

POWERING ADVANCED INDUSTRIES

STATE BY STATE

OVERVIEW



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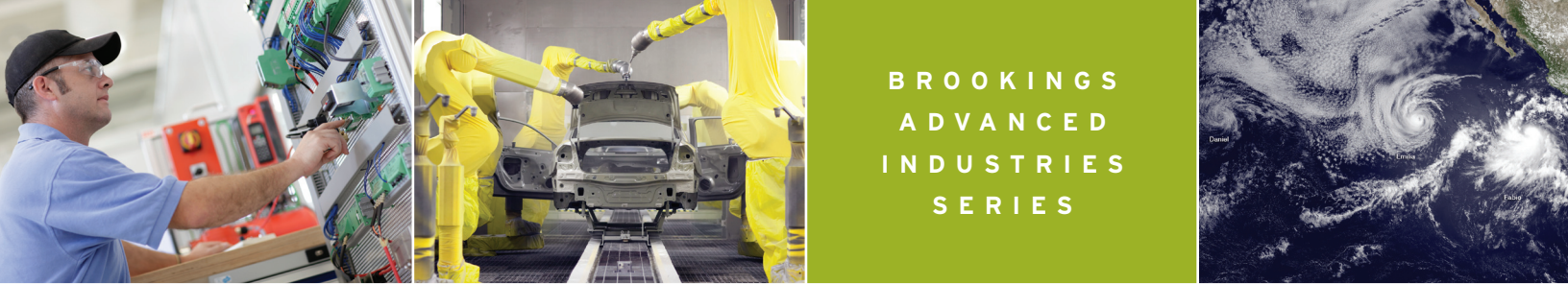
More than four years after the Great Recession, America's economic rebound remains anemic. Despite recently improved forecasts, the nation still faces a job deficit of nearly 8 million, elevated poverty, a negative trade balance, and persistent questions about the competitiveness of its industries and workforce.

Clearly, much work is needed to renew the economy by reorienting it away from its pre-crash obsession with consumption and debt and toward a new focus on innovation, technology, exports, and opportunity.

And yet, who will lead this work? With Congress largely gridlocked, Washington has become a non-factor. Nor do federal budget realities point to solutions: Spiraling health care spending will limit critical investments in innovation, education, and infrastructure for years.

There is hope in some quarters, though. Across the country, smart, ambitious states and regions are stepping up to grow jobs and make their economies more competitive and prosperous by locking their focus onto what the Brookings Metropolitan Policy Program and our associates at McKinsey & Company call "advanced industries."

Advanced industries—the nation's most strategic innovation and STEM (science, technology, engineering, and math) worker-intensive industries—are prime movers of regional and national prosperity in developed countries.



Consequently, the state of Colorado—as part of the Colorado Blueprint economic planning process—commenced a systematic search for a strategy to advance its formidable aerospace industry in the summer of 2012. Likewise, in 2013, the state of Tennessee executed a similar exercise focused on its signature auto manufacturing industry. In both cases, a focused state sensed disruptive change in the air and sought to defend and expand a critical industry, so as to grow more and better jobs during a pivotal decade.

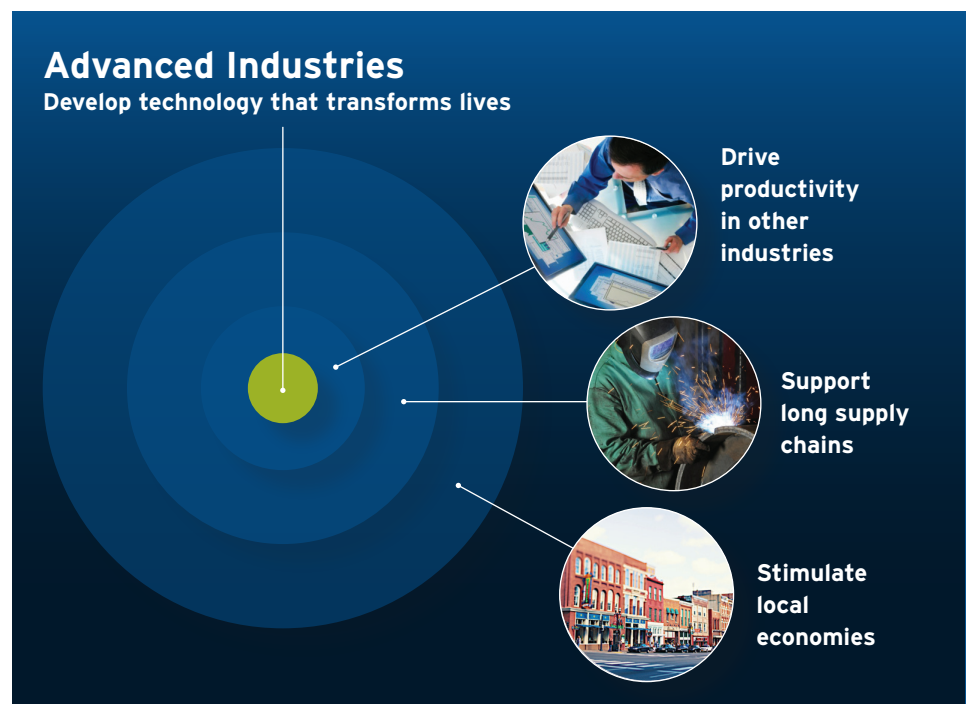
In doing so, Colorado and Tennessee have stepped forward as leaders. In parallel, they have acted on their own to renew the nation's strategic economic base from the “bottom up”: state by state and region by region. Together, these and other efforts to expand America's advanced industries point to an important new priority for economic discussion, research, and work to renew the nation's economy in support of broad-based prosperity.

AMERICA'S ADVANCED INDUSTRIES: WHAT THEY ARE AND WHY THEY MATTER

What, exactly, are advanced industries (AIs)? AIs are crucial drivers of global competitiveness—and therefore prosperity—in the United States. Altogether, Brookings and McKinsey identify 23 AIs that are distinguished by above-average investment in research and development (R&D) and heavy employment of skilled STEM workers. These industries comprise the nation's industrial innovation sector. These industries transform lives and the economy through the introduction and diffusion of new technologies, processes, and solutions.

Why do the AIs matter so much? As prime drivers of technology development, deployment, and diffusion in the United States, AIs:

- Account for **11 percent of GDP** but **80 percent of the private-sector R&D** critical to long-term competitiveness, as well as **one-third of all U.S. exports**
- Provide over **7.4 million direct jobs**, nearly half of which are available to workers with less than a four-year college degree



Defining Advanced Industries

Advanced industries (AIs) encompass those industries that display above-average R&D spending as a share of total sales and employ a workforce in which the average worker is expert in at least one discrete STEM field.

This critical, innovation-intensive subset of the economy includes both manufacturing firms (e.g. pharmaceuticals, aerospace, advanced machinery, motor vehicles and parts, medical equipment, and computers and electronic devices) and services providers (e.g. telecommunications, data processing and hosting, software, and computer systems design).

Twenty-three discrete industries meet these criteria:

NAICS	Manufacturing Industries
3254	Pharmaceuticals and medicine
3332	Industrial machinery
3333	Commercial and service industry machinery
3336	Engine; turbine; and power transmission equipment
3341	Computer and peripheral equipment
3342	Communications equipment
3343	Audio and video equipment
3344	Semiconductors and other electronic components
3345	Navigational; measuring; electromedical; and control instruments
3346	Magnetic and optical media
3352	Household appliances
3353	Electrical equipment
3359	Other electrical equipment and components
3361	Motor vehicles
3363	Motor vehicle parts
3364	Aerospace products and parts
3391	Medical equipment and supplies
	Service Industries
5112	Software publishers
5179	Other telecommunications
5182	Data processing and hosting
5415	Computer systems design
5416	Management; scientific; and technical consulting
5417	Scientific research and development

- Attract high-value investment into the United States, with **one in six AI jobs** provided by foreign-owned companies
- Paid workers an average **annual wage of over \$94,000** in 2012, nearly double the national average

What's more, the sector's economic impact radiates far beyond its 23 constituent industries. After all, in addition to developing transformational technologies like GPS, LASIK, and the smart phone, the AI sector:

- **Drives productivity in other industries.** Many AIs produce and scale the technologies and innovations that other industries adopt into their own production processes. For example, it's estimated that applying advanced analytics, or "big data," to quality and efficiency could save the U.S. health care industry \$300 billion annually.
- **Supports long supply chains.** AIs rely on thousands of domestic supplier firms. Brookings' research in Tennessee revealed that there are 6.5 jobs in the supply chain for each at an automaker. Altogether, AIs support an estimated **5.1 million additional jobs** in their direct supply chains.
- **Stimulates local economies.** While most workers are employed outside the AI sector, because AIs are globally competitive, workers in the sector earn more and stimulate the non-traded sectors of the economy. Spending by AI workers and firms generates an estimated **3.8 million additional jobs** in the communities where they reside.

Enlarging the U.S. AI sector would begin to address the troubling deficits in jobs, income, and trade the nation now confronts.

AMERICA'S ADVANCED INDUSTRIES: WHY STATES ARE ACTING

Expanding the nation's AI sector will not be easy, however. Strong challenges from other nations, inconsistent engineering and workforce training systems, and negative trade balances in some AIs mean that U.S. dominance of the global sector is contested. Moreover, while efforts to expand the AI sector will largely depend on private initiative, political paralysis in Washington has stalled needed national action on R&D investment, skills-building, taxes, trade, and infrastructure. The United States now trails many global competitors in terms of R&D investment as a percentage of GDP, STEM education and training, tax policy that promotes investment and innovation, and trade deals.

As a result, leading states and metropolitan areas are acting on their own—in collaboration with their most strategic industries—to support innovation, invest in local industry clusters, drive trade, and build the STEM skills base for the next round of AI growth.

U.S. AIs' Significance

- Employ 30 percent of all engineers
- Pay employees nearly twice as much on average as non-AI firms
- Predicted to add just under 2 million new jobs over the next decade
- In terms of output, grew four times faster than the economy as a whole over the last decade

THE COLORADO AND TENNESSEE EXAMPLES

Colorado and Tennessee epitomize this new urgency. Each state has targeted a key advanced industry and sought to assess global positioning, competitive opportunities and challenges, and a clear strategy for growth.

COLORADO: TAKING THE SPACE ECONOMY TO THE NEXT LEVEL

In Colorado, the looming threat of last year's federal budget sequestration prompted a serious reassessment of the state's sizable space and aerospace industry cluster.

This flourishing industry concentration supports some 66,000 direct jobs across the public, private, and civic sectors—not only in the aerospace industry proper, which employs 25,000 Coloradans, but also in those industries that directly support or use space systems, including satellite imagery, telecommunications, custom IT, and location-based apps.

However, Colorado industry and government leaders had increasingly come to recognize serious long-term challenges: reduced government spending, new customer demands and competitors, and a looming skills shortage due to an aging workforce.

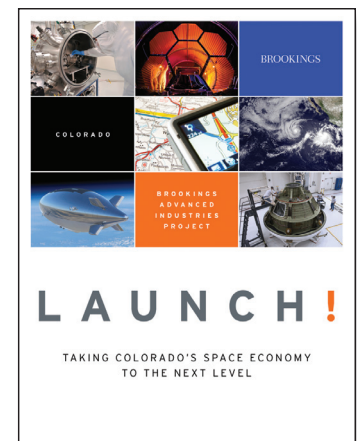
Against that backdrop, Gov. John Hickenlooper convened a joint six-month strategy-setting exercise for the aerospace industry (facilitated by the governor's Office of Economic Development and International Trade, in partnership with Brookings and with pro-bono input from McKinsey) within the state's ongoing Colorado Blueprint economic visioning initiative.

The study revealed a sector far deeper and more diverse than previously thought. A special competence was found in the fast-growing category of firms that employ satellites to deliver services back on earth, such as earth observation

data to power Google Maps. At the same time, a systematic review of strengths, weaknesses, opportunities, and threats exposed a series of competitive challenges, including the state industry's limited involvement in growing commercial market segments; weak space/aerospace-specific tech transfer and access to risk capital; an impending shift in workforce dynamics; and a sub-optimal degree of collaboration across the Front Range space cluster.

Following this review and the February 2013 release of Brookings' "Launch: Taking Colorado's Space Economy to the Next Level" report, the state moved aggressively to reassert its preeminence in space and aerospace. The Colorado General Assembly passed the **Advanced Industries Accelerator Act** with bipartisan support, launching a competitive 10-year, \$15-million-a-year matching grant program to encourage applied research collaborations, foster technology commercialization, and provide support for early-stage AI companies. The state announced the first round of winners in late 2013 and is now accepting a second round of applications. Legislation has recently been introduced to increase the program's funding given its oversubscription.

In addition, the state—working with industry—has taken other steps to bolster its position in new space and aerospace markets. Hickenlooper has appointed a new **chief innovation officer** and its first **aerospace and defense industry "champion"** to drive innovation-oriented networking and economic development. Simultaneously, the state has established an **Advanced Industries Export Grant** to provide financial assistance to aspiring and current advanced industry exporters. The state is also now conducting a comprehensive **AI assessment and roadmap** to better understand how its AIs relate to one another as part of an effort to identify cross-cutting strategies for growing AIs statewide.



TENNESSEE: MOVING THE AUTO SECTOR UP THE VALUE CHAIN

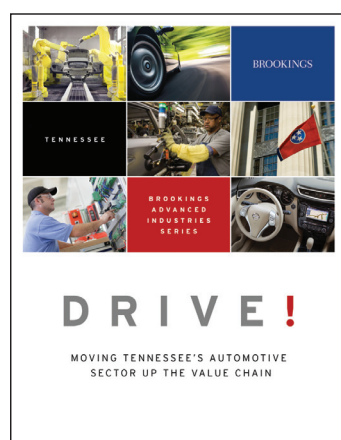
In Tennessee, the auto industry had entered its own challenging period in 2013 as it consolidated efficiency gains made during the Great Recession and began to grow again.

With more than 94,000 employees—anchored by major assembly plants operated by Nissan, GM, and Volkswagen—the state industry had staked out a position as a lower-cost production alternative to Detroit and had exited the economic crisis with genuine momentum. At the same time, industry and government leaders saw unprecedented challenges. The rise of Mexico's auto industry now posed a direct challenge to the state's core advantage, while

the new demands of high-tech production systems required a different, more agile workforce. Overall, the innovation imperative was sharpening, with regulations and shifting consumer demand requiring the implementation of new technology throughout the automotive manufacturing process.

In light of these challenges, Gov. Bill Haslam's team accepted Brookings' offer to provide an in-depth analysis (informed by industry intelligence from McKinsey) on the state auto industry's positioning and formulate a competitive strategy.

The resulting competitive agenda (released in October 2013 and entitled "Drive: Moving Tennessee's Automotive Sector Up the Value Chain") aimed to help Tennessee maintain and improve its position in a shifting industry. Above all, the agenda challenged the private and public sectors in Tennessee to deepen the state's supply



chain, improve the workforce training system, and commit to innovation rather than just low costs. In response, industry leaders, Oak Ridge National Laboratory, Brookings, and state government officials have worked together to design a set of strategic initiatives to enhance the state's competitive position on all three fronts.

On the supply chain front, Haslam is now moving to name a dedicated **automotive “project manager”** in state government to spearhead sector development and serve as the state's chief liaison to industry leadership and other parties. The governor has also committed to strengthening the **Tennessee Automotive Manufacturers Association (TAMA)** and assisting in the launch of the organization's AI³ (Automotive Industry Infrastructure Initiative) platform, engaging in networking, supply-chain, and cluster development.

To address the state's workforce challenges, Haslam this month proposed a series of AI-relevant initiatives aimed at further aligning the state's education and training systems with industry needs. In addition to making two years of community college education free to any graduating high school senior, the state's new skills strategy includes several proposals informed by Brookings work, including the creation of a **director of workforce alignment** reporting to the governor, the establishment of a new **sub-cabinet linking the relevant state agencies** to force more coordination, the provision of new **data and support resources to encourage collaboration** between education and industry, and the creation of a new **\$10 million Skills Gap Grant Competition**. This competition will incite and reward the development of creative, industry-aligned workforce training initiatives in Tennessee regions.

Finally, to promote innovation, the state last year established an auto technologies accelerator (the **autoXLR8R**) in Tullahoma, TN as part of LaunchTN, one of the country's first statewide accelerator networks. More recently, the state has partnered with Oak Ridge to design a mechanism to facilitate technology exchange between the state's manufacturers and the laboratory. The program, called **Revv!**, will award \$2.5 million in state funds in variably sized innovation vouchers to competitively selected firms for the purchase of R&D services from the lab. The program will help Tennessee suppliers respond to the innovation imperative while also promoting exchange between a world-class institution and the state's AI clusters.

CONCLUSION

“States and other locales are moving to reconstruct the underperforming U.S. economy one state and one cluster at a time.”

Colorado and Tennessee—along with other states and metropolitan areas—are helping the nation, unwilling to wait for Washington, work out a new brand of economic stewardship.

Whether these efforts alone will be sufficient remains to be seen. It is hard to believe that AI dominance can be secured without a modicum of federal input on technology development, STEM training, trade, and finance. Yet the progress of states like Colorado and Tennessee deserves increased attention. Acting with urgency, these states and other locales are moving to reconstruct the underperforming U.S. economy one state and one economic cluster at a time. Together, their actions and intentions constitute a bottom-up competitiveness agenda that will undoubtedly inform the national actions of tomorrow. ■

ABOUT THE AUTHORS

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ADVANCED INDUSTRIES SERIES

This paper is part of the Brookings Metropolitan Policy Program's Advanced Industries Series. Aimed at describing and advancing U.S. advanced industries (characterized by R&D- and STEM-worker intensive industrial concerns), the series provides ground-breaking research and innovative strategy recommendations aimed at expanding the large role these industries play in delivering regional and national prosperity. Future work will map the metropolitan distribution of these industries and related innovation and workforce resources; catalogue best practices and develop innovative new recommendations; develop a federalist agenda for advancing the sector; and convene a national advisory council to champion action steps critical to advanced industry firms and workers.

IN THE SERIES

- *Launch! Taking Colorado's Space Economy to the Next Level*
- *Drive! Moving Tennessee's Automotive Sector Up the Value Chain*
- *Powering Advanced Industries, State by State*

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