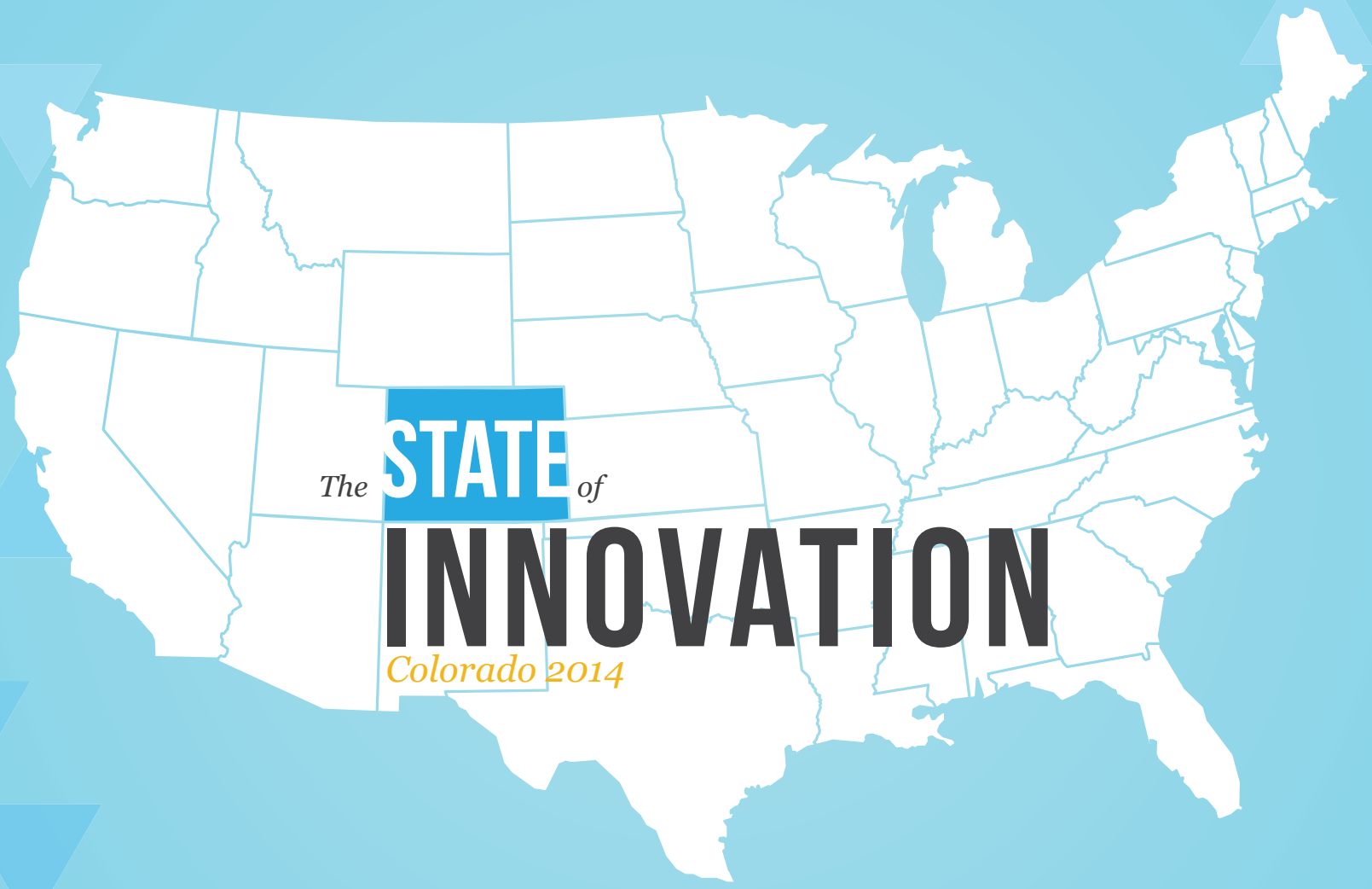


The STATE *of* INNOVATION

Colorado 2014

COLORADO™ innovation network

COLORADO
Office of Economic Development & International Trade

www.coloradoinnovationnetwork.com

CONTENTS

Executive

SUMMARY

For the third year, the Colorado Innovation Network (COIN) shares its research findings on Colorado's economic performance and the role of innovation in that growth. In the core categories of talent, capital, ideas and entrepreneurship, COIN's latest metrics indicate that Colorado has several key strengths which contribute to the health and vibrancy of the state economy.

- Colorado businesses and organizations are leaders in attracting federal funding and grants to foster entrepreneurship and academic research. The state exceeds many of its peer states for patent creation and initial public offerings (IPOs). Peer states have been defined as Arizona, California, Georgia, Illinois, Massachusetts, New York, North Carolina, Texas and Utah. The peer states represent states that are leaders in innovation or close competitors with Colorado for new businesses.

- Colorado boasts a highly-educated workforce which consists of a high percentage of technical occupations. Colorado also graduates a greater number of science, technology, engineering and mathematics (STEM) degrees compared to peer states.

- Colorado has experienced a rapid employment growth rate of 7.1 percent since the recession. However, to stay competitive and foster innovation, Colorado will need to attract more early stage angel and venture capital investment for startups and also reconsider the level of state funding to support higher education research institutions.

2014 REPORT HIGHLIGHTS

TALENT

Colorado has a technically trained workforce and is developing new talent in the fields of science, technology, engineering and math.

- Colorado's workforce is highly educated, with 37 percent having at least a bachelor's degree, the second highest percent in the nation. By comparison, the national average is 29 percent and each of the peer states has a lower share.
- Colorado's percentage of 18-24 year olds enrolled in post-secondary education (37 percent) is less than the national average by 2 percentage points.
- Colorado has a significant share of its workforce in technical areas, above the U.S. average and second among peer states.
- Colorado led peer states with 10.4 percent of all higher education degrees conferred in STEM fields.
- Colorado attracts talent from other states, ranking third among peer states for the rate of migration of individuals into the state with bachelor's degrees or higher.

CAPITAL

Colorado companies are doing well at obtaining federal grants, yet they need to improve their ability to attract interest from the venture capital community.

- Over the 2010-2014 period, Colorado ranked seventh in the nation for the total number of Small Business Innovative Research (SBIR) grants and Small Business Technology Transfer (STTR) grants and sixth nationally for value of the awards. These rankings were without regard to the size of the state. Controlling for the size of workforce, only Massachusetts captured a larger number and higher value.
- Venture capital investment in Colorado has declined since 2012, opposite of the national trend for venture capital investment growth.
- Colorado is lagging behind the national average and its peers in terms of both venture capital funding as a share of the state economy and growth in the number of venture capital deals since the end of the recession.
- Colorado's IPOs have rebounded, giving the state the third-highest ranking among peer states.

IDEAS

Colorado has been successful in undertaking new research and translating that research into new findings with commercial potential.

- Colorado ranks third among peer states in federal research and development (R&D) funding per employed worker and ranks fourth in terms of academic research in the science and engineering fields.
- Colorado placed third among peer states and above the national average output for patent activity in 2013.
- Higher education is an important area where gaps exist. Colorado is ranked last in the nation in state funding for public research universities per full-time equivalent student.

ENTREPRENEURSHIP

Colorado ranks among the highest of its peer group states for startup creation and job creation.

- In 2012, approximately 25 percent of all employed Coloradans owned their own businesses.
- The average birth rate of new businesses in Colorado exceeded all but two peer states from 2003-2011.
- Colorado ranked second among peer states in both gross and net job creation in 2011.
- Startups aged three years or less accounted for approximately 17 percent of total employment in Colorado in 2011.

annual report

INTRODUCTION

This report begins with an overview of Colorado's economic performance over the past several years and then examines the role of innovation in that growth.

The Colorado Innovation Network (COIN), established in 2011 by Governor John Hickenlooper, aims to support and improve the Colorado innovation ecosystem. COIN began tracking innovation performance in Colorado in 2011. For 2012 and 2013, COIN worked with Colorado State University to establish a framework for evolving metrics used to assess innovation performance. A definition was also born. Innovation, for purposes of this report, is a product, process, or service that generates new value in the marketplace. The metrics framework includes four categories: talent, capital, ideas and entrepreneurship. While not a linear process, talent generates ideas, and when combined with capital and entrepreneurs, creates value in the marketplace. To give the metrics context, in addition to national averages, peer states were selected for comparative purposes.

New products and services offer an important opportunity for growth in companies this year. COIN's goal is to provide a meaningful assessment of the innovation landscape in Colorado so that academia, business leaders and policy makers can influence future outcomes for the prosperity of the Colorado economy.

overview

COLORADO ECONOMY

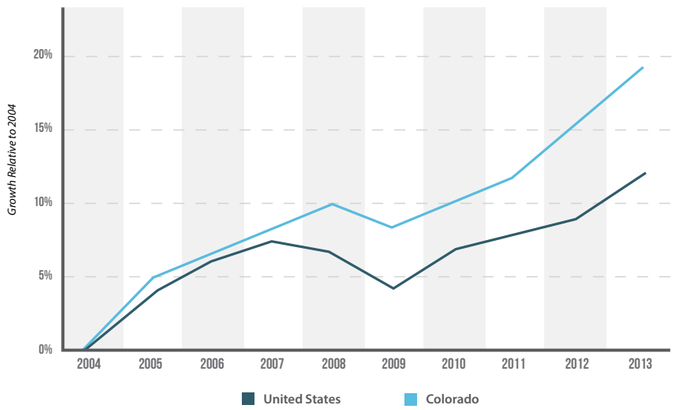
The U.S. economy relies on innovation to fuel future growth. With the digital revolution, all segments of the economy have become "knowledge-based" industries to some degree. New digital products are the first-order manifestation of this development. But even in more traditional parts of the economy, companies are adopting new techniques for designing and manufacturing their products through the collection and analysis of data. They use customer data to develop new marketing approaches to respond to competitors and promote their products. Colorado companies are in the center of this innovation effort, and other aspects of the Colorado economy contribute to the creation of new knowledge and new ways of generating value. For example, Colorado ranks fourth among states in the number of federal laboratories and seventh for labs per capita, according to the Federal Laboratory Consortium for Technology Transfer. These labs are important sources of basic research and development upon which business can create new commercial innovations.

The state government has recognized that innovation is a key element to these new knowledge-based industries. To encourage new startups, Colorado sponsors the Advanced Industries Accelerator Grant Program, which provides proof-of-concept, early stage capital and retention and infrastructure grants to companies in industries including advanced manufacturing, aerospace, bioscience, electronics, energy and natural resources, infrastructure engineering and information and technology. Since the program's inception in 2013, the state has awarded 67 grants for a total of $8.2 million.

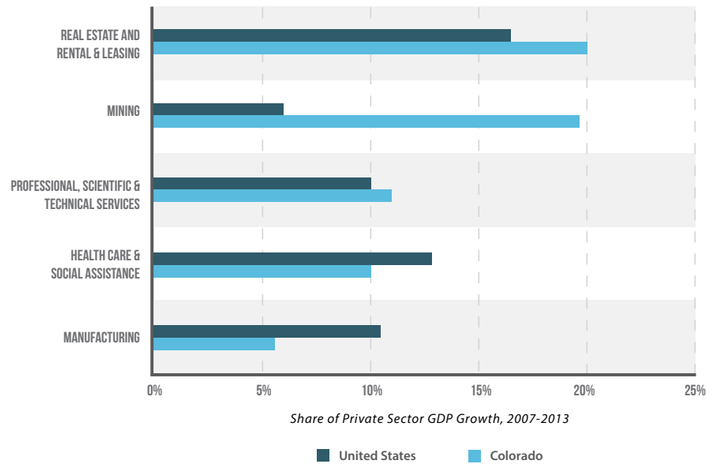
Economic growth between 2004 and 2007 in Colorado was similar to the national average, increasing approximately 8 percent before the Great Recession. Colorado managed to enter the recession later than the overall economy, maintaining positive growth in 2008 (see Figure 1).

Colorado industries that were responsible for most of the private sector growth between 2007 and 2013 tracked closely with national growth metrics. Figure 2 demonstrates the share of gross domestic product ("GDP") growth accounted for by the five industries most responsible for growth. For Colorado, growth in the real estate, rental and leasing sector was responsible for 20 percent of private sector GDP growth between 2007 and 2013; mining was responsible for 19 percent of the growth, and the professional, scientific and technical services sector was responsible for 12 percent of growth.

01/ Cumulative Real GDP Growth
2004-2013



02/ Top 5 Industries Driving GDP Growth
2007-2013



The change in employment in Colorado has exceeded the national rate over the past 10 years. Prior to the recession, employment in Colorado grew by 7.8 percent, compared to 4.1 percent nationally. However, employment during the recession fell by a slightly larger amount in Colorado compared to the national rate (5.4 percent and 5.0 percent, respectively). Since the end of the recession, Colorado employment growth has outstripped national employment growth, 7.1 percent compared to 4.7 percent (see Figure 3).

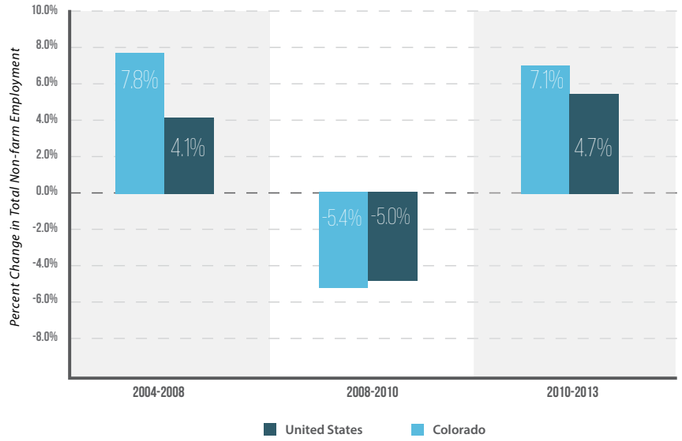
According to PwC's 2014 CEO survey, 62 percent of U.S. business leaders state that they are in a growth mode and are planning to hire more people this year. This represents the highest level of headcount expansion in the past five years for the survey

Colorado's role in the international economy is muted relative to the U.S. economy overall. Exports of merchandise to foreign countries in 2013 represented 3 percent of Colorado GDP, compared to 9.5 percent nationally. Merchandise imports represented 4.4 percent of Colorado GDP, compared to 13.6 percent of U.S. GDP (see Figure 4).

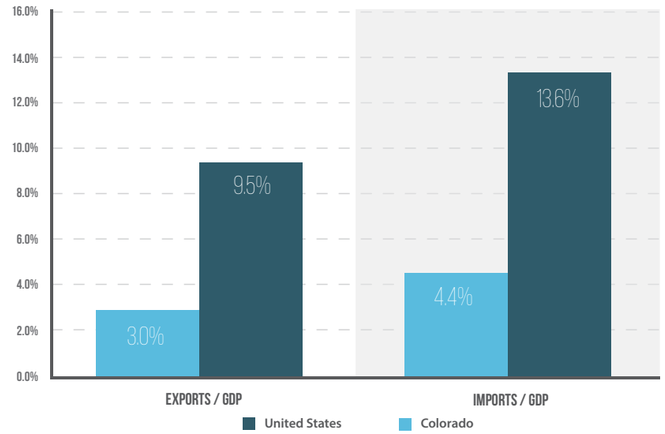
Relative to the national economy, manufacturing is a smaller share of the overall Colorado economy (7.5 percent compared to 12.5 percent nationally); therefore a portion of the difference in exports is attributable to lower relative production levels in the state.

For the second quarter of 2014, the Leeds Business Confidence Index showed a slight increase in the confidence of Colorado business leaders over previous values. Respondents remain optimistic about the prospects for economic growth in the state, consistent with national sentiments.

03/ Total Employment Growth
2004-2013



04/ Merchandise Imports and Exports as a Share of GDP
2013



Advanced industries

Innovations in seven key industries have been important sources of growth in the Colorado economy. These industries are: advanced manufacturing, aerospace, bioscience, electronics, energy and natural resources, infrastructure engineering and technology and information. Figure 5 presents the GDP and employment location quotients, which demonstrates the relative importance of the industry compared with the national economy. A value greater than one signifies the industry is a more important element of the local economy than the national economy. Colorado has location quotients greater than one for aerospace, bioscience, energy and natural resources, infrastructure engineering and technology and information Employment growth in these industries has been rapid. Between 2009 and 2013, employment has grown approximately 12.7 percent across the seven industries; by comparison, total Colorado employment grew by 6.0 percent.

Several of these industries also receive significant percentages of the state's venture capital: the technology/information segment collected 37 percent of total venture capital funding in 2013; biosciences collected 20.5 percent; and industrial /energy (a combination of natural resources and energy and advanced manufacturing) received 14.6 percent (see Figure 6). By comparison, at the national level, larger shares of venture capital dollars went to technology/information (44 percent) and bioscience (23 percent), but less to industrial/energy (5 percent)

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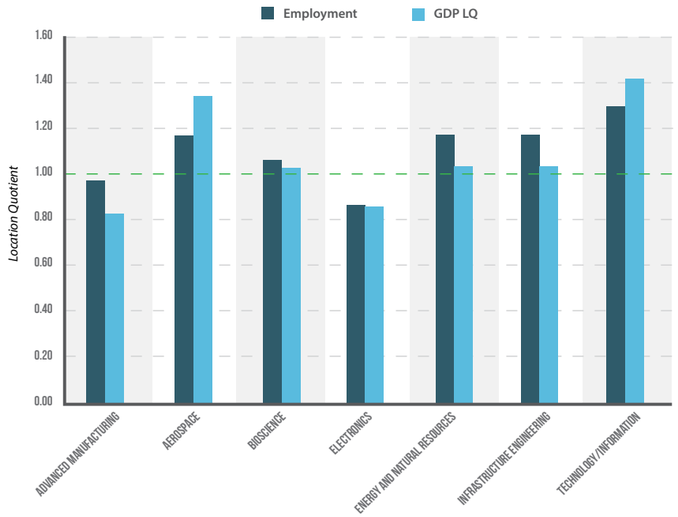
05/ Relative Importance of 7 Key Industries in Colorado

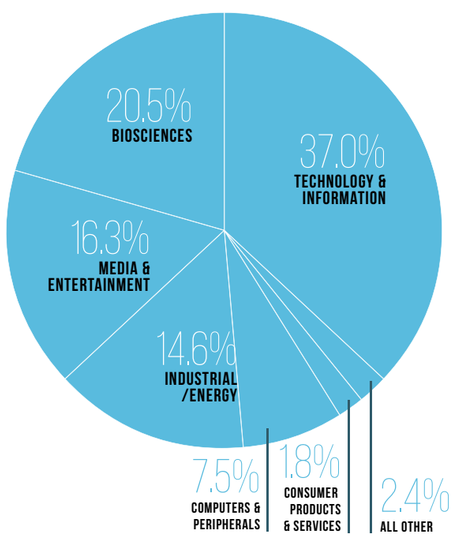
(Employment and GDP)



Note: The Location Quotient ("LQ") represents the ratio of the Colorado industry's share of the total economy in Colorado to the U.S. industry's share of the total U.S. economy

06/ Venture Capital Dollars in Colorado, by Industry

2013



MEGATREND DISCUSSION

A few leading trends are influencing economic development in the U.S. and global economies. These "megatrends," explored in PwC's "Five Megatrends and Possible Implications" include accelerating urbanization, climate change and resource scarcity, technological breakthroughs, the rise of emerging economies and demographic shifts. Each trend will affect how businesses operate and innovate.

The effects of the megatrends on Colorado are described below.

ACCELERATING URBANIZATION:

- According to the U.S. Census Bureau, 86.2 percent of Colorado's population in 2010 resided in urban settings (defined as areas with more than 2,500 residents), compared to 80.7 percent for the U.S. overall.
- The pace of urbanization in Colorado has accelerated over the past 20 years. In 1990, 83.8 percent lived in urban areas; in 2000, 84.5 percent and in 2010, 86.2 percent. Nationally, the pace has also increased: 78.0 percent in 1990, 79.0 percent in 2000 and 80.7 percent in 2010.

CLIMATE CHANGE AND RESOURCE SCARCITY:

- Colorado is an important source of metallic and non-metallic minerals in the United States. In 2011, the state produced $1.9 billion worth of non-fuel minerals, making it the 12th-largest producer nationally.
- In renewable energy, Colorado has significant potential for wind resources, large scale solar development, and a significant network of smaller hydroelectric facilities.

TECHNOLOGICAL BREAKTHROUGHS:

Colorado is home to several national labs and is focused on fostering an environment supporting product development innovation. In 2011, R&D spending per worker in the state exceeded the national total ($1589 compared to $940)

- The number of patents received per million workers in the state was 111, compared with the national average of 90.
- In 2013, the number of IPOs, when compared to the total number of business establishments in Colorado, exceeded the national level: Colorado had 4.0 per 100,000 establishments while the national average was 2.6 per 100,000 establishments.

SHIFT IN ECONOMIC POWER TO DEVELOPING COUNTRIES:

Colorado's connection to the global market is increasing. Between 2008 and 2013, the dollar value of its merchandise imports increased by 23.9 percent and the value of its exports increased by 12.7 percent. However, relative to the size of its economy, the value of exports and imports are a much smaller percentage of GDP in Colorado compared to the national total (see Figure 4).

DEMOGRAPHIC CHANGES:

- Colorado had a similar share of its population under the age of 18 in 2012 compared to the U.S.: 23.7 percent in Colorado versus 23.5 percent nationally. However, the state has a slightly smaller share of its population over the age of 65: 11.8 percent compared to 13.7 percent nationally.
- The age distribution of the population between ages 20 and 65 is similar to national metrics.

**See PwC, Five Megatrends and Possible Implication, November 2013.*

TALENT

“Understanding the flow of talent to the workforce, beginning with post-secondary education enrollment is critical.”

In 2013, COIN blogged about the “War for Talent,” which has never been more apparent than it is today. Understanding the flow of talent to the workforce, beginning with post-secondary education enrollment is critical. Approximately 65 percent of U.S. jobs through 2020 will require some college or an associates degree, according to a study done by Georgetown University (“Recovery: Job Growth and Education Requirements Through 2020”).

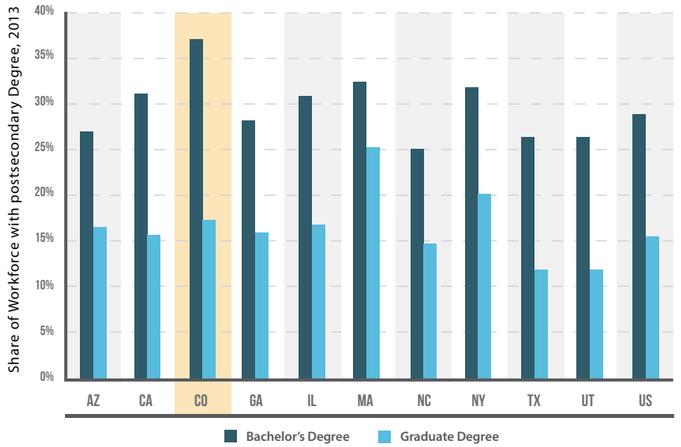
talent

Colorado boasts a highly-educated workforce, with over 35 percent of its workforce having at least a bachelor's degree (see Figure 7). Looking forward, however, the state's percentage of 18-24 year olds enrolled in post-secondary education (37 percent) is less than the national average by two percentage points. McKinsey estimated that employers in advanced economies could face a labor shortage of 16 to 18 million college-educated workers by 2020, in the consulting firm's June 2012 report, "The world at work: Jobs, pay, and skills for 3.5 billion people". The report found that STEM, healthcare professions, healthcare support and community services will be the fastest growing occupations in Colorado. These occupations require high levels of post-secondary education.

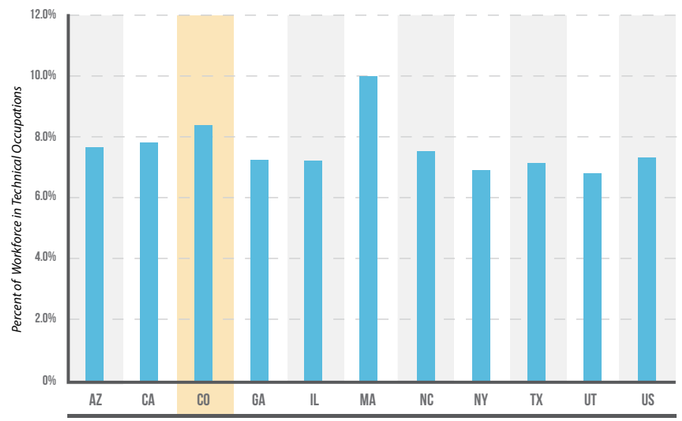
According to PwC's 2014 CEO Survey, 70 percent of U.S. business leaders are concerned about the availability of key skills, a significant increase from 2013 (54 percent). As technology advancements transform businesses rapidly, the need for technology-savvy talent increases. Positively, Colorado has a significant share of its workforce in technical areas, above the U.S. average and second among peer states as of May 2013 (see Figure 8).

07/ Educational Attainment of the Colorado Workforce

2013



08/ Colorado's Technical Workforce



*Technical fields consist of occupations relating to computer, mathematical, computer, architecture, engineering, life, physical and social sciences, and healthcare practitioners.

In 2012, Colorado led the peer states with 10.4 percent of all degrees conferred in STEM fields (see Figure 9). Colorado also exceeded the peer states for the percentage of women with degrees in STEM fields (see Figure 10).

Colorado does comparatively well in terms of post-secondary degree attainment in STEM. National trends show that only about 50% of students who earn STEM credentials actually enter STEM fields. Further, while diversity of people and ideas drive innovation, the STEM pipeline in Colorado lacks diversity. Females and Hispanics are vastly under represented in STEM occupations, yet females make up nearly half of the overall workforce and Colorado's Hispanic population is the fastest growing population in the state. Colorado will be challenged to meet future skill demand so growing the local talent base is of the utmost importance. The Colorado Education Initiative, a Colorado non-profit focused on advancing K-12 public education through capacity building, innovation, and increased collaboration, is spearheading a process to define a plan for improving STEM education in ways that increase opportunities for all students, meet business needs, and attract new companies to the state – the Colorado STEM Education Roadmap. This plan recommends four goals and a suite of corresponding strategies that seek to enhance STEM core cognitive competencies for all students in Colorado.

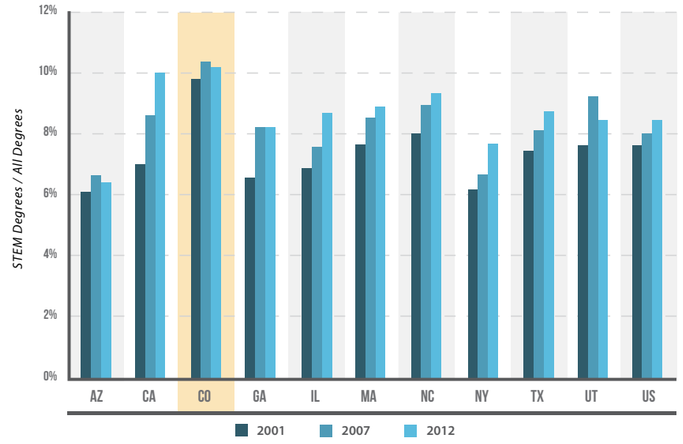
These goals include:

- Build awareness and support for STEM education among all stakeholders
- Increase the number and diversity of STEM-literate students in the education pipeline
- Increase the capacity of educators and learning environments to foster quality STEM education and experiences for all learners
- Develop a STEM proficient workforce, adequately prepared to meet the needs of Colorado industry

This effort is funded through the Gill Foundation's Gay and Lesbian Fund for Colorado, the United Launch Alliance, and JP Morgan Chase. This effort builds on the work of Governor John Hickenlooper's Education Leadership Council's STEM committee's work to develop a state plan to advance STEM education.

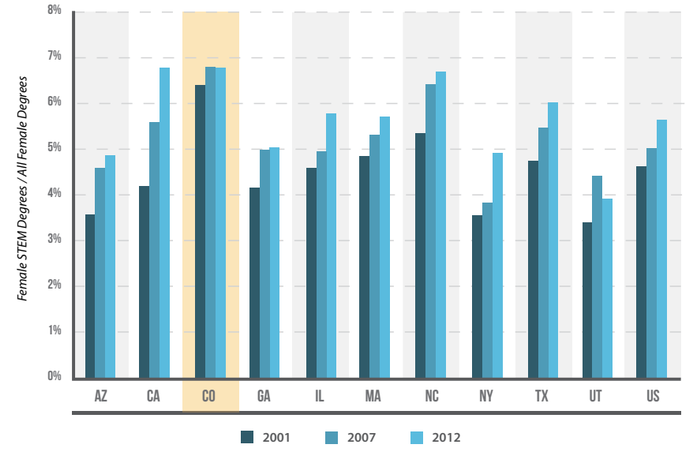
09/ Share of Graduates from Colorado Universities

Earning STEM Degrees

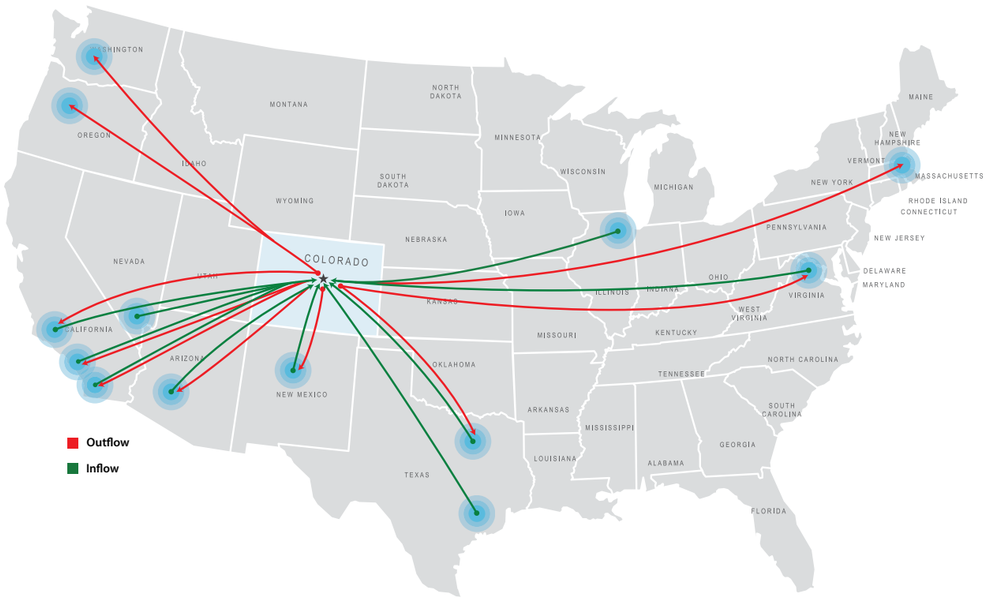


10/ Share of Female Graduates at Colorado Universities

Earning STEM Degrees

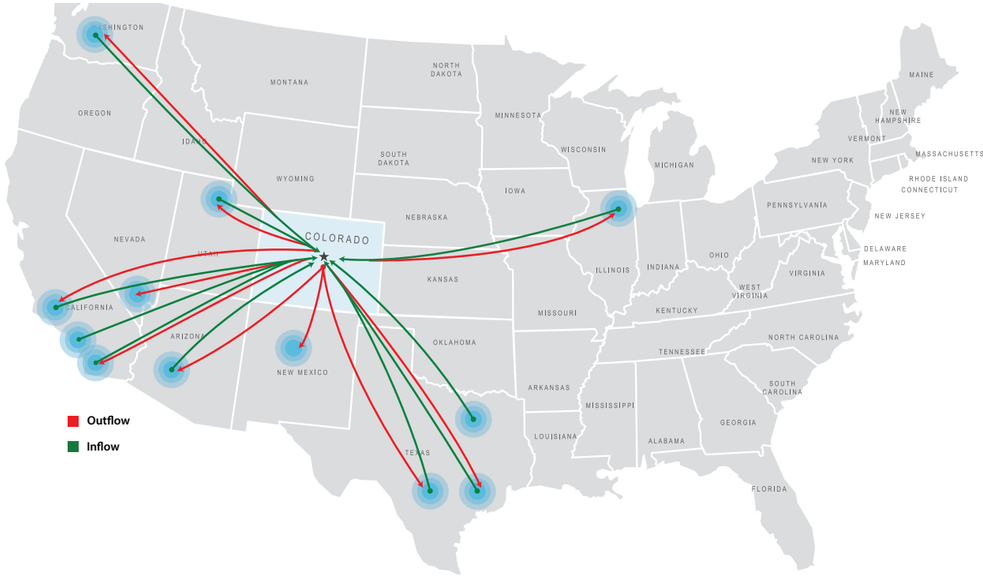


11/ Migration Map
by education



While Colorado continues to enjoy success in producing an educated workforce, it also benefits greatly from migration. Colorado ranks third among peer states for the rate of educated migration, or those with a bachelor's degree or higher (1.25 percent of educated population). Colorado ranks second among peer states for the rate of young migration, or those aged 25 to 34 (approximately 1 percent of young population). For both the educated population and young population migration inflow, Colorado's greatest source of talent comes from California, Arizona, and Illinois. Colorado's biggest competitors when considering migration outflow for both the educated population and the young population are California, Washington, and Arizona.

12/ Migration Map
by age (25-34)



CAPITAL

“Innovating requires investment, and depending on the industry, it can be very expensive.”

Innovating requires investment, and depending on the industry, it can be very expensive. The state sponsors programs that support startups. The Advanced Industries Accelerator grant program provides proof of concept, early stage capital and retention and infrastructure grants to companies in the advanced industries. Colorado also sponsors the Advanced Industry Investment Tax Credit, designed to stimulate private sector capital formation by rewarding local investors for taking equity stakes in startup companies with high growth potential. The program targets technology sectors with a strong presence in Colorado and is complementary to the $12.5 million per year Advanced Industry Acceleration grant program.

Capital

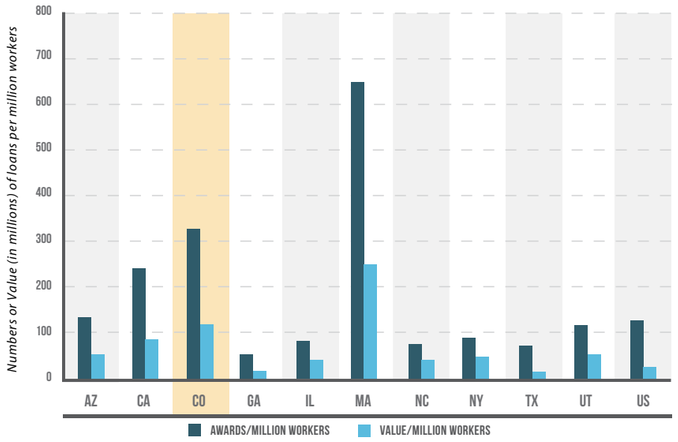
Entrepreneurs in Colorado have enjoyed great success with the federal Small Business Innovative Research (SBIR) grants and Small Business Technology Transfer (STTR) grants. Over the 2010-2014 period, Colorado ranked seventh in the nation for the total number of awards and sixth for overall value of the awards. Controlling for the size of the domestic workforce, only Massachusetts captured a larger number and higher value of loans among the peer states (see Figure 13).

Startups must obtain funding to build their operations while acquiring customers. Relying on debt preserves equity ownership but can have restrictive repayment requirements and limitations on the total amount available.

Venture capital funding is attractive to entrepreneurs for several reasons, including the ability to attract a significant cash infusion and gain access to the expertise and contacts of the investors. Nationally, in terms of dollars and awards, venture capital investment has rebounded compared to post-recession levels. However, unlike its peers, Colorado has lagged behind this trend. Colorado lags behind the national average and its peers in terms of both the venture capital funding as a share of the state economy and the growth in the number of deals since the end of the recession (see Figures 14-16).

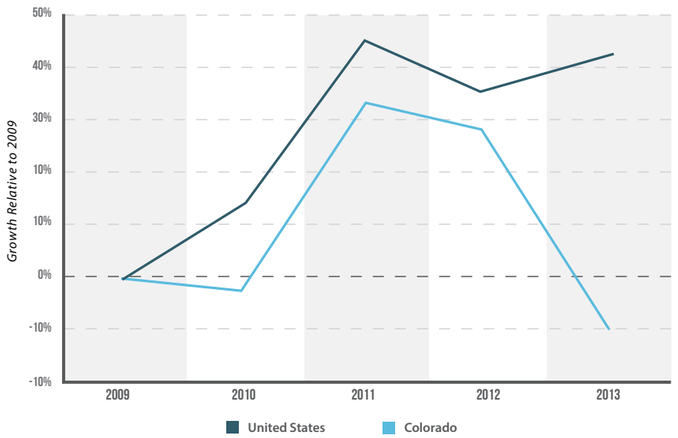
13/ SBIR/STTR Loans Received Relative to State Workforce

2010-2014



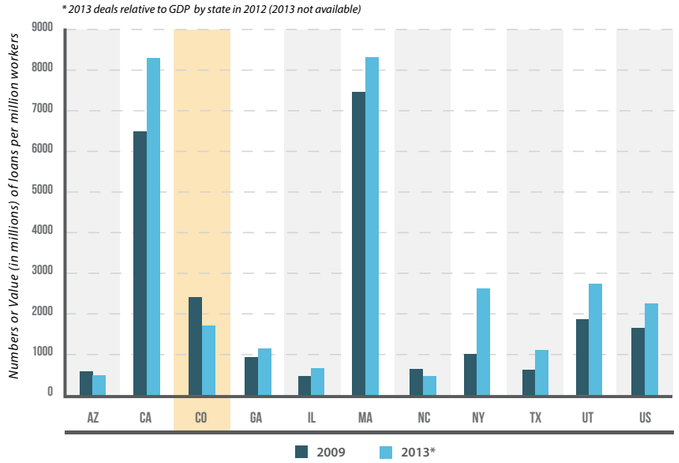
14/ Growth in Venture Capital Dollars

2009-2013



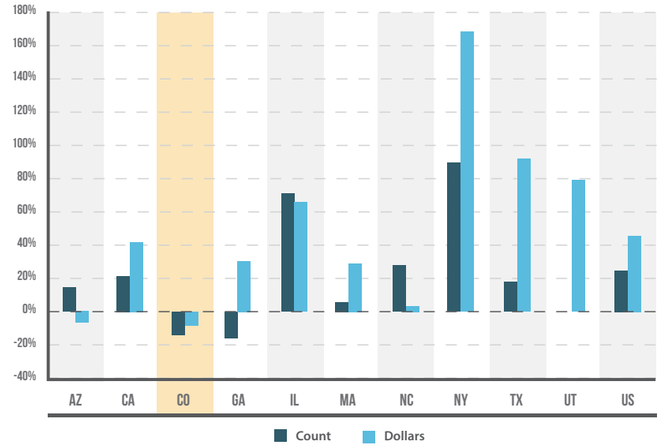
15/ Venture Capital funding per Million Dollars of Total GDP

2009 and 2013



16/ Growth in Venture Capital Deals

2009-2013

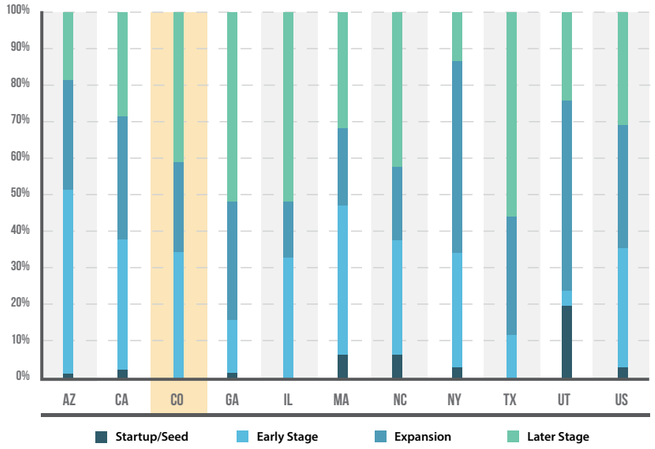


Capital

Colorado's venture capital by investment stage in 2013 prompts interesting questions. Colorado companies received no ***seed investment** funding.
Only Utah had any significant percent of their total venture investment in this stage across the peer states. Colorado's greatest concentration of funding occurs in later stage, although when compared to peer states, investment is fairly evenly distributed (see Figure 17).

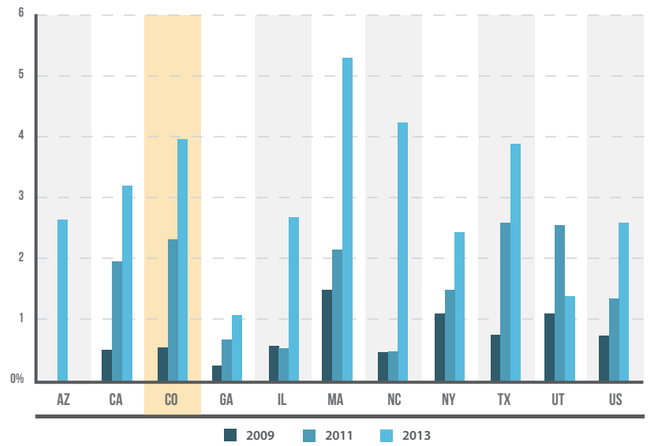
17/ Allocation of Venture Capital Dollars by Stage

2013



While venture capital investing in Colorado was lackluster compared to peers, Colorado's IPOs rebounded and are among the top of the peer states in 2013 (see Figure 18). These companies made it through the startup stages and have successfully raised funds from broader markets.

18/ IPOs Issued Per 100,000 Establishments



*SEED INVESTMENT

SEED/STARTUP STAGE:
The initial stage. The company has a concept or product under development, but is probably not fully operational. Usually in existence less than 18 months

EARLY STAGE:
The company has a product or service in testing or pilot production. In some cases, the product may be commercially available. May or may not be generating revenues. Usually in business less than three years.

EXPANSION STAGE:
Product or service is in production and commercially available. The company demonstrates significant revenue growth, but may or may not be showing a profit. Usually in business more than three years.

LATER STAGE:
Product or service is widely available. Company is generating on-going revenue; probably positive cash flow. More likely to be, but not necessarily profitable. May include spin-offs of operating divisions of existing private companies and established private companies.

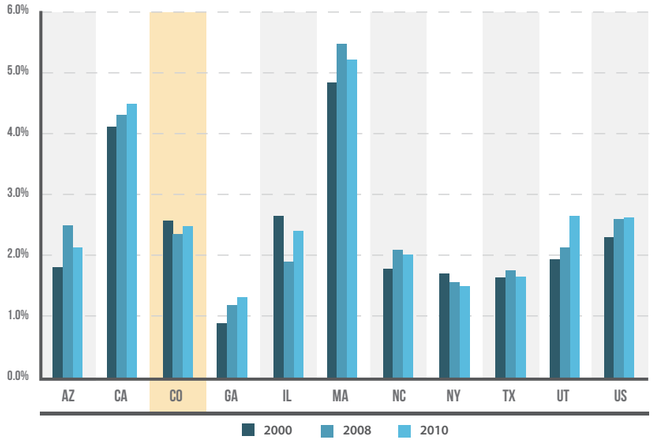
IDEAS

“Innovation is the creation and development of new ideas.”

Innovation is the creation and development of new ideas, and these new ideas require investment in R&D.

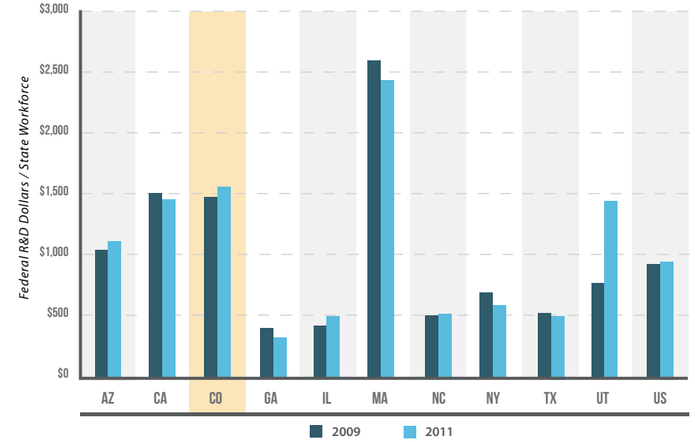
Colorado ranks close to the national average in terms of its R&D investment relative to the size of its economy but lags behind Massachusetts, California and Utah (see Figure 19).

19/ Research and Development as a Percent of State GDP

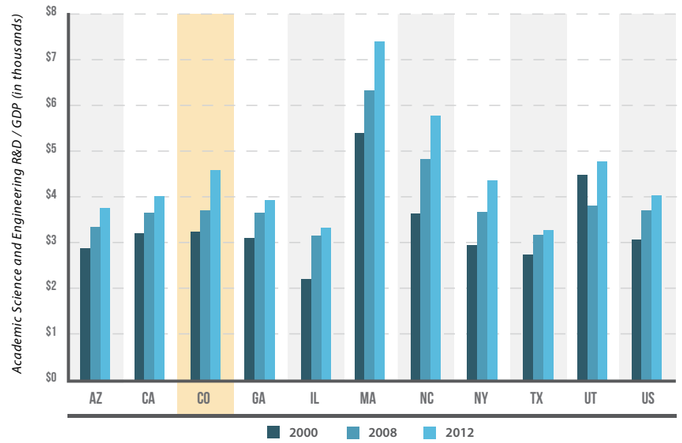


Colorado performs relatively well compared to its peers in terms of federal R&D funding it receives and its academic research in the science and engineering fields. Colorado ranks third among peer states in federal funding per employed worker and ranks fourth in terms of academic research in the science and engineering fields (see Figures 20 and 21). Colorado does not fare as well in state government funding of universities. The state is ranked last in the nation in state funding for public research universities per full-time equivalent student.

20/ Federal R&D Funding Relative to Workforce

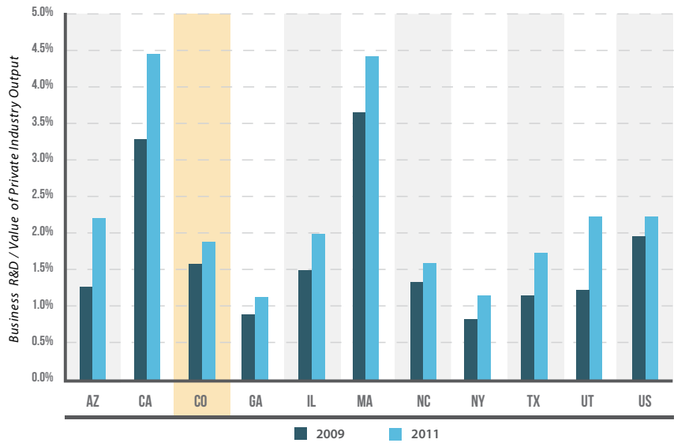


21/ Academic Science and Engineering R&D
per $1,000 of GDP



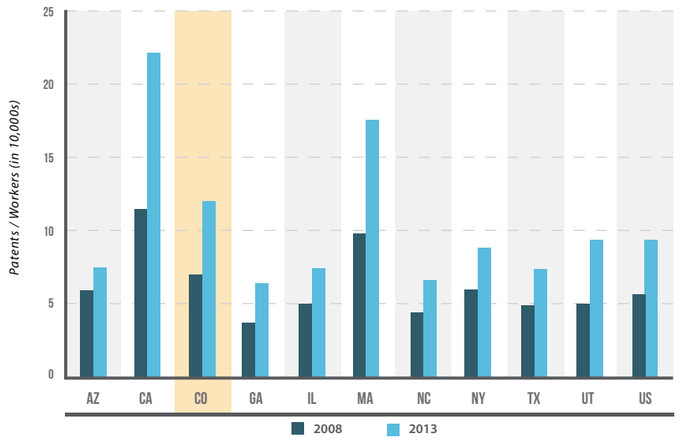
According to the National Science Foundation, approximately 80 percent of U.S. R&D is performed by the business sector. Only 11 states exceed the national average for business-performed domestic R&D relative to private industry output. Colorado lagged behind the national average but ranked within the second quartile in 2011, the most recent year available (see Figure 22).

22/ Business-Performed Domestic R&D as a Percentage of Private-Industry Output



While Colorado's R&D funding and spending provided mixed results, the state's output as measured in patent activity positioned it as highly productive in 2013. Colorado placed third among peer states and above the national average for patents (see Figure 23).

23/ Patents Issued per 10,000 Workers



ENTREPRENEURSHIP

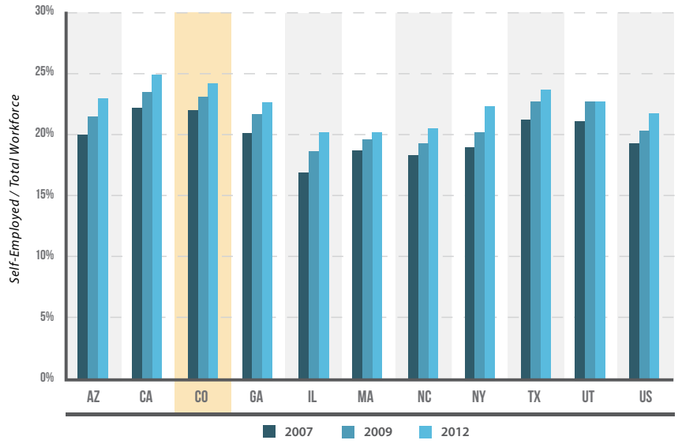
“Colorado’s high self-employment and new establishment birth rate illustrate its strong entrepreneurial spirit.”

Colorado has garnered national attention for its high level of entrepreneurial and innovation activity, as indicated in various reports:

- The Kauffman Foundation’s 2013 Entrepreneurial Index ranked Colorado the 5th most entrepreneurial state
- Bloomberg’s Top 20 Most Innovative State’s List in 2013 ranked Colorado 8th
- Fast Company’s Top State for Innovation List in 2013 ranked Colorado 7th

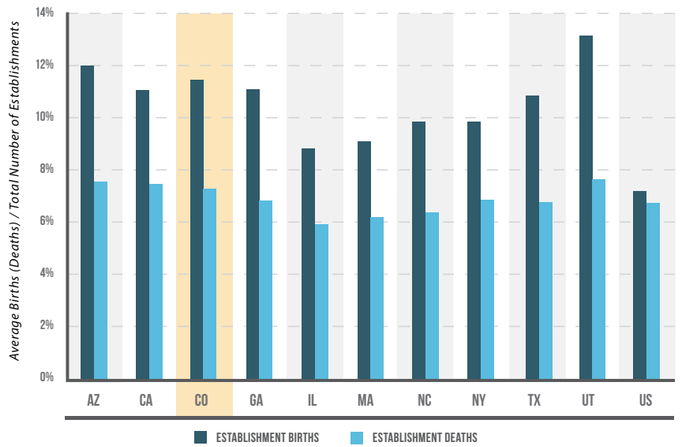
Colorado's high self-employment and new establishment birth rate illustrate its strong entrepreneurial spirit. In 2012, approximately 25 percent of all employed Coloradans owned their own businesses. The birth rate of new establishment in Colorado exceeded all but two peer states on average over the 2003-2011 period (see Figures 24 and 25).

24/ Self-Employed Workers as a Percent of Total Work Force



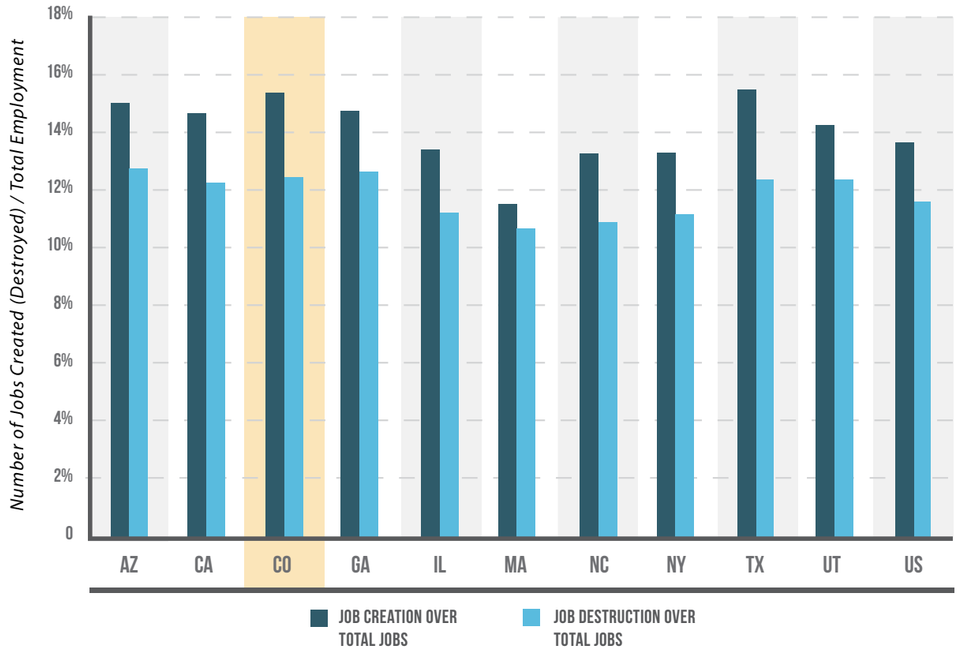
25/ Average Rate of Establishment Birth and Deaths

2003-2011



26/ Job Creation and Destruction Rate

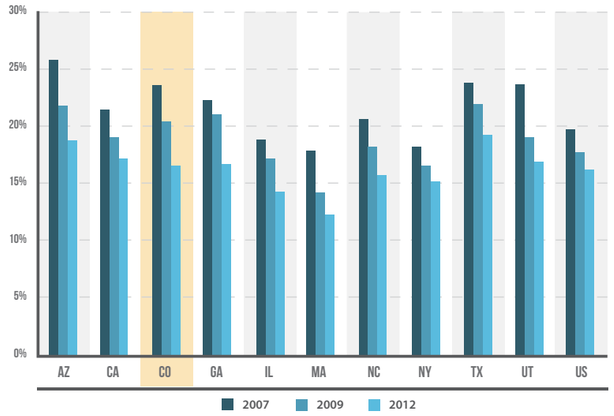
2011



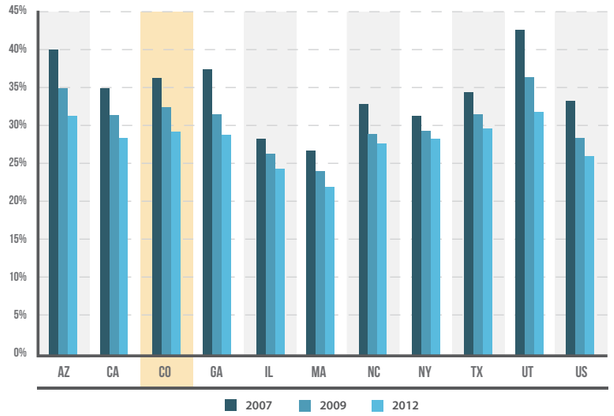
High self-employment and new establishment birth rates are indicative of an active entrepreneurial class, made more positive when job creation goes hand in hand. Colorado ranked second among peer states in gross job creation in 2011 (see Figure 26). Taking job destruction into account, Colorado also ranked second among peer states in net job creation in 2011.

New businesses end up being responsible for a large share of the total employment in the economy. Firms aged three years or less, or startups, accounted for approximately 17 percent of total employment in Colorado in 2011. By comparison, the national average is 15.5 percent. The recession has taken a toll on the number of startups, with the number of establishments and the share of employment in these new firms falling for all peer states between 2007 and 2011 (see Figures 27 and 28).

27/ Employment within Firms Aged 3 Years or Less as a Share Total Employment



28/ Firms Aged 3 Years or Less as a Share of Total Firms



CONCLUSION

This report has focused on the key elements that promote innovation. A pipeline of local talent is necessary to create, develop and market new innovations. New ideas must be nurtured through investments in R&D. Capital is needed to fund new pursuits in the critical early stages of operation and individual entrepreneurs must be willing to take new risks and start new businesses. These elements combine to lead to new areas of economic growth. Innovation is a necessary element for a vibrant, growing economy, yet other elements are also necessary.

For example, government and private sector institutions must support new business development; efficient infrastructure must be present to facilitate the movement of goods and services; and macroeconomic conditions must be stable and conducive to risk-taking by entrepreneurs. This list is not exhaustive. The future economic growth of Colorado will depend on the state's ability to promote innovation in an environment conducive to its development and adoption.

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(Icons)
Light Bulb designed by aLf from the Noun Project
Man designed by Moh Kamaru from the Noun Project

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overview	1	Real GDP Growth, 2004-2013	U.S. Bureau of Economic Analysis (2014). Regional Data, GDP and Personal Income. Retrieved from http://www.bea.gov/iTable/index_regional.cfm; PwC calculations.
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