# Strategic Positioning in ASCEND Technologies

## Why Colorado-Wyoming Matters Now

May 30, 2025

*Prepared by Denizens LLC for Innosphere Ventures*

https://tinyurl.com/CO-WY-ASCEND

# Introduction

Advanced Sensing and Computation for Environmental Decision-Making (ASCEND) technologies represent a new frontier of dual-use innovation—one that blends environmental science with artificial intelligence, climate adaptation, and remote sensing capabilities. These technologies not only underpin climate resilience and natural resource monitoring, but also support national security, aerospace, and intelligence missions. Today, global leadership in ASCEND is being rapidly consolidated by China, whose dominance in ASCEND patenting poses strategic challenges to the United States.

Against this backdrop, the Colorado-Wyoming (CO-WY) region has emerged as a national leader in ASCEND innovation. It ranks among the top ten U.S. regions for ASCEND invention volume and stands out even more when normalized by economic size—ranking fourth in ASCEND patents per job. This research brief distills key findings from an in-depth landscape analysis to illustrate the strategic significance of ASCEND technologies and to elevate the Colorado-Wyoming region as a high-leverage site for U.S. investment, coordination, and innovation.

# 1. Why ASCEND Matters

ASCEND technologies comprise a growing constellation of tools that capture, analyze, and interpret environmental conditions to enable real-time decision-making. These technologies are central to applications such as wildfire early warning systems, agricultural optimization, water and air quality monitoring, disaster response, and climate forecasting.

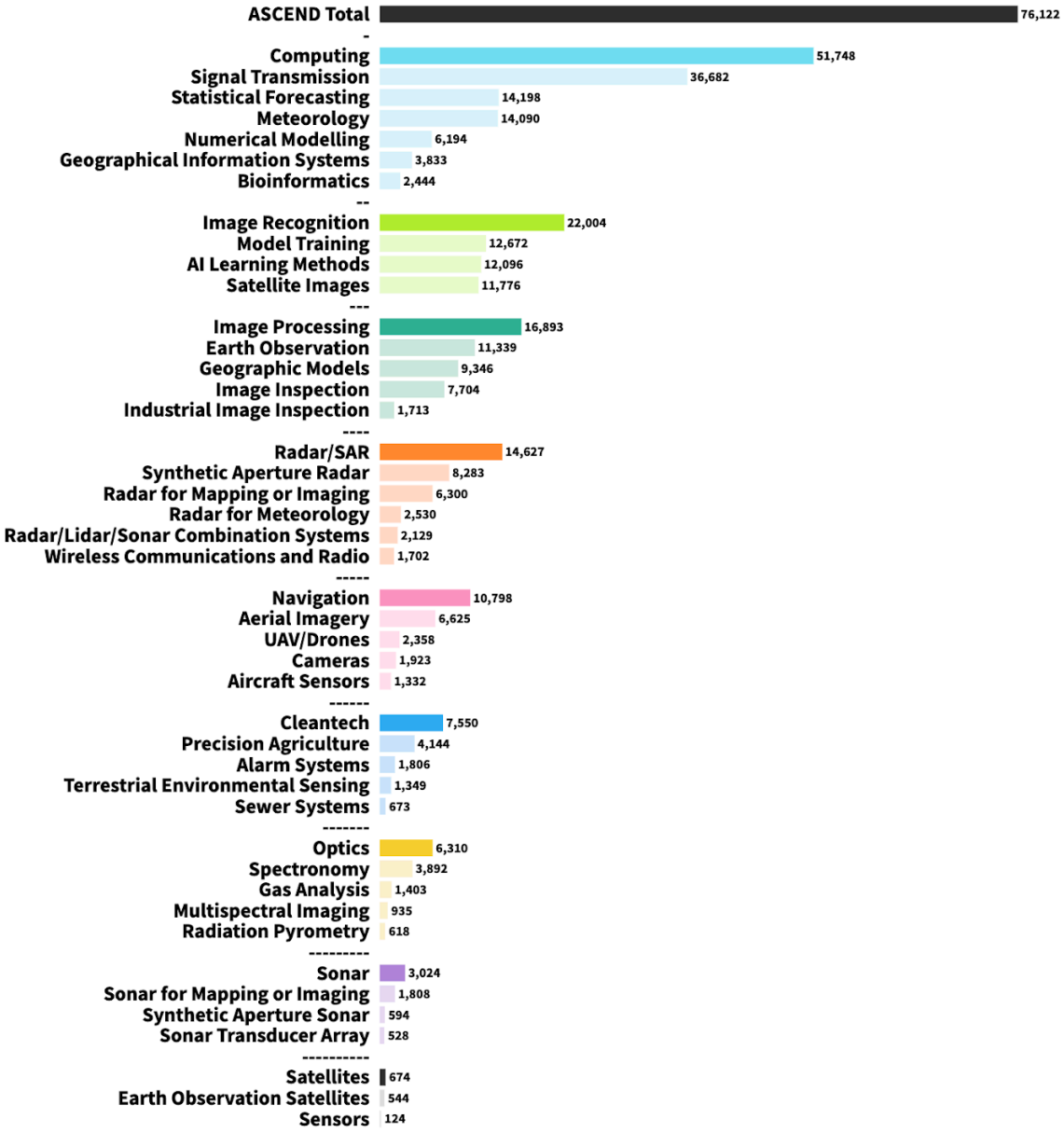
However, the strategic value of ASCEND extends far beyond environmental applications. Technologies such as synthetic aperture radar (SAR), image recognition, digital twins, and AI-powered inference engines are equally critical to military intelligence, aerospace surveillance, autonomous navigation, and dual-use satellite systems. The same radar-enabled drone that monitors crop health can surveil military installations. As such, ASCEND technologies sit at the convergence of environmental protection and geopolitical competition.

## Strategic Positioning in ASCEND Technologies

These insights argue for closer alignment between regional innovation assets and national security and resilience priorities. Federal agencies such as the Department of Energy, the Department of Defense, and FEMA may find value in cultivating inland testbeds for ASCEND systems that are hardened for dual-use deployment, advancing both climate resilience and strategic readiness.

### NINE CORE TECHNOLOGY CLUSTERS EMBODY ASCEND INVENTION

ASCEND INVENTIONS FILED SINCE 2010 BY ML-INFERRED TECHNOLOGY CLUSTER




Source: Denizens LLC analysis of Lens data.

## 2. A Race with China

The past decade has seen an explosive rise in ASCEND invention. Since 2010, global patent authorities have recorded nearly 76,000 new ASCEND inventions. But over 80% of these inventions have originated from one country: China.

China now dominates every major cluster of ASCEND technology:

- 85% of ASCEND computing inventions
- 87% of inventions in image recognition
- 76% of inventions in advanced radar sensing
- 70% in optical sensing

In contrast, the United States has contributed only 10% of ASCEND inventions over the same period. Its share of new inventions has declined from 30% in 2010 to just 7% in 2023. In 2023 alone, Chinese inventors and applicants were responsible for 96% of global ASCEND inventions.

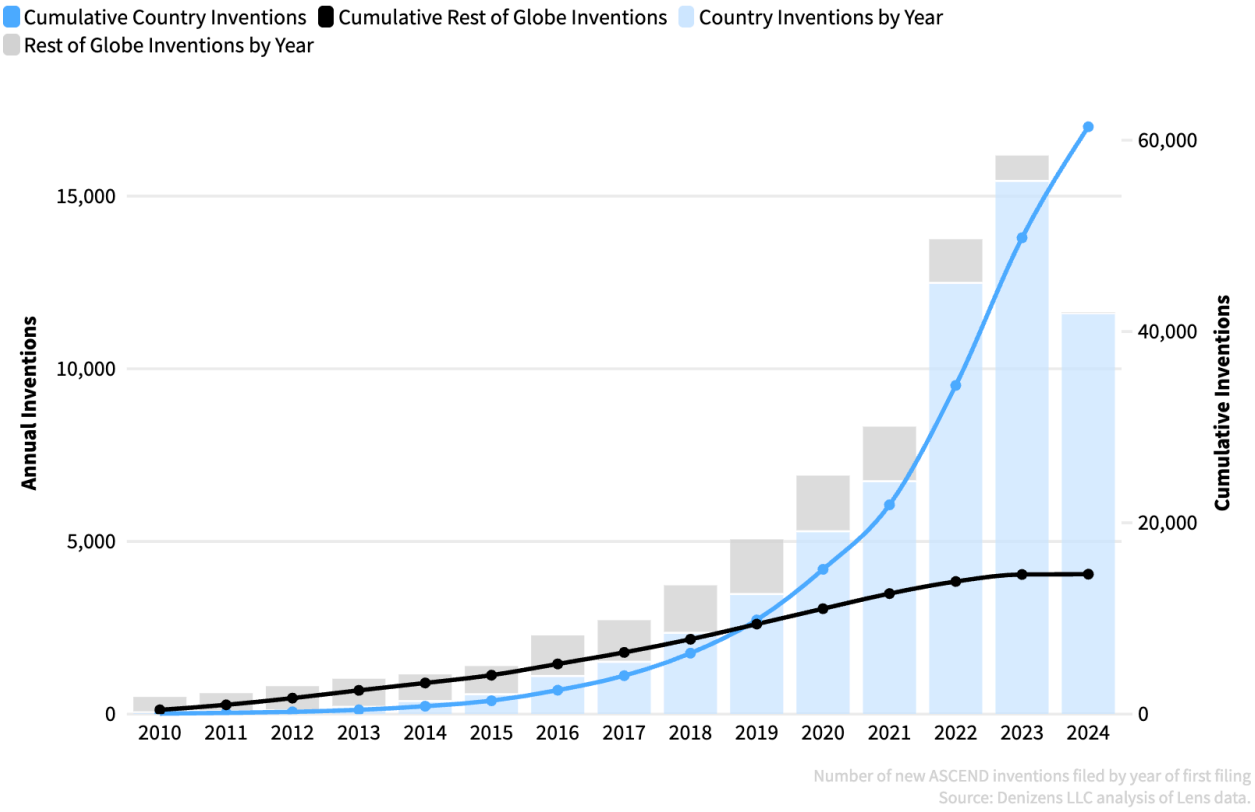
**CHINA DOMINATES GLOBAL ASCEND INNOVATION**

ASCEND INVENTIONS BY COUNTRY OF ORIGIN*


Number of ASCEND inventions filed by country since 2010 according to location of patent applicants or inventors
* Inventions can originate from more than one country. • Source: Denizens LLC analysis of Lens data.

## CHINA'S ASCEND INNOVATION HAS ACCELERATED

GROWTH IN ASCEND INVENTIONS SINCE 2010




Yet this dominance comes with caveats:

- 92% of Chinese ASCEND patents are single-origin, involving only Chinese inventors and applicants
- 90% are protected only within China, lacking international patent protections
- China's ASCEND inventions garner 0.19 foreign patent citations each, on average, compared to 2.1 globally

These statistics suggest an insular and potentially lower-impact innovation ecosystem. However, China's overwhelming dominance likely contributes to the global trend of faster ASCEND commercialization. Since 2016, the average age of sources cited by ASCEND inventions has fallen from over seven years to under four years—meaning a majority of sources cited by 2024 ASCEND inventions did not exist before 2020. China is driving this acceleration of technological convergence and integration, and increasingly owns what is most cutting-edge within the ASCEND landscape—reinforcing the urgency for a U.S. response.

These insights argue for a stronger domestic push—especially in regions like Colorado and Wyoming—to close the gap between world-class science and deployable technologies. Federal innovation agencies may find strategic value in supporting regions where invention quality is high, but commercialization infrastructure remains underdeveloped.

## 3. ASCEND as a Real Market Opportunity

While invention is a crucial indicator of technological leadership, the commercialization of ASCEND technologies reveals just how real—and investable—this market has become. Companies across a range of sectors are not only filing ASCEND patents but raising substantial capital to bring these technologies to market.

Since 2010, companies that have commercialized ASCEND inventions have collectively raised $162 billion in capital following their first patent filing. Though these companies may have other products or services, this figure reflects the deep market relevance and investor confidence in ASCEND technology areas.

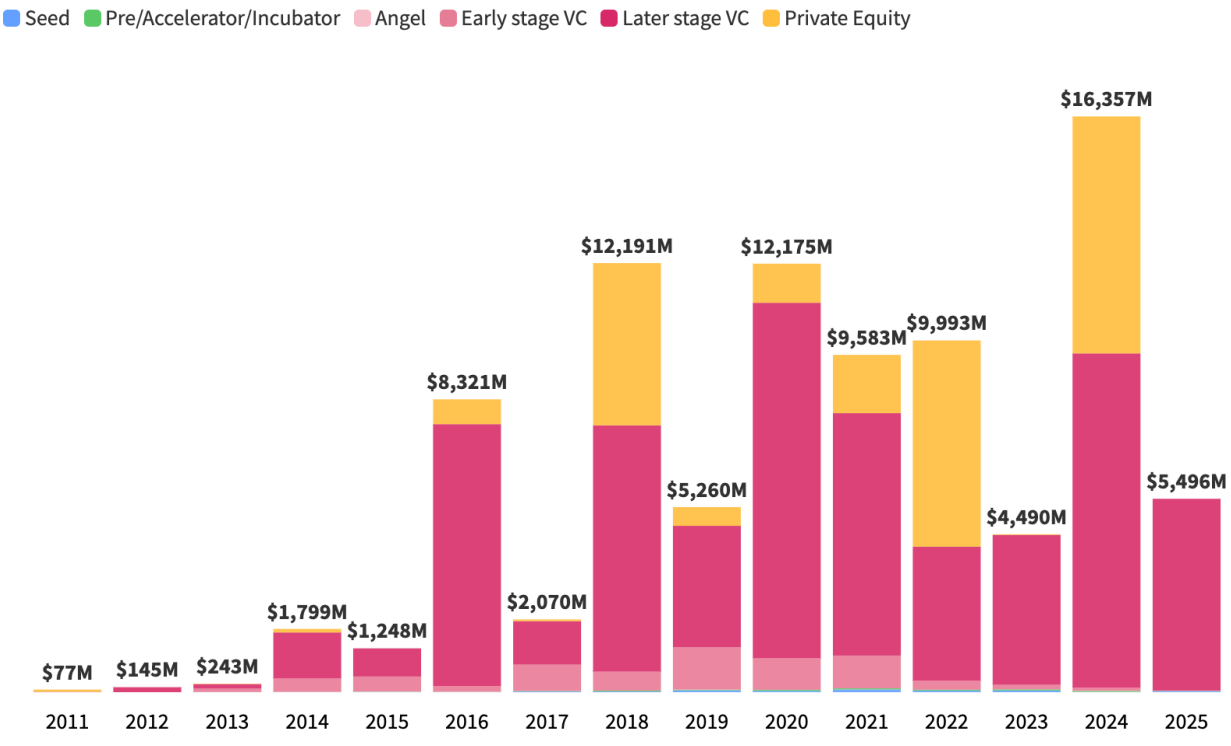
Much of this investment comes from growth capital sources:

- 55% of all funding—approximately $89 billion—has come from seed, angel, or venture capital
- Later-stage venture capital accounts for two-thirds of that growth capital, indicating that many ASCEND companies are maturing into scale-up phases
- Private equity firms constitute the second-largest category of investors

The industries most actively commercializing ASCEND technologies include information technology, energy, aerospace and defense, advanced manufacturing, and environmental services. Companies in these sectors are integrating ASCEND tools into geospatial analytics, environmental forecasting, precision agriculture, autonomous navigation, and smart infrastructure. Many of these firms operate across multiple ASCEND clusters simultaneously, reflecting the technologies' inherently convergent nature and broad market relevance.

## ASCEND STARTUPS RELY HEAVILY ON LATER-STAGE VC

GROWTH CAPITAL INVESTED IN ASCEND-RELATED COMPANIES BY YEAR




Capital raised by startup companies to finance growth, in current U.S. dollars
Capital raised since companies filed their first ASCEND patent. • Source: PitchBook Data, Inc.

Commercialization is not limited to the private sector. Universities and government labs—such as the Chinese Academy of Sciences, MIT, and Colorado State—are among the most frequent originators of ASCEND patents. This highlights the importance of strong technology transfer ecosystems in sustaining innovation.

These insights argue for deliberate partnerships between regional ASCEND clusters and large-scale corporate and institutional players already active in this space. Companies like Microsoft, IBM, Boeing, and Palantir are actively investing in ASCEND-adjacent fields—from AI-driven geospatial intelligence to environmental simulation—and may see advantage in aligning with a regional engine that anchors real-world data and test environments.

# 4. Colorado-Wyoming: A High-Leverage Outpost for U.S. Leadership in ASCEND

Amid global competition, Colorado and Wyoming have emerged as powerful but under-recognized centers of ASCEND innovation. Since 2010, the region has produced 329 ASCEND inventions, spanning every major technology cluster and subcluster identified in the global network analysis.

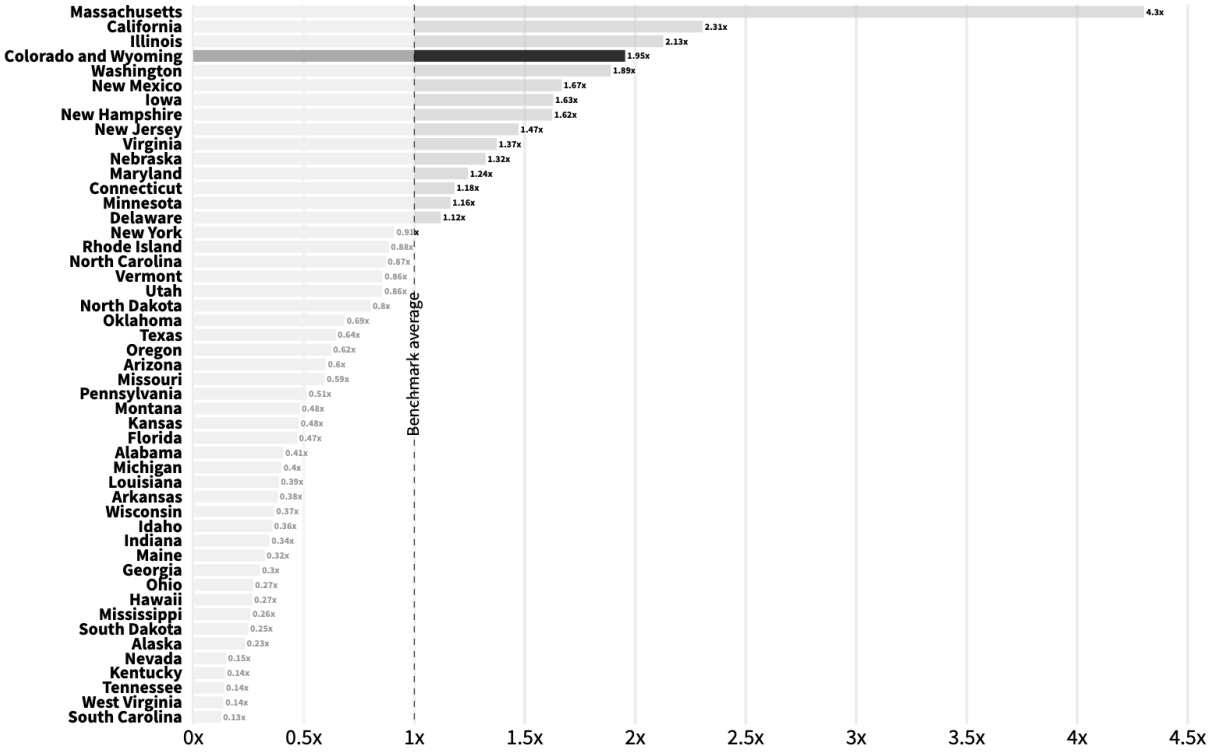
Key strengths include:

- Top 10 nationally in total ASCEND invention volume
- 3rd nationally in optically enabled gas analysis
- Among the top 5–7 in computing, optics, image processing, navigation, and radar clusters

But the most striking metric is economic concentration: the region produces nearly twice as many ASCEND inventions per job as the U.S. average—and over 4x the national average in aircraft sensors, cleantech, and satellite imaging subclusters.

**ASCEND INVENTION IS CONCENTRATED IN CO-WY**

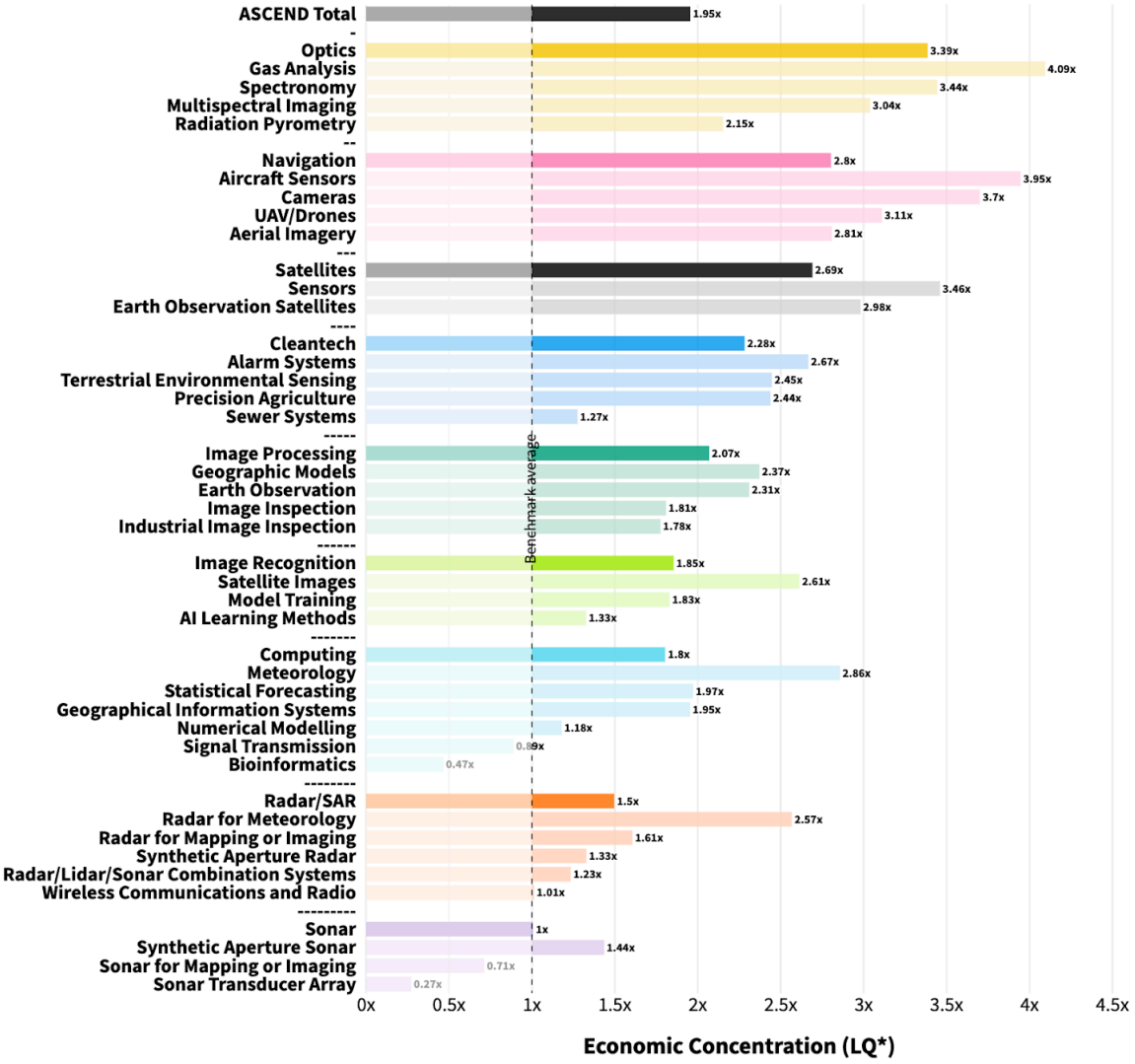
ECONOMIC CONCENTRATION OF ASCEND INVENTIONS FILED SINCE 2010 BY STATE




* economic concentration measures how the share of inventions per job in the study geography compares to the same of the United States.
Source: Denizens LLC analysis of Lens and Bureau of Labor Statistics data.

## ASCEND INVENTION IS CONCENTRATED IN CO-WY

ECONOMIC CONCENTRATION OF ASCEND INVENTIONS FILED SINCE 2010 BY TECHNOLOGY CLUSTER




* The location quotient (LQ) is a science's share of total local articles divided by its share of total global articles. It reveals how research activity is allocated differently compared to the United States.

Source: Denizens LLC analysis of Lens and Bureau of Labor Statistics data.

These insights argue for targeting the region as a "dense-but-underserved" node in the national innovation system—one where high-impact discoveries are made, but often stalled by limited capital, startup pipelines, or downstream commercialization capacity.

Opportunities exist to link local innovation capacity with firms like Esri, Trimble, BAE (formerly Ball Aerospace), and leading agtech players that could benefit from real-time environmental intelligence platforms. Aligning federal demonstration grants, philanthropic capital, and private co-investment around shared innovation needs could catalyze new growth in these sectors.

## Strategic Implications for NSF and National Competitiveness

The case for federal investment in Colorado and Wyoming's ASCEND ecosystem is grounded in both defensive logic and offensive opportunity.

Defensively, the U.S. cannot afford to cede strategic technologies to China. While Chinese ASCEND patents may be of lower quality, their sheer volume and speed of development are reshaping global norms. The U.S. needs resilient interior hubs that can scale up ASCEND capabilities quickly.

Offensively, the CO-WY region offers one of the most concentrated, versatile, and under-capitalized ASCEND ecosystems in the country. It is especially strong in dual-use technologies (optics, sensors, environmental modeling) that align with both NSF and DoD priorities.

But the region's most pressing opportunity may be in addressing the core constraint identified in this landscape analysis: a lack of regional capacity in AI and image-based analysis—domains that are driving ASCEND growth globally. While CO-WY excels in domain-specific sensing, it remains underrepresented in modeling, prediction, and image recognition technologies.

Rather than masking this gap, these insights argue for a strategic response:

- Invest in partnerships with national AI and computing hubs
- Accelerate AI training programs embedded in environmental science use cases
- Match local sensing inventions with external commercialization and analytics talent

This is not just a gap—it's a solvable constraint directly aligned with the mission of NSF's Regional Innovation Engines.

The region is already generating globally cited discoveries. The opportunity now is to translate those into applications, startups, and systems. These insights argue for investment in activation infrastructure that makes those discoveries interoperable and scalable.

These findings also suggest actionable partnerships with:

- DoE, for sensing and energy-environment modeling demonstration projects
- DoD, for inland dual-use sensing and early-warning systems
- Microsoft, IBM, Boeing, and other firms seeking geospatial, climate, and analytics partnerships

## Conclusion

Colorado and Wyoming are not just contributors to the ASCEND domain—they are national assets. Their concentrated strengths in sensing, computing, and environmental decision systems make them uniquely suited to help the United States lead in technologies critical to both climate resilience and national security.

With thoughtful investment and coordination, the region can become a testbed and commercialization hub for ASCEND innovations, helping bridge the gap between federal science, startup invention, and industrial deployment.

The insights in this report reflect a rare convergence of opportunity and strategic urgency. The question is not whether the CO-WY ASCEND ecosystem matters. The question is: will the United States invest in it before others do?

## Appendix: Methodology and Data Sources

This analysis of ASCEND (Advanced Sensing and Computation for Environmental Decision-Making) technologies is based on a structured methodology that integrates international patent data, machine learning-based clustering techniques, region-specific benchmarking, and capital flows.

**Defining ASCEND Technologies:** The ASCEND domain was first defined using a taxonomy of Cooperative Patent Classification (CPC) codes. These codes were selected based on their relevance to technologies associated with climate adaptation and environmental monitoring, computational analysis and artificial intelligence, and remote sensing and Earth observation. Codes related to unrelated sectors—such as human health—were filtered through expert review and exclusion logic.

**Data Sources:** Patent data was sourced from The Lens, an open global patent database. Only patents with an earliest priority date of 2010 or later were included. Patent families were used as the unit of analysis to avoid duplication. For citation analysis, both backward (cited) and forward (citing) references were examined to understand knowledge flows, international appeal, and time-to-commercialization. Data on the articles cited by ASCEND inventions came from OpenAlex. Data on capital flows into companies commercializing ASCEND technology came from PitchBook Data Inc.

**Clustering and Network Analysis:** To identify technology clusters within the ASCEND domain, each CPC code appearing on an ASCEND invention was treated as a node in a network. Edges were weighted by the number of co-occurrences of CPC codes on the same invention. Louvain community detection was used to identify nine core technology clusters and their subclusters, revealing the convergent and multi-domain nature of ASCEND inventions.

**Emergence and Generativity Metrics:** Using information theory and patent analytics, each CPC code was scored along two axes: generativity (its ability to support new invention) and emergence (the pace and breadth of its growing relevance). These metrics helped identify which technologies are most critical to the ASCEND ecosystem.

**Geographic and Institutional Mapping:** To examine global and regional leadership, patents were linked to inventor and applicant locations. Metrics were calculated for invention volume, specialization (e.g., location quotient), and economic concentration (e.g., patents per job). For Colorado and Wyoming, additional analysis identified the most-cited local research institutions and authors within ASCEND patents.

**Commercialization Analysis:** To assess commercialization activity, the analysis examined growth capital raised by companies filing ASCEND patents, tracking the timing and magnitude of investment following patent filings. Firm-level data was used to identify sectoral patterns, dominant verticals, and the maturity of commercialization pathways.

Together, these methods provide a comprehensive, empirical foundation for understanding ASCEND's global structure, its commercialization dynamics, and Colorado-Wyoming's position within this emerging technological domain.

# Acknowledgements

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