration and innovation in governmental policies.

Appendix

Existing federal innovation programs

In this appendix, we will briefly present each of five sets of federal innovation programs that the Economic Development Administration would work with in league with a White House innovation team. We chose these policy programs because we believe they should be linked together by an explicit federal clusters initiative.

The five sets of policies we review include, first, the Small Business Administration's Small Business Innovation Research program and the Small Business Technology Transfer program, with the SBIR program spread across 11 different executive-branch departments and agencies and the STTR program involving five departments and agencies.⁵⁶ In 2004, the last year for which comprehensive data is available, the SBIR program provided over \$2 billion in funding to startup companies and the STTR program over \$208 million.⁵⁷

Second, federal funding for innovation is provided by the National Science Foundation. The NSF's Partnerships for Innovation competitive grant program fosters collaboration between academia, government, and the private sector, and its Advanced Technology Education program and Industry-University Cooperative Research Partnership program promote collaboration with technical colleges.

Third, the Department of Commerce runs federal innovation programs such as the Manufacturing Extension Program, or MEP, which consists of 59 manufacturing extension centers and 393 satellite locations throughout the United States and Puerto Rico, each center working directly with local companies to provide expertise and services tailored to their most critical needs, including employee training, new business practices, the application of information technology, and basic process improvements.

The Department of Commerce also funds the Technology Innovation Program, a new enterprise that makes competitive grants to businesses, universities, and non-profit groups to invest in high-risk, high-reward research in areas of critical national need.

Fourth, to boost workforce training, the Department of Labor runs two grant programs designed to help regional economic development: The Employment and Training Administration's WIRED program and the Community-Based Job Training program. These programs provide regions with funding, ongoing technical assistance and support from a group of experts to expand employment and advancement opportunities for American workers and catalyze the creation of high-skill and high-wage jobs.

Fifth, the Department of Energy has proposed the creation of a regional innovation hubs program to tackle hard problems in the science of energy.

This selection of programs is by no means exhaustive—there are many other programs in many other agencies, such as the Rural Business Enterprise Grants Program in the Department of Agriculture, the Enterprise Zones Initiative in the Department of Housing and Urban Development, the Brownfield Redevelopment Programs in the Environmental Protection Agency, among others. All of them contribute in some way or another to the development of innovation clusters, although not explicitly. The programs outlined below are the programs of the greatest size, impact, and prominence.

SBIR/STTR programs

The Small Business Innovation Research program, or SBIR, founded in 1982 by the Small Business Innovation Development Act, and the Small Business Technology Transfer program, or STTR, founded in 1992 by the Small Business Research and Development Enhancement Act, provide competitive small-business grants to encourage and foster commercialization and innovation. These grants have become essential to helping small businesses get off the ground and cultivate the entrepreneurial culture and network that spur the development of innovation clusters.

The SBIR program's goals are "to stimulate technological innovation; to use small business to meet federal research and development needs; to foster and encourage participation by minority and disadvantaged persons in technological innovation; and to increase private sector commercialization derived from federal research and development."⁵⁸ The program involves 11 agencies, most prominently the Department of Defense, the National Institutes of Health, the National Aeronautics and Space Administration, the Department of Energy, and the National Science Foundation, each of which contributes 2.5 percent of their annual extramural R&D funds to the program. The Small Business Administration directs the 11 agencies' implementation of SBIR, reviews their progress, and reports annually to Congress on the program's operation. In 2004, the last year for which comprehensive data is available, SBIR made over \$2.01 billion in grants.⁵⁹

An exhaustive report on the SBIR program by the National Academy of Science highlighted the program's great success, calling it "sound in concept and effective in practice."⁶⁰ The study found that the program is effectively "stimulating technological innovation, increasingly private-sector commercialization of innovations, using small businesses to meet federal research and development needs, providing widely distributed support for innovation activity, and fostering participation by minority and disadvantaged persons in technological innovation."⁶¹

The STTR program's goals are similar to that of the SBIR program, different only in the fact that "central to the program is expansion of the public-private sector partnership to include the joint venture opportunities for small business and the nation's premier nonprofit research institutions."⁶² In other words, the STTR program has a more direct technology-transfer focus than SBIR, linking small businesses with federally funded nonprofit research centers. The STTR program will distribute funds, for example, to a small gene sequencing startup with the local medical school research group doing genetics research. The STTR program directs five federal department and agencies to contribute 0.3 percent of their annual extramural R&D funds to the program. The STTR program granted over \$208 million in 2004, the last year for which comprehensive data is available.⁶³

Despite the highly complimentary report on the program by the National Academies, it is clear that there are several problems with SBIR-STTR that deserve serious consideration. In fact, Congress is currently considering making several substantive changes to the program in its imminent reauthorization legislation, some of which come directly from the recommendations of the National Academies.

Firstly, grant sizes have not increased since they were first set in 1982 at \$100,000 for Phase I grants and \$750,000 for Phase II grants. These grant sizes are significantly too low. There is a strong consensus among business leaders and policymakers alike that federal SBIR/STTR program awards grants are insufficient for small companies doing the expensive high-tech research that the program is designed to support.

Case in point: the National Institutes of Health has seen a significant reduction in the number of applicants for SBIR funding over the past few years, indicating that the SBIR funding is not significant enough for small biotech companies doing cutting-edge R&D to even apply. The House of Representative's reauthorization legislation calls for an increase in Phase I grants to \$250,000 and Phase II grants to \$2 million.

Secondly, as currently structured, small businesses in which venture capital firms hold a controlling interest cannot be supported by SBIR grants. This structure was established only recently, in a 2002 directive that stated that eligible small businesses must be "at least 51 percent owned and controlled by one or more individuals who are citizens of, or permanent resident aliens in, the United States."⁶⁴ This policy has been met with strong criticism from small businesses and many policymakers alike, who assert that it is not sound good policy to penalize companies merely because they have already proven sufficiently attractive to private-sector investment. According to the National Academies study on the SBIR program at NIH:

Even firms benefiting from venture funding may well seek SBIR awards as a means of exploring a new concept, or simply as a means of capitalizing on existing research expertise and facilities to address a health-related need or, as one participant firm explained, to explore product-oriented processes not 'amenable to review' by academics who review the NIH RO1 grants. Some of the most successful NIH SBIR award-winning firms have been successful only because they were able to attract substantial amounts of venture funding as well as SBIR awards.⁶⁵

As this paper went to press, both the House and the Senate have included in their SBIR reauthorization bills different ways of dealing with this issue. The House bill has no caps on the amount of the SBIR-STTR funding that can be allocated to venture-backed companies—so long as the firm is not majority owned by just one venture firm and does not have the majority of board seats held by one venture firm. The Senate version proposes a cap of 8 percent for each federal agency that provides SBIR funding to venture-backed startups, except for the Department of Health of Human Services, which has a proposed cap of 18 percent.

Overall, the SBIR/STTR programs have carved out a respectable niche as flexible, well-managed, and well-leveraged federal innovation enterprises, serving as a model for many state as well as international efforts. But the SBIR/STTR system must undergo a significant expansion and reorientation if it is to continue to play a central role in the overall federal innovation policy system for our 21st century high-tech economy.

Cluster strategy must be at the center of this reorientation. With a focused, explicit, and clear set of federal cluster policies, SBIR/STTR can work within the larger and more cogent framework of committing to regional economic growth and leverage its unique strengths in pursuit of more structured goals. Federal cluster policy would both strengthen the work of the SBIR/STTR program and be strengthened by it.

National Science Foundation programs

NSF's Partnerships for Innovation program, created in 2000, fosters connections between public and private organizations to spur innovation in a technology area, industry, or region. Academic institutions are the core organization, but they must have a private or non-profit business partner. Ten to 15 awards are given per year for up to \$600,000 each, with an award length of two to three years. Partnerships can be made in three different areas: Research, technology transfer, or commercialization; workforce education and training; and creating the infrastructure for facilitating and disseminating innovation.⁶⁶

NSF's Advanced Technology Education program, or ATE, helps facilitate the education of high-technology technicians via our two-year colleges. The program partners academic institutions and employers to promote the education of science and engineering technicians at the undergraduate and graduate school levels. The ATE program supports curriculum development, professional development of college faculty and secondary school teachers, career pathways to two-year colleges from secondary schools and from two-year colleges to four-year institutions, among other activities.

NSF's Industry-University Cooperative Research Partnership program develops Industry-University Cooperative Research Centers that perform the basic research that results in technology transfer from academia to industry. NSF provides seed money in the form of a planning grant of \$10,000 (for 18 months) and an initial five-year award of up to \$70,000 annually, renewable for a second five-year period for \$35,000 annually. Each center, however, must have at least six business partners that provide at least \$300,000 in membership dues. This program is a prime example of federal programs acting as facilitators for more broad-based, multi-stakeholder investment.

In general, these NSF programs, like the NIST work discussed in the next section, make respectable contributions to the creation of regional innovation clusters, encouraging the development of a 21st high-tech U.S. economy focused on meeting the challenges of global competition, creating high-paying jobs, and promoting the innovations that power our economic growth. But these programs are sorely underfunded, poorly marketed and mostly uncoordinated with each other. A more comprehensive and substantive economic development policy and innovation cluster creation effort will make these programs more efficient, focused, and united in common goals. Federal cluster policy can be the glue that holds these programs together and the binoculars that give them vision.

National Institute of Standards and Technology external programs

In addition to operating the only federal laboratories expressly focused on boosting private-sector competitiveness, NIST operates so-called “external” programs that fit naturally with the strengths of regional innovation clusters.

The precursor to the Manufacturing Extension Partnership program, or MEP, was created by the Omnibus Trade and Competitiveness Act in 1982, with the MEP as we currently know it coming into existence in 1988. A program with a FY2010 proposed budget of \$125 million, MEP is a network of 59 centers in 393 locations in every state and in Puerto Rico that employs over 1,600 specialists in business and manufacturing, and assists small- and medium-sized businesses embrace the process improvements and growth strategies that increase their competitiveness and profitability. MEP centers are non-profit organizations receiving one-third of their funding from NIST and two-thirds from state or other regional funds, including fees paid by manufacturers.

A study of the program’s fiscal year 2007 efforts found that with relatively little resources, the MEP improved productivity among 8 in 10 MEP clients, created or retained 57,000 jobs, created or retained \$10.5 billion in sales, spurred \$2.2 billion in new private investment, and saved over \$1.4 billion in costs.⁶⁷ These figures suggest that the program has played an important role in assisting small- and medium-sized manufacturers that are the bedrock of this nation’s economy, though it is clear that the program could be improved.

The Technology Innovation Program, which is a successor to the Advanced Technology Program, was created by the America COMPETES Act of 2007,⁶⁸ for the purpose of assisting small businesses, academic institutions and consortia to accelerate innovation through high-risk, high-reward private sector research that supports national challenges. The explicit focus is on private-sector innovation that may be too novel or too multi-disciplinary to fit without traditional innovation programs. Thus, the new TIP mission focuses on developing technologies that address areas of critical national need.

TIP is operating under a \$69 million budget for fiscal year 2009, which ends in September this year, to spend on competitive, cost-shared grants to businesses, universities, and nonprofit institutions—or collaborative ventures—to promote and enable innovation that solves pressing national problems. The 2009 competition is currently underway; NIST has announced that it is seeking proposals that focus on manufacturing through the improved use of advanced materials, such as superalloys and nanomaterials, and civil infrastructure through the creation of tools, such as sensor devices, that boost the ability of local governments to manage the structural integrity of infrastructure, such as dams, bridges and highways, as well as better methods of repairing existing infrastructure.⁶⁹ The Obama administration has sought a budget of \$70 million for FY 2010.

Increased, sustained support for the MEP and TIP would provide a stronger support for the commercialization of innovation technologies. And NIST already has experience with successful cluster strategy, for example, through work with the Albany nanotechnology cluster.⁷⁰ But both MEP and TIP are natural candidates for work to strengthen clusters—the MEP because it focuses on the needs of local manufacturers and the TIP because of its new ability to work with academic institutions and consortia on issues that combine national challenges with regional expertise. Indeed, Vice President Biden and Secretary of Commerce Gary Locke recently announced a NIST effort, through the MEP program, of just this kind to support automobile industry supply-chain competitiveness in the Midwest.⁷¹

Department of Labor workforce development programs

Workforce development programs, housed in numerous government agencies and departments, have been moderately effective but are essential to the development of innovation clusters for the high-tech 21st century economy. The Department of Labor's Workforce in Regional Economic Development, or WIRED program and its Community-Based Job Training program are the most prominent of these programs, but both have seen only modest success.

WIRED is a Department of Labor program that makes focused, strategic investments in the development of workers with skills to staff the high-tech companies that are the foundation of innovation clusters, as well as investments in the development of workers that can compete with the increasingly skilled international workforce. In general, the program focuses on building the workforce in struggling regions, such as those affected by global trade shifts, dependent on a single industry, or recovering from natural disasters.

In three rounds of grants and in dozens of specific regions across the country, WIRED has spent about \$326 million since its inception in 2005. WIRED follows a six-step plan to economic and workforce transformation that includes identifying the regional economy, forming the core leadership group, performing a SWOT analysis (strengths, weaknesses, opportunities and threats in a region), creating a shared regional identity and vision for the local economy, devising strategies, and leveraging resources and implementing the program.⁷²

The Community-Based Job Training program, a \$125 million annual enterprise, was created in order to develop partnerships between the workforce system and the community college-vocational education network, increasing the ability of community colleges and other vocational schools to meet the needs of employers in the 21st century. The program makes grants for two central purposes:

To increase the capacity of community colleges to provide training in a local high-growth, high-demand industry through activities such as the development of training curricula with local industry, hiring qualified faculty, arranging on-the-job experiences with industry, and using up-to-date equipment; and to train new and experienced workers in identified high-growth, high-demand industries, with the aim of employing and/or increasing the retention and earnings of trained workers, while meeting the skill needs of businesses within targeted industries.⁷³

A number of observers have written on the importance of workforce development programs in spurring the development of regional innovation clusters, but they have evaluated these Department of Labor programs as moderately successful at best. A recent report on clusters and competitiveness called the WIRED program "too small and too short-lived to do the necessary [cluster-creation] work on its own."⁷⁴ Critics of WIRED have also highlighted the fact that it is sorely underfunded and far too ad hoc in its structure to build the collaborative stakeholder network that is one of its central goals.

In general, the jury is still out on the effectiveness of WIRED and the Community-Based Job Training program, and their validity as cultivators of highly-skilled workers and multi-stakeholder innovation networks. For this reason, many feel that these programs, especially WIRED, might not have such a long future.⁷⁵ But the goals of these programs should be included in a nationwide innovation clusters strategy.

Department of Energy

The Department of Energy's 2010 budget request features \$280 million for Energy Innovation Hubs designed to "support cross-disciplinary research and development focused on the barriers to transforming energy technologies into commercially deployable materials, devices and systems."⁷⁶ While it is not clear how much of this request will be appropriated, these energy hubs are forward-thinking proposals that will spur the development of the innovation clusters that will help solve our national energy challenges, create jobs, and promote widespread economic growth.

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- 35 Dr. Steven Chu, Testimony before the House Committee on Appropriations, June 3, 2009, available at http://appropriations.house.gov/Witness_testimony/EW/Steven_Chu_06_03_09.pdf.
- 36 Commentators have suggested the creation of a new innovation institution within the federal government and, to be sure, that greater emphasis on innovation, particularly at the micro-economic level, is critically necessary. Robert Atkinson, President of the Information Technology and Innovation Foundation, and Howard Wial, fellow of the Metropolitan Policy Program at the Brookings Institution, have advocated for the creation of a National Innovation Foundation in the Department of Commerce: Atkinson and Wial, "Boosting Productivity, Innovation, and Growth through a National Innovation Foundation." The NIF would support regional clusters by distributing funding and resources and coordinating the federal response. The estimated start-up costs of the NIF are \$1 billion, but Atkinson and Wial point out that \$432 million of this can be consolidated from federal spending on innovation promotion efforts elsewhere in the budget.
- 37 President Barack Obama and Vice President Joe Biden, "Barack Obama and Joe Biden: Supporting Urban Prosperity," available at <http://www.barackobama.com/pdf/issues/UrbanFactSheet.pdf>.
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- 42 The subcommittee also directed "EDA to provide quarterly reports on progress and funding awards, and expects proven performance to continue the initiative": *Commerce, Justice, Science, and Related Agencies Appropriations Bill, 2010*, House report 111-149 111th Cong., 1st sess. (Government Printing Office, 2009, available at http://thomas.loc.gov/cgi-bin/cpquery/?&dbname=cp111&sid=cp1116vwgR&refer=&r_n=hr149.111&item=&sel=TOC_39279&).
- 43 Departments of Commerce and Justice, and Science, and Related Agencies Appropriations Bill, 2010, Senate Report 111-034, 111th Cong., 1st sess. (GPO, 2009) available at http://thomas.loc.gov/cgi-bin/cpquery/?&dbname=cp111&sid=cp111M3rLF&refer=&r_n=sr034.111&item=&sel=TOC_35689&.
- 44 A similar peer review process is used when awarding grants by the Manufacturing Extension Partnership under NIST in the Commerce Department, by the National Institute of Health for grant applications, and by the National Academies of Science when reviewing drafts for publications.
- 45 *America COMPETES Act of 2007, Public Law 110-69*, 110th Cong., 1st sess. (August 9, 2007), available at http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=110_cong_bills&docid=f:h2272enr.txt.pdf, p. 116.
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Acknowledgements

The authors would like to especially acknowledge the assistance of Maria Li, a research fellow at The Glover Park Group during the summer of 2009, and a graduate student at the University of Virginia's newly-established Batten School of Leadership & Public Policy. The authors would also like to thank the members of the Science Progress Task Force on Regional Centers of Innovation for inspiring this paper and in substantial ways informing its direction, and of course for their continuing support. Lastly, the authors are grateful to those who reviewed earlier drafts of this paper, including Joseph Bartlett, Michael Ettliger, Maryann Feldman, Christina Gabriel, Mark Muro, Andrew Reamer, Louis Soares, and James Turner.

Science Progress, a project of the Center for American Progress, is a magazine specifically designed to improve public understanding of science and technology and to showcase exciting, progressive ideas about the many ways in which government and citizens can leverage innovation for the common good. Since its inception in the fall of 2007, *Science Progress* has helped shape the conversation about our country's investment in science.

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