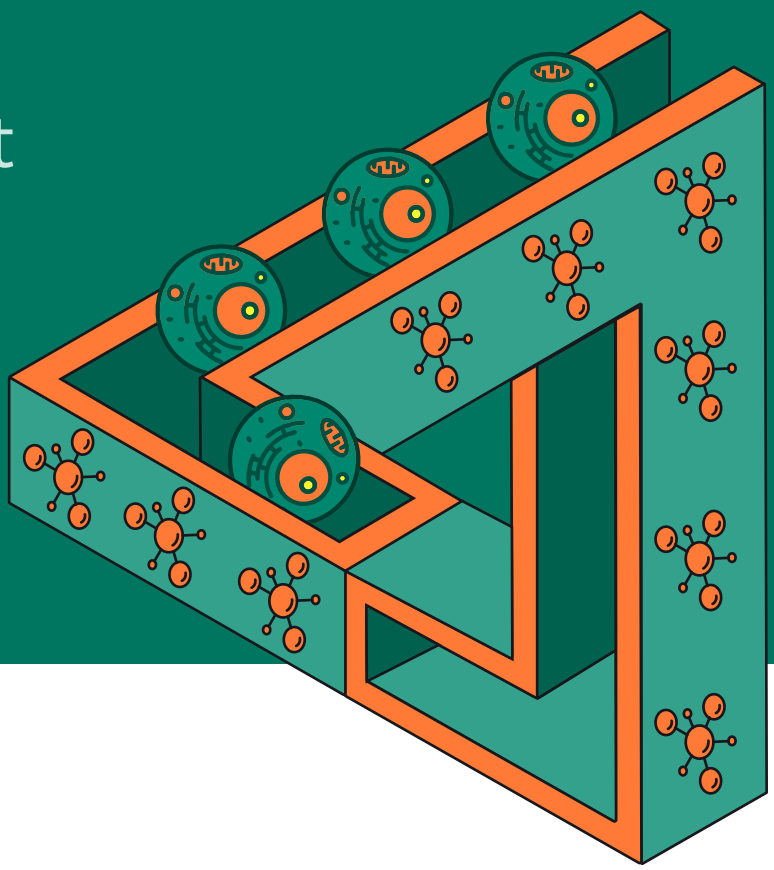
cytiva | Global Biopharma Index

The innovation illusion:

Why biopharma breakthroughs aren't moving the market

5 years of insights help the industry navigate uncertainty, maximize performance, and tap unprecedented clinical potential



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Executive summary: Biopharma under pressure

What's working for the business of biopharma, and what needs to change? We surveyed more than 1200 biopharma executives globally and evaluated the state of the industry to learn from the leaders and chart a path to progress.

To start with some good news: industry revenues rose nearly 8% in 2024 (1), and forecasts project a compound annual growth rate of up to 9.7% between 2024 and 2029 (2). There's no denying that biopharma is getting bigger.

But bigger doesn't always mean better. A closer look at our most recent survey results points to an industry under increasing pressure, as leaders signal widespread market strain.

- **Almost half (49%)** said their firm is behind its revenue growth and profitability targets.
- **60%** are falling short of market share expansion goals.
- **59%** report delays in time-to-market for new therapies.

What's driving these industry pain points? While groundbreaking innovation is fueling big changes in cell and gene therapies, mRNA platforms, AI-driven discovery, and more, market performance has fallen behind.

Biopharma executives say they're failing to hit commercial targets and cite loss of market share as a critical concern. The gap between top performers and the rest of the pack has widened, with two-thirds of the leading 20 biopharma companies seeing a decline in market capitalization in 2024 and just three surging ahead with growth over 10% (3). Smaller biopharma players are having a difficult time gaining traction in the market amid fierce funding challenges (4). And, in certain countries, key industry drivers in the biopharma ecosystem are hindering rather than enabling growth.

So, what can we do to steer biopharma in a better direction? This year's snapshot tells us that innovation alone isn't enough. Industry success now depends on working together to create a strong foundation for change that harnesses the power of unprecedented scientific advancement.

Learning from biopharma leaders across the globe

The third edition of the *Global Biopharma Index* highlights the industry's progress, challenges, and—most importantly—opportunities for improvement.

In this report, we share 2025 survey results and index scores across the following industry pillars: supply chain resilience, talent pool, R&D ecosystem, manufacturing agility, government policy and regulation, and—new in 2025—sustainability. Findings from the survey are contextualized with insights from 11 industry leaders offering their unique perspectives on industry performance and trends. All together, these data sources allow us to examine the actions of top performing countries and businesses to build recommendations for change and a better future for biopharma.

Stronger ecosystems are associated with better commercial outcomes

Why invest in the ecosystem as well as the enterprise? Because countries with stronger biopharma ecosystems tend to host more firms that beat their targets.

Across our sample of 1250 executives, 13% of respondents report that their organization is ahead of targets on both revenue growth and market share. These "high-growth firms" are more concentrated in top-tier index countries: 38% of high-growth firms are based

in the top third of countries surveyed versus 29% of other firms (a 41% relative uplift). At the same time, high-growth firms report lower perceived exposure to key ecosystem risks, such as tariffs and approval timelines.*

While this analysis shows association rather than causation, it strengthens the case for coordinated action: when the country-level pillars (supply chain, talent, R&D, manufacturing agility, policy/regulation, sustainability) improve, the share of firms ahead of target tends to rise.

Headline findings from the 2025 research:

1. **Biopharma is slipping across key pillars:** The global average index score has dropped from 6.08 out of 10 in 2023 to 5.96, reflecting systemic gaps across the biopharma ecosystem in areas such as manufacturing capacity, policy, regulatory efficiency, supply chain design, and access to skilled talent.

2. **The global landscape is shifting rapidly:** Since our 2023 report, South Korea has made a monumental climb from 12th to third in the global index ranking, while the United States (US) has fallen from second to fifth. These movements signal a rebalancing of global biopharma leadership, with investment, talent, and innovation capacity rapidly shifting across regions.

3. **Geopolitical uncertainty is a growing threat:** 59% of executives say geopolitical instability is a critical concern, and 53% expect their government to impose more trade restrictions in the next year.

4. **Use of digital technologies is a key differentiator:** High-growth firms are significantly more likely to use technologies such as AI, automation, and analytics across drug development, clinical trials, and supply chains, suggesting that digital maturity underpins resilience, speed, and competitiveness.

5. **Access to talent is tightening:** Specialized skills are in short supply, especially for novel modalities and sustainability. Only around one in three executives believe their government supports workforce scaling or overseas recruitment.

6. **Sustainability is being deprioritized:** 63% say sustainability is losing out to cost and operational pressures, and almost half are behind on their climate-related targets.

*Method note: Country grouping is based on top-third of index rankings (7 of 22 countries); one respondent per company. Results are directionally robust and statistically significant at the 10% level.

We're facing choppy waters, and I hope we'll get back to a place of calm. Many scientists relocate to the US because it was seen as the best place to do science. The big risk we have is government being short-sighted and not understanding that the industry requires ongoing and strategic investment."

- **Johannes Fruehauf**, Founder and CEO, LabCentral and BioLabs

The world is shifting from globalization to more regional perspectives, partly due to politics, economics, and the diminished focus on COVID. But to bring sophisticated products to market, we need to be as collaborative as we've ever been."

- **Michael May**, President and CEO, CCRM

About the *Global Biopharma Index*

Our index report, launched in 2021 and published biennially, benchmarks the performance and resilience of global biopharma ecosystems across six pillars:

1. **Supply chain resilience**
2. **Talent pool**
3. **R&D ecosystem**
4. **Manufacturing agility**
5. **Government policy and regulation**
6. **Sustainability (new in 2025)**

Built from insights provided by **1250 senior biopharma executives from 22 countries worldwide**, it also incorporates external datasets from UN Comtrade, Organisation for Economic Co-operation and Development (OECD), Centre for Innovation in Regulatory Science (CIRS), and BioPlan Associates.

We spoke with the following industry experts to get a deeper understanding of biopharma challenges:

- **Joanne T. Beck**, COO of Elektrofi and former CTO of Abata Therapeutics (US)
- **Angie Jiwon Chun**, Chief Growth Officer, LOTTE BIOLOGICS (South Korea)
- **Johannes Fruehauf**, Founder and Chief Executive Officer, LabCentral and BioLabs (US)
- **Wei Huang, President**, Shanghai Henlius Biotech, Inc. (China)
- **Eric Langer**, President and Managing Partner, BioPlan Associates (US)
- **Leszek Lisowski**, President, Gene2Cure Foundation (Australia)
- **Gary Lye, Director**, Manufacturing Futures Lab, University College London (UCL) East (UK)
- **Michael May**, President and Chief Executive Officer, Center for Commercialization of Regenerative Medicine (CCRM) (Canada)
- **John Milne**, Director of Bioprocessing Training Alliances and Innovation, National Institute for Bioprocessing Research and Training (NIBRT) (Ireland)
- **John Robson**, Managing Director, BioOra Limited (New Zealand)
- **Fabio Vasconcelos Fonseca**, Sr. Director, Bionova Scientific (US)

Global index results

After a period of sustained global attention and investment, biopharma has slid into a decline. For the 2025 *Global Biopharma Index*, the average industry score fell to 5.96, down from 6.08 in 2023 and 6.60 in 2021.

But it's not all bad news. This overall drop reflects mixed performance across the six pillars—while some areas are struggling, others give reason to be optimistic.

Our most recent research suggests that supply chain resilience is strengthening. While the talent pool pillar also saw a small boost since 2023, there's still work to do to adequately support certain areas of biopharma in the long term. On the flip side, manufacturing agility and government policy scores have declined.

The index highlights biopharma's strengths and gaps to show the industry where action can make the most impact. Our 2025 results show that addressing the following challenges has the potential to drive big change:

- Persistent **talent shortages**, particularly in advanced modalities
- **Regulatory inconsistencies** in mature and emerging markets alike
- A shift in **manufacturing priorities** following post-pandemic volatility
- **Sustainability ambitions stalling** amid competing operational priorities

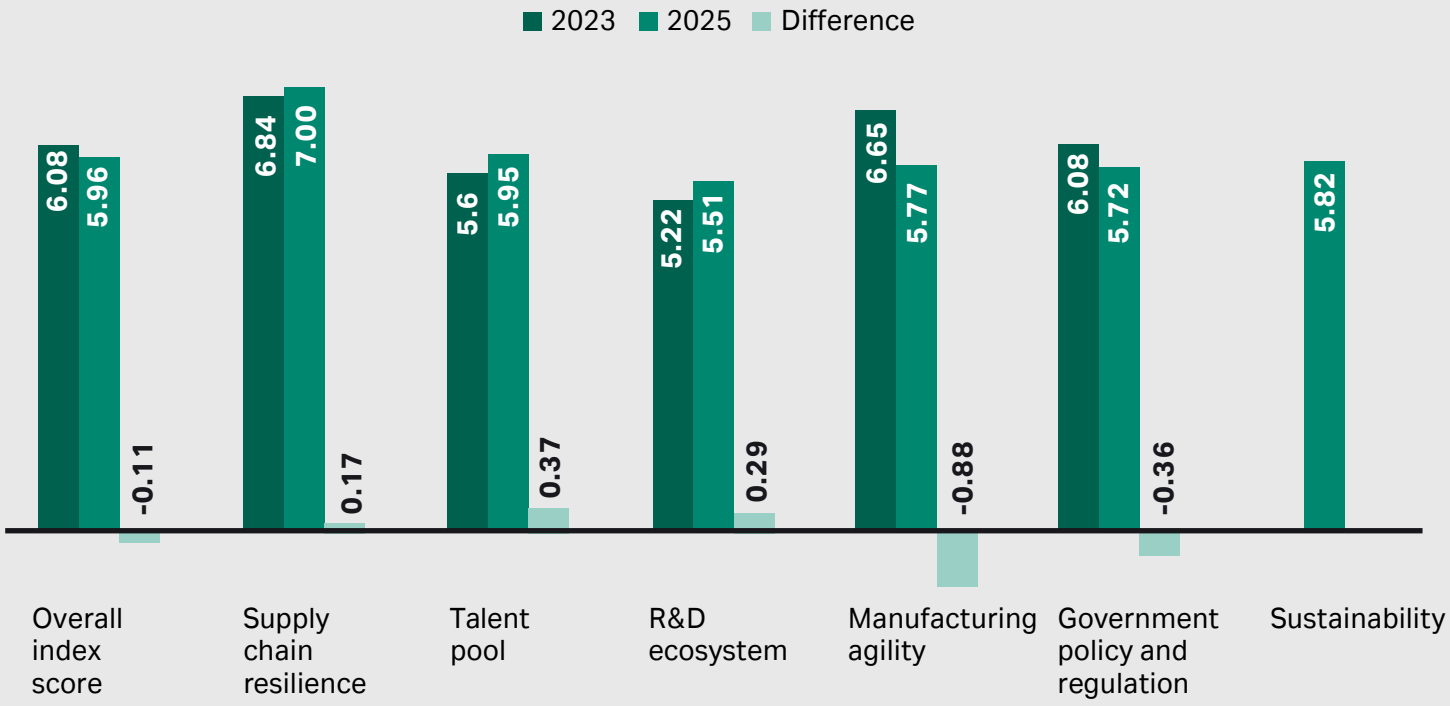


Fig 1. Signals of strength, signs of strain: While overall biopharma resilience has dropped since 2023, pillar scores show a mixed picture.

As some countries step up their game, biopharma's global leaderboard shifts.

There's been a shuffle in the index's regional rankings for 2025, with notable changes to the **top three countries**. While **Switzerland** holds on to first place and the **United Kingdom (UK)** has a small jump from third to second, **South Korea** made a large leap from 12th to third—a rise attributed to its scaling of digital innovation, clinical trial capacity, and R&D output. The US has dropped to fifth, in part due to regulatory uncertainty and policy disruption.

	Country	2025 index score	2023 index score	Ranking change
1.	Switzerland	6.99	6.98	Same
2.	United Kingdom	6.66	6.78	1 ▲
3.	South Korea	6.49	6.05	9 ▲
4.	Ireland	6.43	6.25	4 ▲
5.	United States	6.34	6.96	-3 ▼
6.	Singapore	6.29	6.41	-1 ▼
7.	Japan	6.24	6.06	4 ▲
8.	Sweden	6.09	6.58	-4 ▼
9.	Germany	6.06	6.33	-3 ▼
10.	India	6.04	5.95	5 ▲
11.	Canada	6.03	6.32	-4 ▼
12.	France	5.96	6.18	-2 ▼
13.	Australia	5.76	6.02	Same
14.	Italy	5.75	5.99	Same
15.	Spain	5.74	6.18	-6 ▼
16.	China	5.72	5.95	Same
17.	Thailand	5.59	5.36	3 ▲
18.	UAE	5.58	5.17	4 ▲
19.	South Africa	5.43	5.37	Same
20.	Brazil	5.29	5.79	-3 ▼
21.	Saudi Arabia	5.28	5.20	Same
22.	Mexico	5.12	5.42	-4 ▼

Fig 2. 2025 country rankings show us who's gained and lost ground over the past 2 years, with South Korea making a monumental climb from 12th place to the top three.

South Korea's biopharma success is built on three pillars: a deep talent pool, execution excellence, and regulatory expertise. Over time, Korean companies have mastered complex approval pathways both locally and internationally, and these capabilities are now setting new benchmarks for the global industry."

- **Angie Jiwon Chun**, LOTTE BIOLOGICS

Compared to 2023, economic strength is now a weaker predictor of a country's success in biopharma.

There's a clear correlation between biopharma resilience and economic development, as measured by gross national income (GNI) per capita. However, the 2025 data shows that this relationship is becoming less predictive. Some upper-middle-income countries are closing the gap, especially when they focus investment on advanced manufacturing, regulatory reform, and innovation incentives.

Regions rising in the ranks:

- **India** climbs into the top 10, driven by sustained investment in R&D and generics capacity.
- **United Arab Emirates (UAE) and Thailand** improve in talent and supply chain readiness.
- **China** holds steady, with notable strength in biomanufacturing despite weaknesses in policy and regulation.

Countries losing ground:

- **Germany, France, and Spain** decline due to R&D and manufacturing agility score drops.
- **Sweden** has experienced critical shortages and regulatory burdens.
- **Mexico and Brazil** lag on digitalization and sustainability.

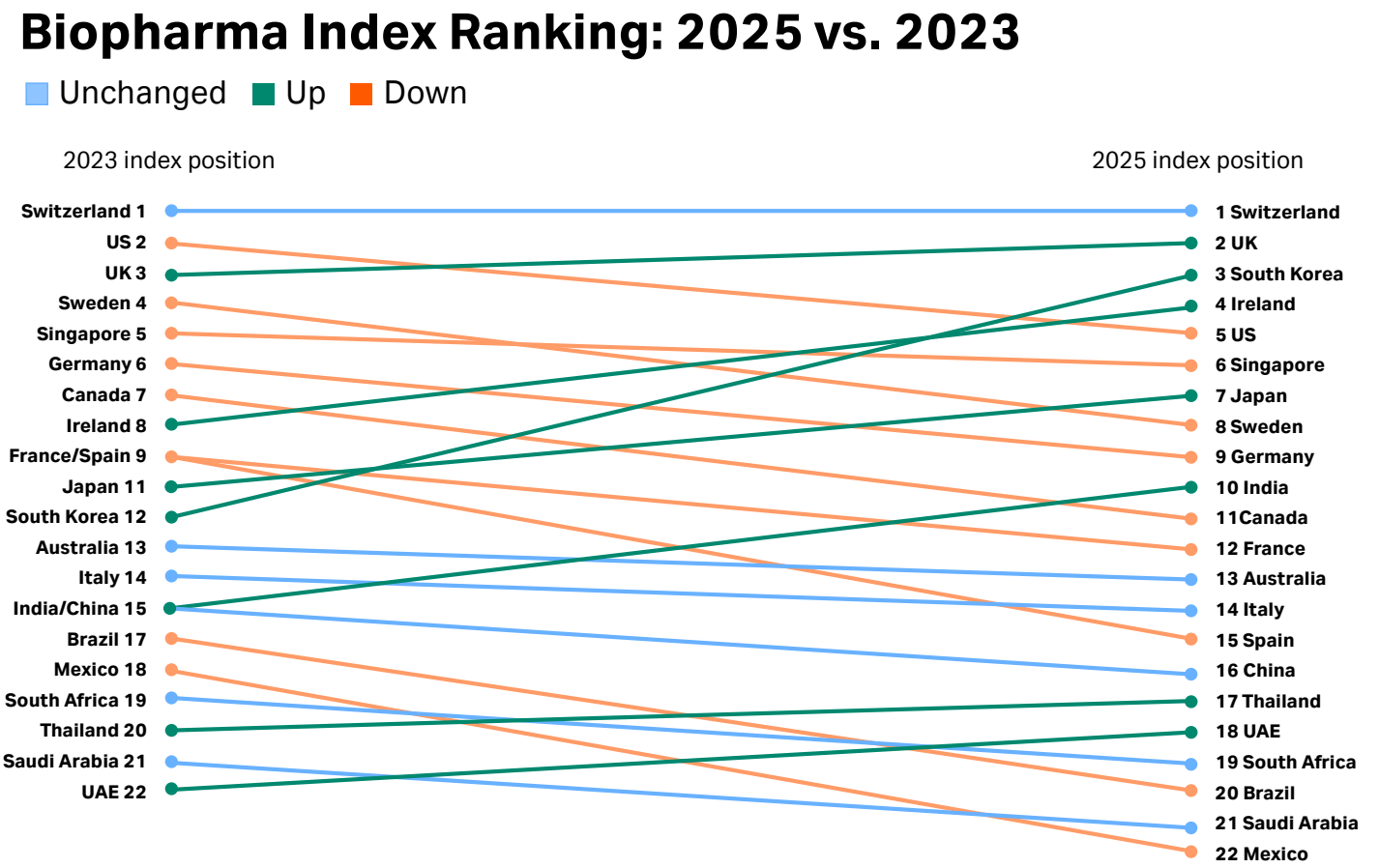
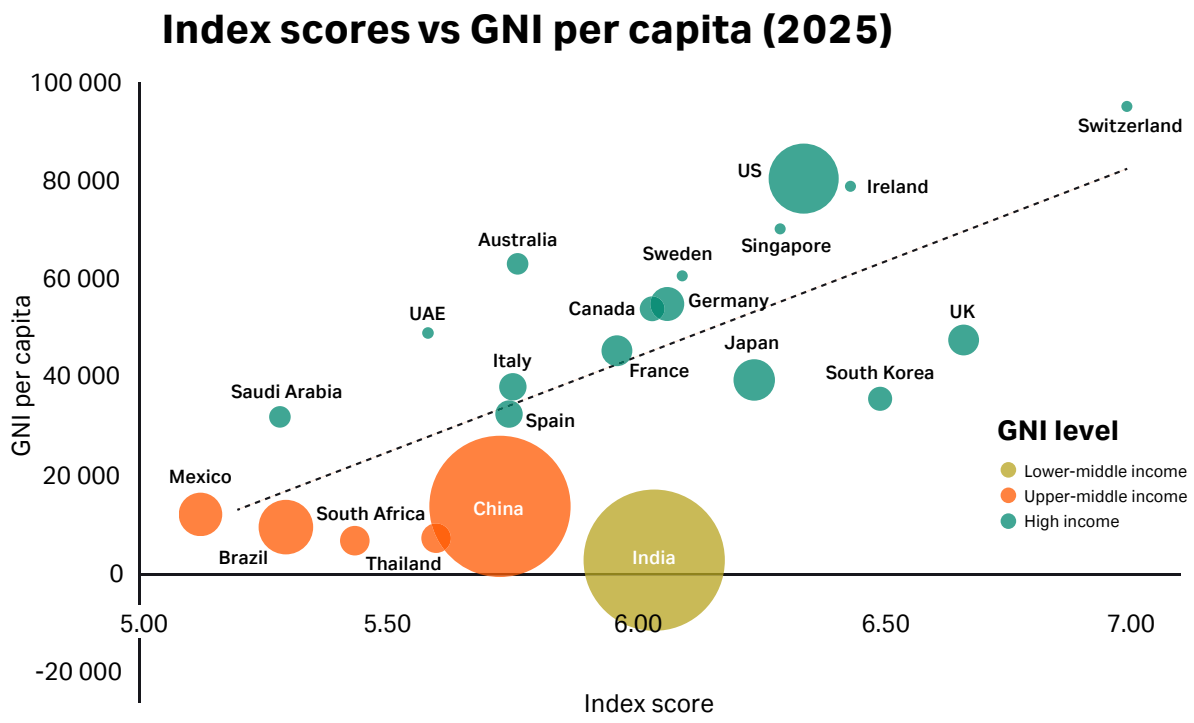
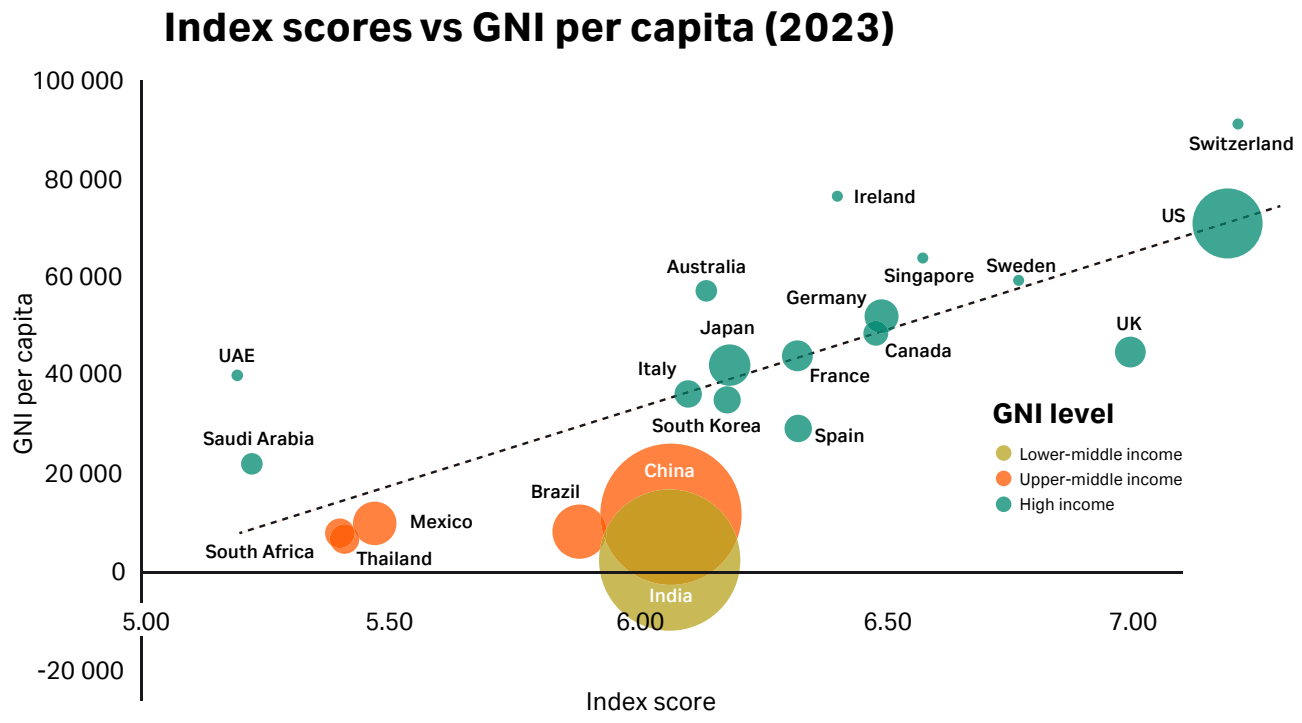


Fig 3. In 2025, the UK, South Korea, Japan, Thailand, and UAE are rising in the ranks. The US, Sweden, France, Brazil, and Mexico show signs of struggle.





Figs 3 and 4. Does money matter? Biopharma performance still correlates with income, but the relationship is weaker in 2025. India, China, Thailand, and South Africa are notably punching above their weight.

Several countries delivered higher index scores than their income levels would predict. For example, India, China, Thailand, and South Africa all have lower GNI per capita than peers with similar index scores, suggesting that targeted policy, regulatory evolution, and ecosystem choices can help offset macro constraints and improve sector performance.

Turning industry insight into action

To build true resilience, the global biopharma industry needs to perform consistently across interconnected areas: from drug discovery to manufacturing and the policy, people, and infrastructure that underpin progress.

Together, we analyzed the six pillars listed below to yield index scores and form a snapshot of biopharma's readiness to deliver innovation at scale, and when under pressure.

1. **Supply chain resilience**
2. **Talent pool**
3. **R&D ecosystem**
4. **Manufacturing agility**
5. **Government policy and regulation**
6. **Sustainability**

Pillar 1

Supply chain resilience

Confidence in supply chain security is rising—but so are the risks.

Supply chain resilience is improving slowly, but the path forward is far from certain. This year's survey shows that 55% of executives believe their country's biopharma supply chains are more robust than they were 12 months ago, up from just 44% in 2023. Investing in security of supply is paying off.

But the optimism isn't unanimous among survey respondents:

- More than a quarter (26%) still say their supply chain is not equipped to support advanced modalities, such as **cell and gene therapies**.
- **76% predict that geopolitical volatility**, including tariffs and trade barriers, will significantly affect their sourcing strategies in the year ahead.
- 56% agree that **domestic manufacturing of biologics** is set to increase dramatically over the next three years, compared with 50% who said this in 2023.

"Products such as gene therapies, particularly patient-specific treatments, by definition have to be manufactured onshore," explains Gary Lye, Director of the UCL East Manufacturing Futures Lab. "In the UK, we need to be more resilient in our ability to manufacture these therapies, and biopharmaceuticals in general."

But as Michael May, President and CEO of CCRM, points out, onshoring brings its own challenges. "The reagents and source materials are complex, and so are the supply chains. I'm not sure any one place can do it all."

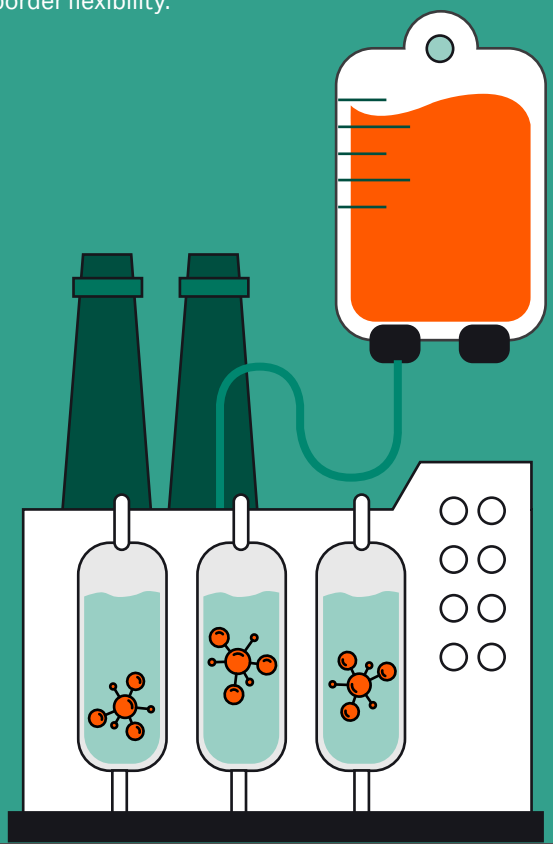
The relationship between supply chain resilience and business performance is reflected in the data. Firms that are exceeding their targets for manufacturing and supply chain efficiency are far more likely than those falling behind to outperform on other critical business targets, including revenue and profitability (24% vs 10%), market share expansion (21% vs 8%), and clinical trial success rates (14% vs 4%).

Anticipated trade uncertainties are influencing supply chains.

Firms are already acting on expected trade barriers, with more than **six in 10 companies (61%) planning to increase regional and domestic sourcing or onshoring** to bolster supply security. These efforts are especially apparent in countries where national strategies are increasingly focused on self-sufficiency and risk mitigation, such as the UK, China, the US, and India.

"As more assets reach the clinic, the real challenge shifts to the supply chain—ensuring security, sustainability, and quality," explains Wei Huang, President of Henlius. "In China, new facilities often leapfrog into the latest technologies, but building is only the first step. True success comes from designing multi-product plants, training talent, and running world-class operations that meet global standards."

While these changes might be driven by a certain uneasiness around what's to come, the shifts also represent a positive trend for the industry: countries and companies are **rebalancing global networks**, combining local resilience with cross-border flexibility.



> **I think we all are striving for the same goal: we all want to get medicines to sick people and improve people's lives."**
>
> - **John Milne**,
> Director of Bioprocessing Training Alliances and Innovation, NIBRT

Digitalization improves supply chain visibility and control.

Digital tools are also becoming central to supply chain resilience, with data linking supply chain digitalization to stronger business performance. Firms that are ahead of their revenue and market share targets are more likely than lower-performing firms to:

- Say they're using digital technology well to improve supply chain resilience (64% vs 51%) and supply chain visibility (59% vs 49%)
- Agree that they're engaged in extensive digitalization to improve supply chain speed, resilience, and security (59% vs 53%)
- Report that they can accurately forecast demand levels (59% vs 52%)

These technologies are a hallmark of high-growth firms and are helping companies move from reactive to predictive supply chain management. This shift is vital to industry success, as executives surveyed expressed the belief that a recalibration of global supply chains has the potential to influence every element of the biopharma industry.

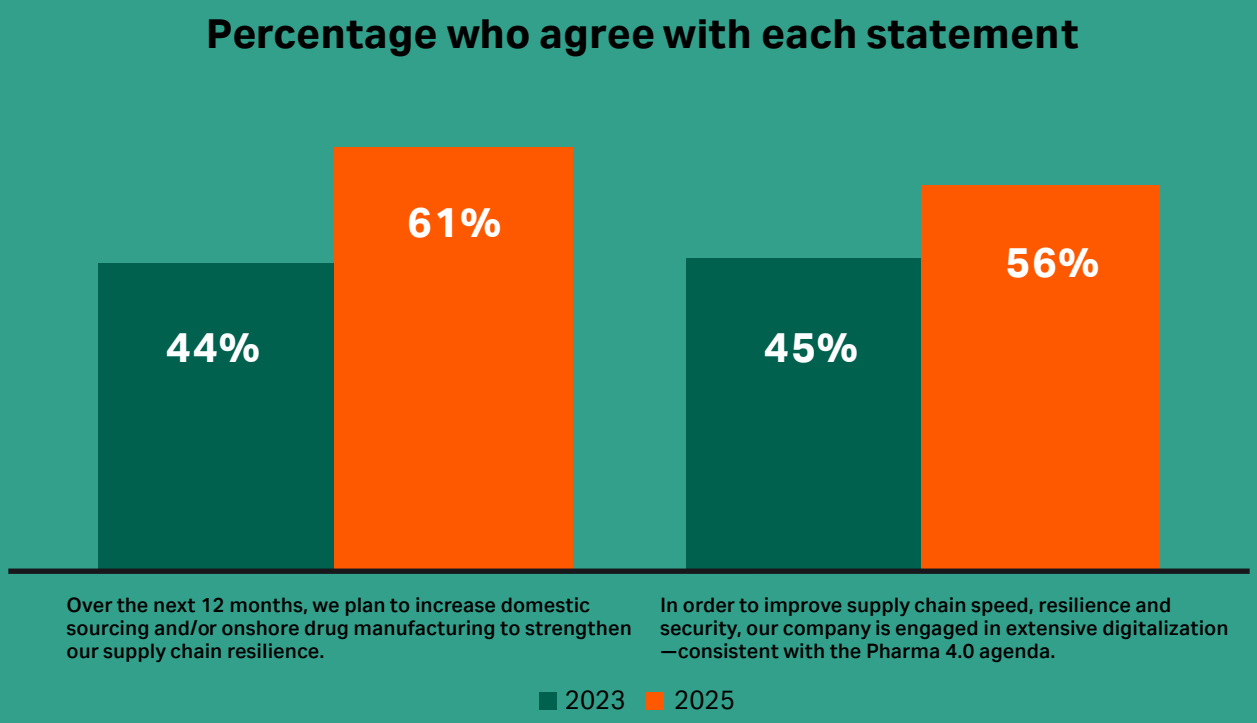
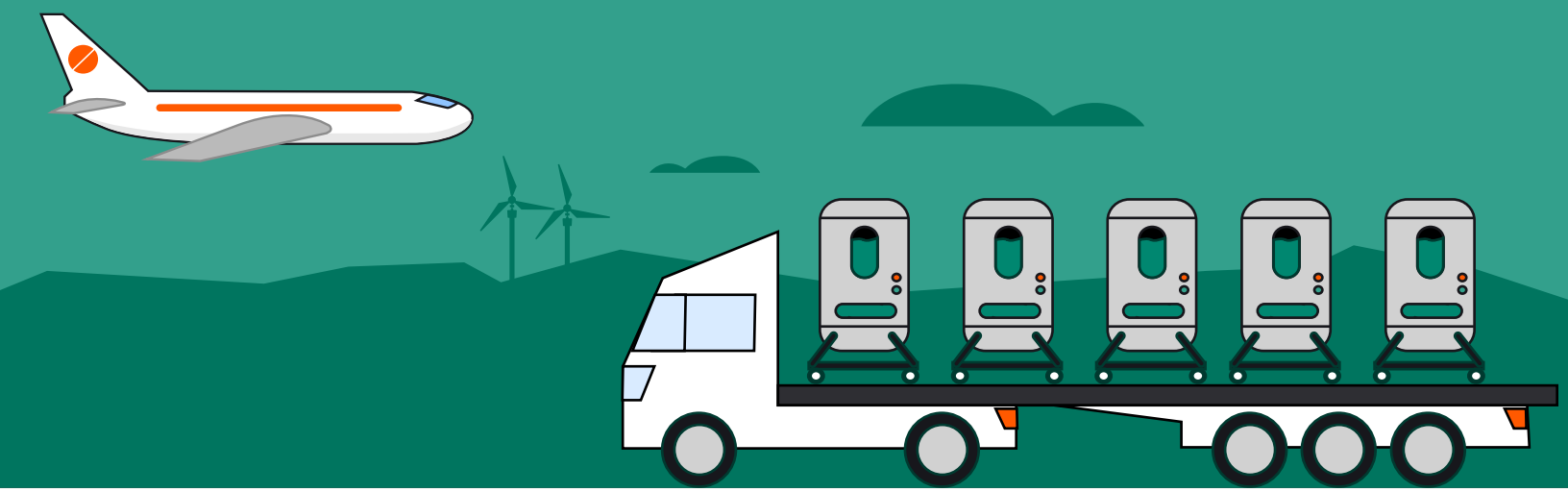


Fig 6. Onshoring and digitalization are shaping stronger supply chains.



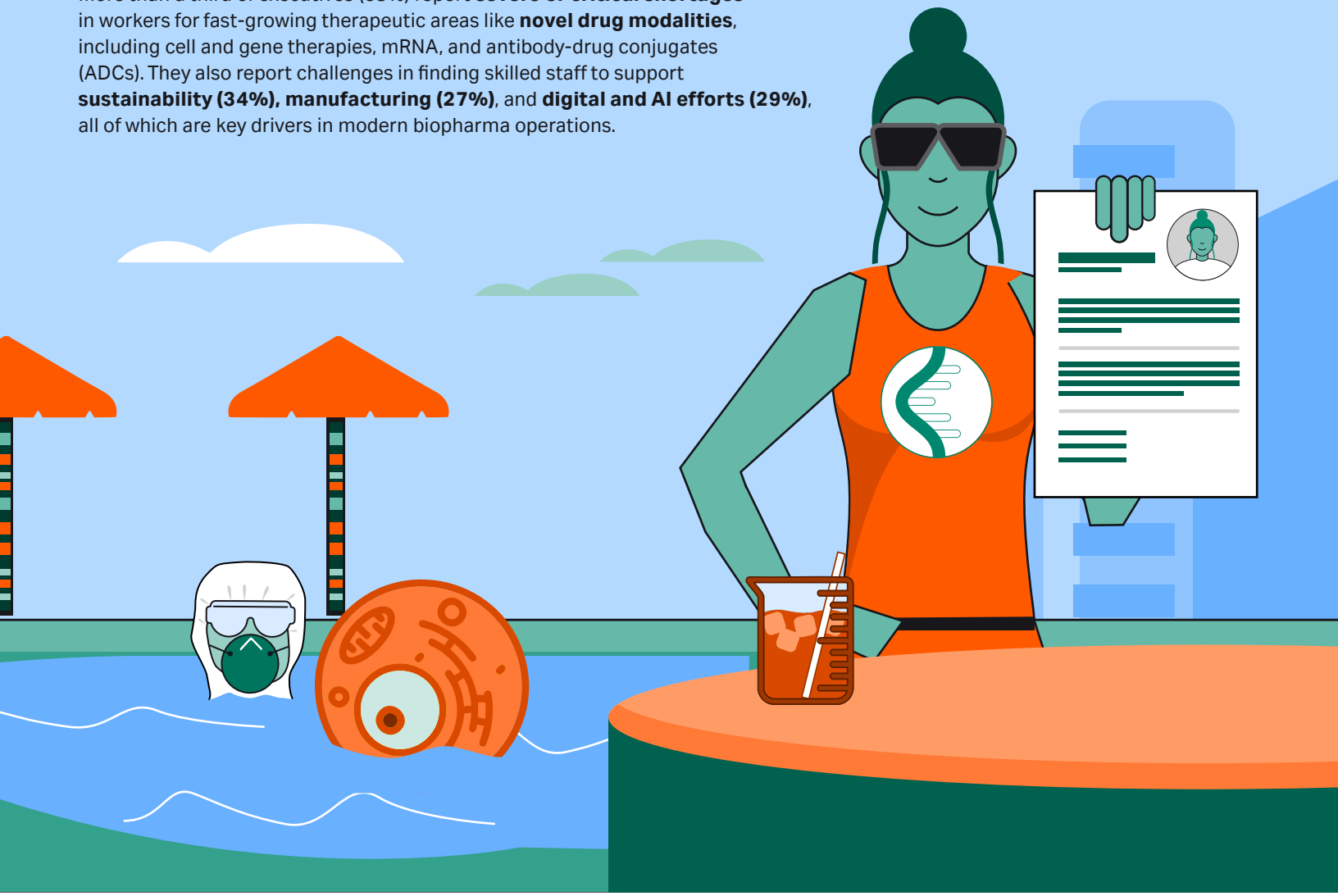
Pillar 2
Talent pool

Skill shortages remain a challenge in building a capable workforce, as government support slips away.

Access to specialized talent is one of the strongest predictors of commercial success in biopharma, yet—despite a slight boost in our most recent findings—talent has persistently been one of the weakest index areas. In 2025, the industry's talent pipeline remains under serious pressure.

Why is progress lagging? For one, building a capable workforce is a long game. And in an industry that's innovating quickly, it's nearly impossible to catch up in time to see immediate returns.

More than a third of executives (38%) report **severe or critical shortages** in workers for fast-growing therapeutic areas like **novel drug modalities**, including cell and gene therapies, mRNA, and antibody-drug conjugates (ADCs). They also report challenges in finding skilled staff to support **sustainability (34%), manufacturing (27%)**, and **digital and AI efforts (29%)**, all of which are key drivers in modern biopharma operations.



"Our 2025 annual report indicates that over the past 15 years, over 50% of the bioprocessing industry has seen significant difficulties in hiring," says Eric Langer, President and Managing Partner at BioPlan Associates. "Demand for skilled staff has exceeded the output and training resources, even where excellent universities and training groups exist."

There's now a growing gap between firms that can attract or retain top talent, and those that can't. Our findings suggest that this discrepancy amounts to real business consequences, as companies that report being ahead of their talent acquisition and retention targets are more than seven times as likely to report that they're ahead of their revenue growth and profitability targets, compared with firms that struggle to access talent.

Percentage who say they are experiencing a critical or severe talent shortage

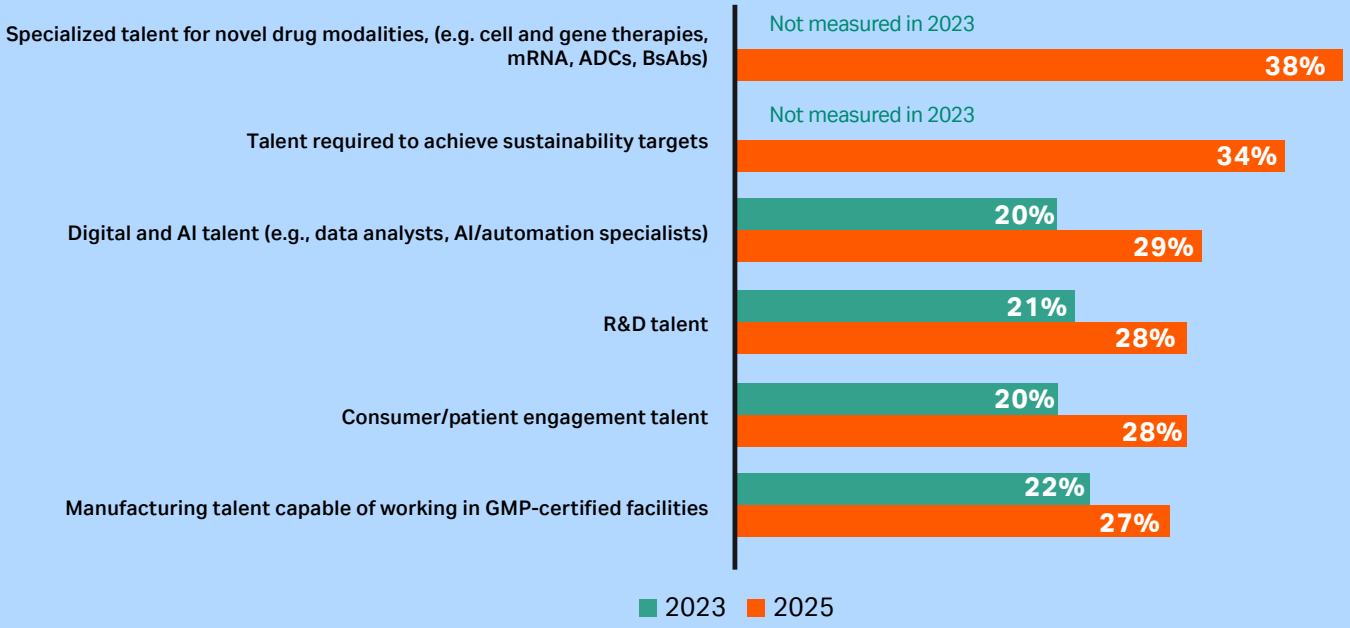


Fig 7. Severe talent shortages continue to threaten biopharma's progress and performance.

The regulatory environment has become less supportive of workforce development.

Compared with 2023 findings, executives now report declining confidence in government support for workforce development.

- **Almost half as many respondents** believe government policy gives them the flexibility to rapidly scale their workforce (33% vs 65%).
- **Only a third of executives** this year say government policy makes it easy to recruit talent from overseas, down from 67% in 2023.

These shifts seem linked to tightening immigration policies in several markets, including the US, UK, and parts of Europe where access to global talent was previously seen as a strength.

Gary Lye, Director of the UCL East Manufacturing Futures Lab, emphasizes the impact of more stringent immigration policies on recruitment to academic

programs aligned to careers in the life science sector. "Before Brexit, about 20% of our students used to come from continental Europe. Post Brexit, this has reduced to around 2%."

Talent retention is just as important as recruitment.

As specialized roles become more competitive, **retention has become a strategic priority.** Many of the experts we spoke with explained that their firm strives to make workers feel challenged and valued, offering employees:

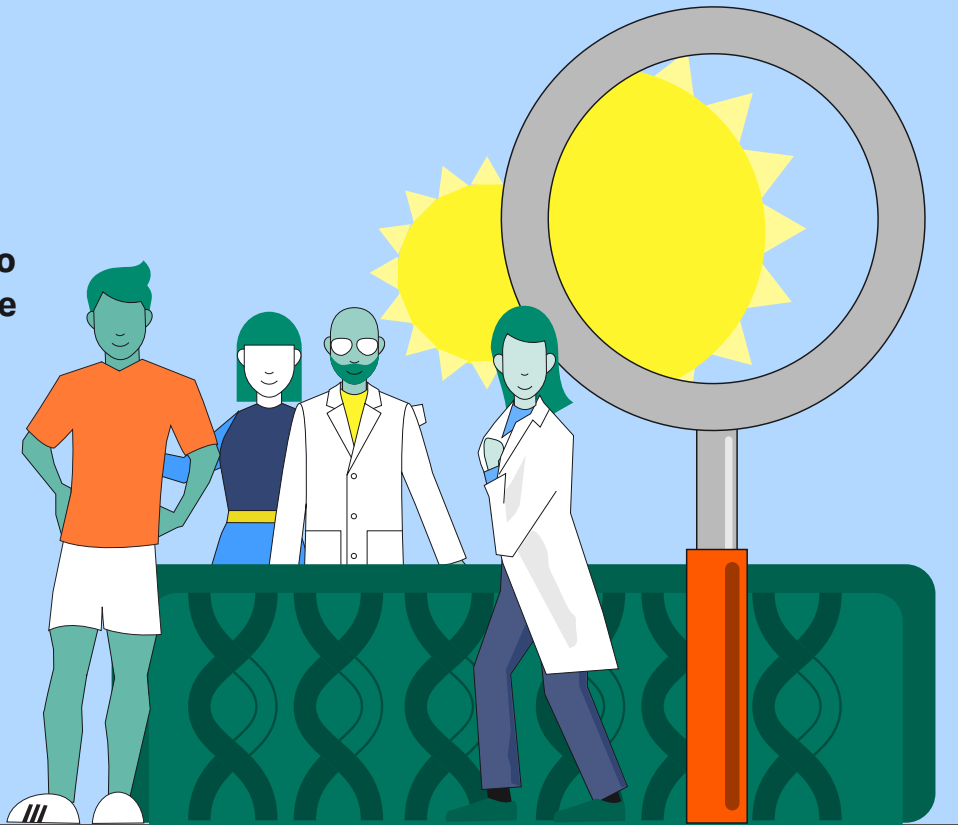
- Clear development pathways
- Cross-functional project experience
- Exposure to novel technologies
- Greater flexibility in work models

In an industry with a lot of shake ups, Angie Jiwon Chun, Chief Growth Officer at LOTTE BIOLOGICS, underscores the importance of retaining expertise during acquisitions and mergers. "When we acquired our antibody manufacturing site in Syracuse, NY from Bristol Myers Squibb, we retained 90% of the workforce. This preserved critical know-how and ensured operational continuity from the outset. In biomanufacturing, talent and flawless execution are inseparable—scale only becomes meaningful when powered by skilled people and trusted processes."

Organizations are turning to digital technologies to help nurture their retained talent. Biopharma respondents who report the greatest financial success were more likely than their less successful competitors to say that they're using digital technologies to train talent (68% vs 55%). These technologies may be enabling firms to upskill high-potential employees with industry-specific skills.

"There's a lot of talent out there. What people bring to the table is their brain plasticity; their ability to absorb information and use it in the context of a new therapy. Trying to find someone with 15 years of experience isolating and growing T cells? That's a unicorn."

- **Joanne T. Beck,**
COO of Elektrofi and
former CTO of Abata Therapeutics



Pillar 3

R&D ecosystem

R&D both drives and embraces innovation to build biopharma resilience.

The R&D ecosystem is the engine room of biopharma innovation and resilience, and our index shows that this industry pillar is growing strong.

Countries with higher scores on the R&D pillar—such as Switzerland, the US, and South Korea—tend to bring new therapies to market faster, attract more investment, and adapt more quickly to scientific advances. According to our most recent data, executives in these three countries are also more likely than those in other countries to:

- Have confidence that the domestic education system is providing the biopharma industry with a strong pipeline of PhD-qualified talent, GMP-qualified engineers, and talent with the skills they need to achieve digital and sustainability targets
- Rate their country's regulatory agency as "very good" on speed and openness to innovation, and agree that tax or trade policies actively encourage domestic biopharma R&D
- Say that their organization is integrating advanced digital technologies "very well" to drive innovation across a number of areas
- Report that their company has had highly successful collaborations with academic partners, national and regional government laboratories and think tanks, and contract manufacturing organizations

Collaboration can be a powerful tool for R&D performance.

Cooperation across the ecosystem—between companies, academia, government, and service providers—is a critical enabler of R&D strength. Unfortunately, collaboration remains underdeveloped in many markets.

In 2023, only 37% of executives said their country had a strong culture of collaboration across the biopharma ecosystem, and our 2025 interviews suggest this challenge persists. Now, nearly half say it remains difficult to find high-quality organizations to work with, such as:

- Contract research organizations (CROs)
- Contract development and manufacturing organizations (CDMOs)
- Academic research institutions
- Government labs and think tanks

"With monoclonal antibodies, it took 30 years to get where we are now," explains Joanne T. Beck, COO of Elektrofi and former CTO of Abata Therapeutics. "Industry and academia should collaborate to solve complex problems in order to make progress faster: this will benefit them and the patients."

Industry leaders emphasize that it's especially important for smaller or lower-scoring countries to focus on collaboration, as biopharma resources may be scarce and public investment more limited.

"External collaborations are critical for a small country like New Zealand," says John Robson, Managing Director, BioOra Limited. "We simply don't have an industry that supports like you see here in the US. It's really important for us to be able to collaborate with universities, suppliers, and manufacturers in different ways than the standard revenue type model. We need them to support early-stage therapy and early-stage research so that we can commercialize products as quickly as possible from a tiny little country in the South Pacific."

Even in larger, high-ranking markets, prioritizing collaboration over competition can open new doors given the speed and complexity of emerging science—and the data backs this idea up. Executives who reported their firm had exceeded targets for clinical trial success rates were more likely than those who are behind targets to report:

- Successful collaborations with industry partners, from government think tanks to contract manufacturing organizations (CMOs)
- Tax and trade policies in their country that encourage international collaboration (62% vs 49%)

Across many regions, our research suggests that **connected firms perform better than those who fail to collaborate**.

Digitalization is redefining how R&D happens.

The role of digital tools in R&D is expanding, as they're becoming more regularly integrated across the discovery pipeline. Firms are using advanced analytics and AI to automate tasks, identify targets, streamline trial design, and implement predictive modeling during process development. The deeper embrace of digital is enabling faster decision-making and shortened timelines.

But this year's data shows a widening gap: 69% of high-growth firms are using advanced technology to support drug discovery, compared with just 39% of underperformers. This finding suggests that digital maturity is no longer an experimental differentiator—it's a core driver of competitive advantage.

And there's plenty of opportunity for the biopharma industry to go even further in reaping the full benefits of digital.

"Companies are increasingly building data lakes, moving from paper-based systems to consolidated digital infrastructure. That's the foundation you need before advanced AI can deliver real value," explains Gary Lye, UCL East Manufacturing Futures Lab.

Percentage of executives who report their firms are doing well at integrating and making use of advanced digital technologies to discover drug targets

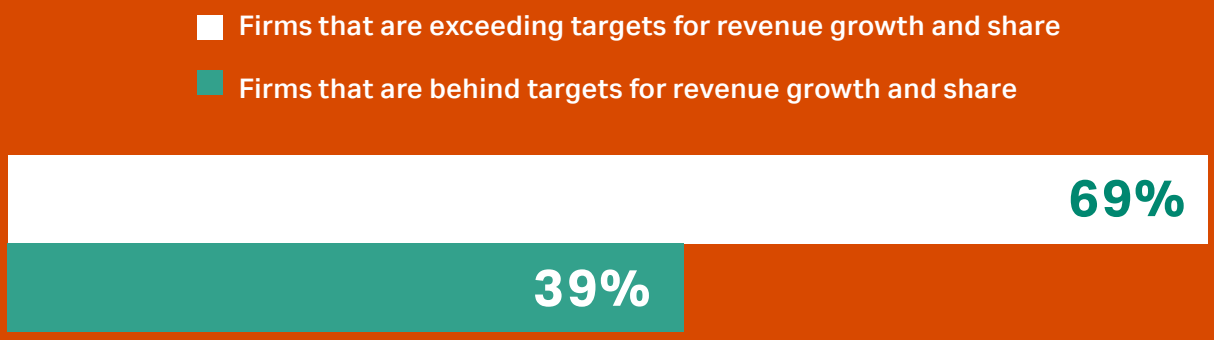


Fig 8. High-growth companies are using advanced digital technology to discover—and hit—targets.

Analytics and automation are key to scaling complexity.

As therapies become more personalized and complex, the need for real-time monitoring and data-rich analytics is growing fast.

"There's still so much to do on automation, including biosensors that can monitor in real time what's happening as cells are being produced," explains CCRM's May. "Then there's analytics and being able to characterize cell and gene therapy products, as they're living and changing all the time. Everyone talks about automating manufacturing, but we also have to automate analytics."

Firms that invest in real-time biosensors, predictive analytics, and digitally integrated trial platforms are building a sustainable innovation advantage—one that is likely to reduce development cost, increase speed, and improve decision-making.

Pillar 4

Manufacturing agility

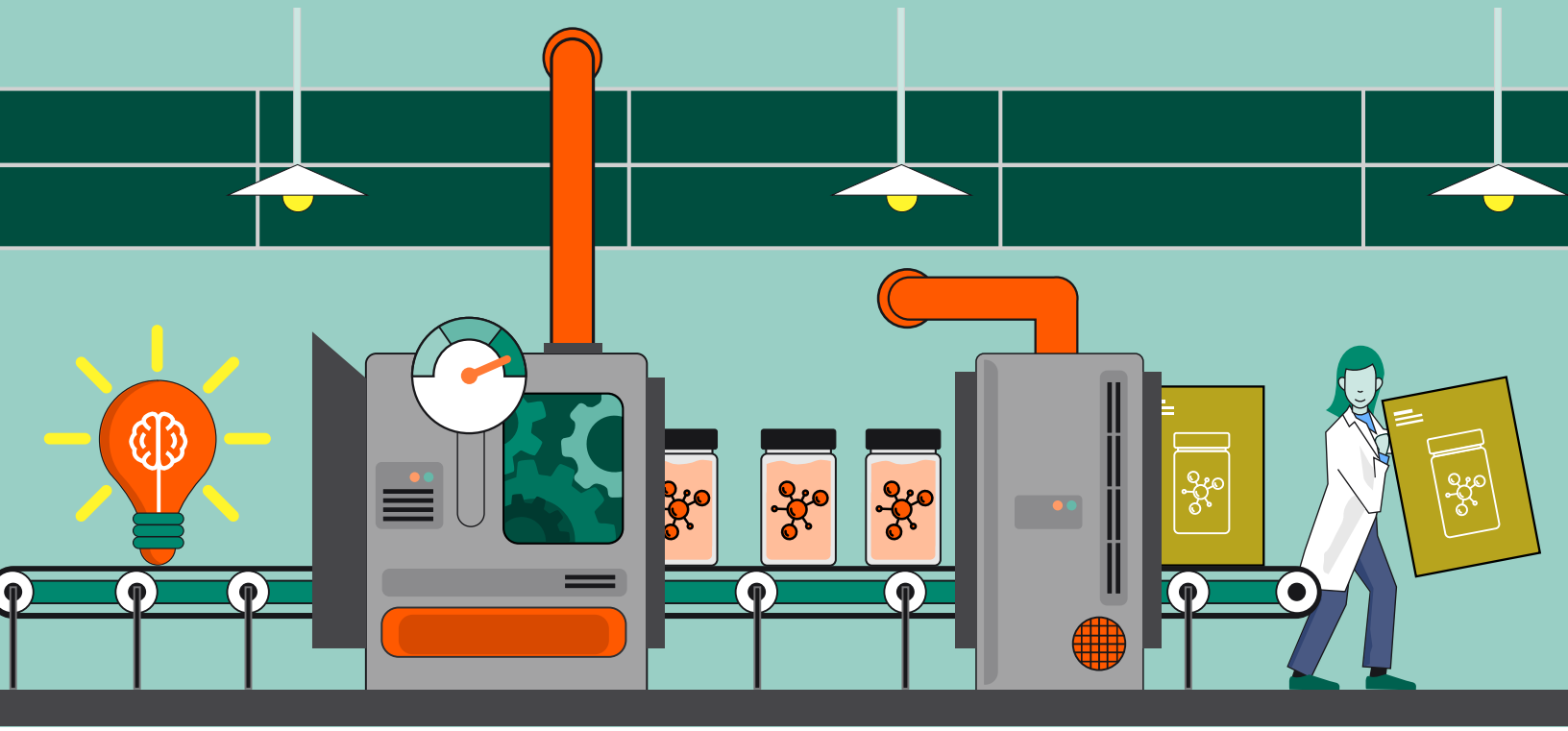
Capacity is expanding, but agility remains a challenge.

Whether for seasonal vaccines, new pandemic threats, or breakthrough personalized therapies, manufacturing agility is central to biopharma's ability to respond to demand. But, as in 2023, our 2025 data shows that **many firms lack the ability to scale production quickly**, particularly for novel treatments and certain critical, life-saving products.

Around **a third** say their organization would be slow or very slow to ramp up manufacturing of:

- **Hormone-based products**, such as insulin
- **mRNA vaccines**
- **Cell and gene therapies**

For newer modalities, the challenge is compounded by a lack of **standardization**. As Eloktrofi's Joanne T. Beck notes, "Many companies develop unique processes with different requirements. There's very little streamlining for CDMOs, and that can make scaling out cell and gene therapies difficult."



Biopharma manufacturing has shifted from cost-driven efforts to a focus on quality.

The pandemic underscored the need for responsive, high-quality manufacturing. In 2023, cost efficiency remained the top priority but, in 2025, we've seen a notable shift.

- **40% of executives** say that cost-cutting is compromising product quality.
- **36% of executives** now report that modifications to their manufacturing process are driven more by cost control than quality improvements, versus 47% in our previous index study.

This strategic reset is especially noteworthy in the biosimilar market, as well as with mid-tier and emerging-market players, who may have been more likely to focus exclusively on cost as a source of competitive advantage.

Percentage agreeing that modifications to manufacturing processes are driven more by cost control than quality improvements

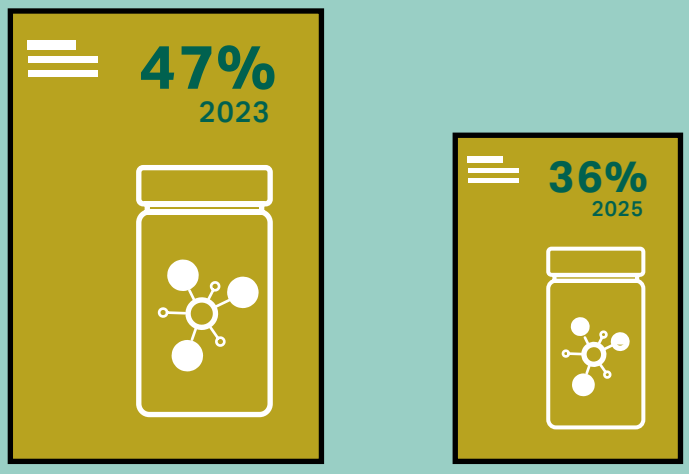


Fig 9. While cost still matters, quality is becoming a bigger area of focus in biopharma manufacturing.

CDMO collaborations are helping to fill the agility gap.

To strengthen their own manufacturing capabilities, many companies are turning to **trusted CDMOs**. In 2025:

- **57% of firms** say they have increased their use of CDMOs in the past year.
- Satisfaction with CDMOs is high, especially for **quality (72%), speed (70%), and availability (66%).**

BioPlan's Eric Langer explains that having a strong network of CDMOs is important for establishing a country or a region as a biomanufacturing hub. "Starting in the early 2010s, there has been a gradual increase in likelihood of outsourcing to the US, from a low of 15.1% in 2011. This was followed by a gradual increase in the recognition of the US as a key biomanufacturing hub. Potential reasons for this trend include advanced infrastructure, availability of bioprocess expertise, strong regulatory compliance, and the presence of numerous CMOs offering specialized services."

It's important to note that the trend towards outsourcing is not just about cost—it's also driven by a need to **improve resilience, speed, and regulatory readiness.** Countries that score well on manufacturing agility (e.g., Switzerland, South Korea, and Ireland) tend to have:

- Strong CDMO ecosystems
- Advanced biomanufacturing facilities
- Reliable regulatory environments that support fast tech transfer

"I think the two most important words for manufacturing companies now are flexibility and agility, so being agile to market needs for your product, maybe having to scale up or scale out," says John Milne, Director of Bioprocessing Training Alliances and Innovation, NIBRT. "But equally then, from a talent perspective, having people who are comfortable with that type of environment that can change."

Digital technology is gaining traction in production workflows.

Digital technologies provide clear advantages in biopharmaceutical manufacturing, from improved batch consistency and faster release timelines to reduced downtime and waste. Our data shows that high-growth organizations are more likely to be harnessing digital technologies across multiple manufacturing areas compared to underperformers.

"Automation and digital analytics will be central to scaling living therapies like CGTs," says Michael May of CCRM. "It's not just about how you make them, it's how you monitor and release them that matters."

Pillar 5

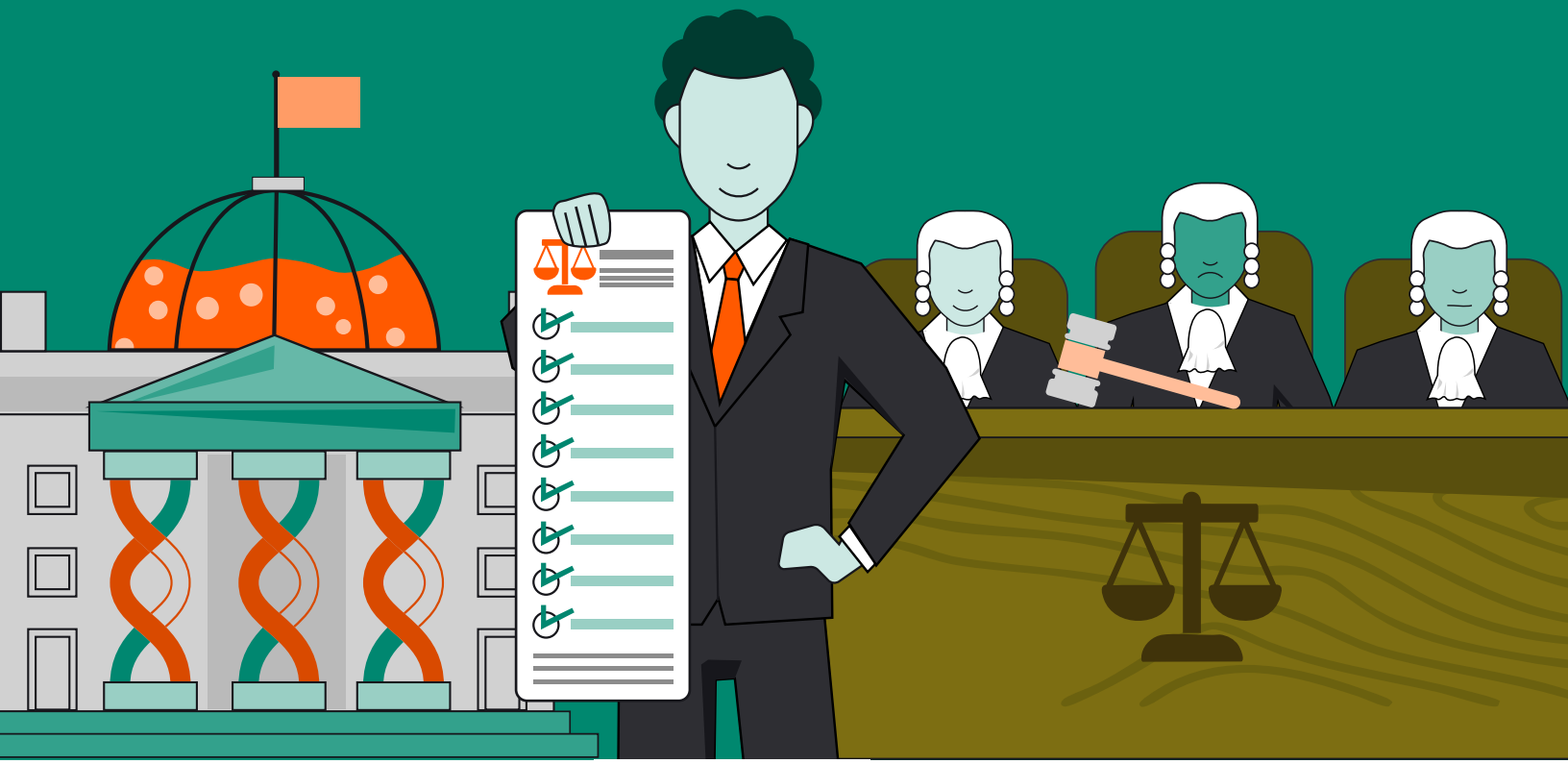
Government policy and regulation

Uncertainty and inconsistency are holding the industry back.

Effective policy and regulation are critical to biopharma performance. They set the rules of engagement for investment, innovation, and market access. In 2025, our data shows that **many executives are struggling with fragmented, unpredictable policy environments**, even in traditionally stable markets.

- **51% of executives** say government policy is inconsistent, up from 45% in 2023.
- **Half** say it's now harder to raise capital due to current market conditions (up from 42% in 2023).
- One quarter believe that policy and regulatory processes are not fit for purpose when it comes to **cell and gene therapies**.

These issues are not limited to emerging economies. Even in developed countries, changes in leadership, shifting political priorities, and reactive policymaking are disrupting long-term planning.



Johannes Fruehauf of LabCentral shares some additional insight. "The US remains one of the best places to practice science, but science requires consistency, in funding, in regulation, in support for talent. When those things change with every administration, it's very hard to make long-term plans."

Policy inconsistencies make strategic planning difficult.

In the wake of major global elections in 2024, biopharma leaders are facing a new wave of regulatory reviews, tax changes, and shifting trade rules. The result is a patchwork of policies—some encouraging, others contradictory. For example:

- Some governments promote domestic R&D but impose restrictive price controls.
- Other regions offer IP protection but delay regulatory harmonization.
- Several countries are investing in sustainability but failing to align this focus with manufacturing or trade policies.

The latest data reveals a clear link between the rise in tariffs and business uncertainty. Executives who believe tariffs are likely to increase (56%) in their country over the next 12 months are more likely to say that government policy in their country is inconsistent. Examples of inconsistencies include promoting R&D but maintaining pricing controls that limit reinvestment in R&D, or encouraging manufacturing while failing to protect intellectual property. These respondents are also more likely to agree that government policies on pricing control have negatively impacted their ability to achieve R&D targets (52% vs 45%).

This lack of coordination is making it harder for companies to allocate investment, manage timelines, and ensure compliance across jurisdictions.

"A lot of the regulations are based on monoclonal proteins, but for advanced therapies like lenti and AAV, we need to work closely with regulators and kind of teach them. With back-and-forth dialogue, we can streamline cell therapies."

- **Fabio Vasconcelos Fonseca**, Sr. Director, Bionova Scientific

Regulatory frameworks are struggling to keep pace with innovation.

Innovation is moving faster than regulations can keep up with, especially when it comes to emerging modalities. Many companies report frustration with legacy approval pathways that don't reflect the complexity or structure of cell and gene therapies, mRNA platforms, or platform-based delivery systems.

Elektrofi's Beck highlights the mismatch. "At the moment, we're applying things that work for more traditional drugs in the approval process to cell and gene therapies. We're trying to fit a square peg into a round hole."

The gap is even more pronounced in emerging markets where, compared with developed markets, executives are less satisfied with their regulators' capabilities across a range of measures.

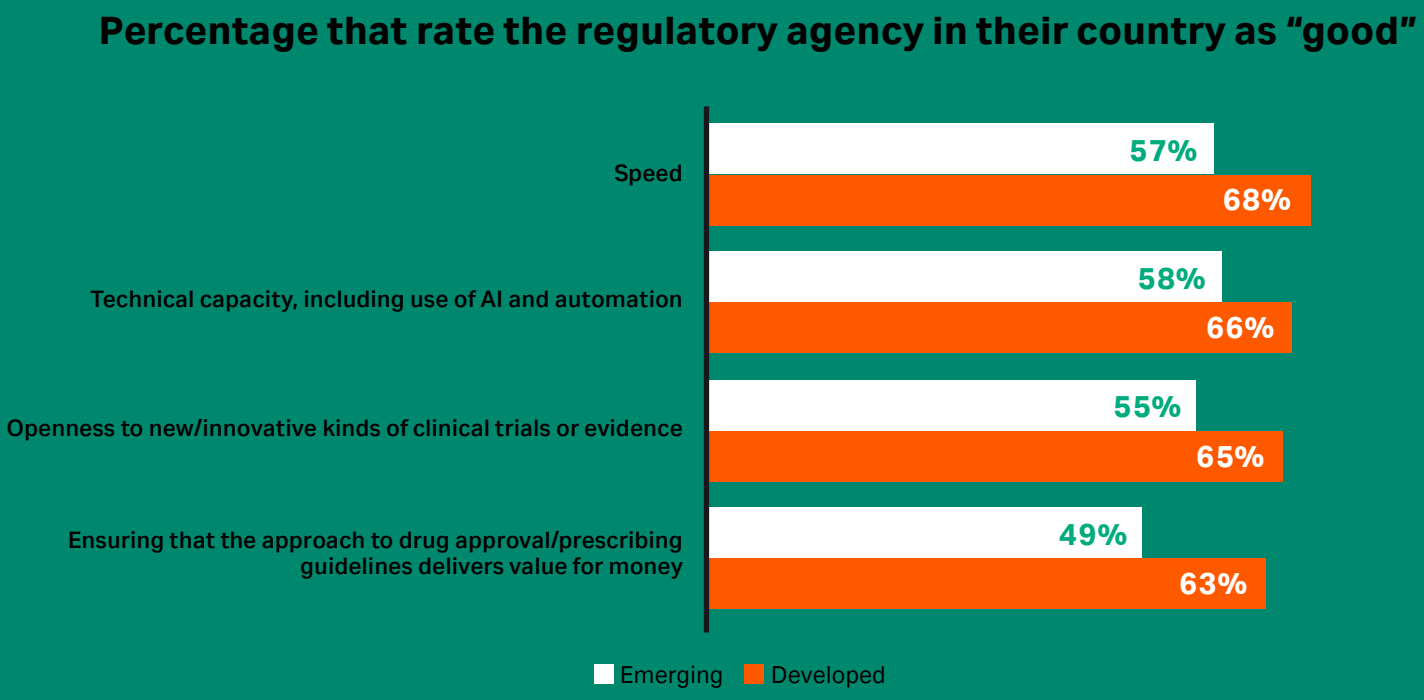


Fig 10. Companies in emerging markets report facing more regulatory challenges on the path to approval.

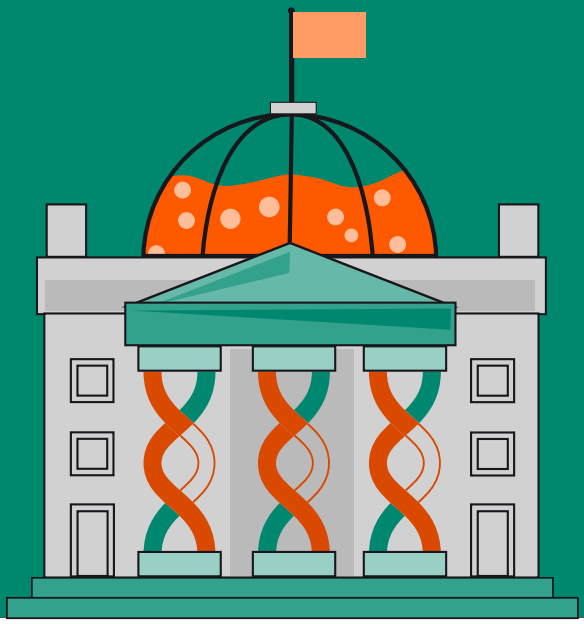
Signs of regulatory progress are present, but uneven.

Several countries have launched regulatory reform efforts aimed at streamlining clinical trial approval, accelerating access to therapeutics, and enabling better use of real-world evidence.

- In the UK, the Medicines and Healthcare products Regulatory Agency (MHRA) is implementing mutual recognition pathways with trusted international regulators (5).
- In the US, recent updates to Prescription Drug User Fee Act (PDUFA) and the FDA's Type D meetings aim to improve early-stage developer guidance (6).
- In the EU and the UK, regulatory sandboxes and harmonized clinical trials regulation (CTR) frameworks are gradually taking effect (7,8).

These global efforts show that steps are being taken to make regulatory processes more efficient in the face of fast-paced innovation. Still, our data suggests that smaller firms, in particular, perceive regulatory approval processes as a significant barrier. Companies with less than $50 million in annual revenues were less likely to rate the regulator as "good" across many areas, from technical capacity to value for money, compared with firms that report revenues of $5 billion or above.

"If governments came in earlier and helped academia and non-profits, the drugs that come out at the end could be significantly cheaper," says Leszek Lisowski, President, Gene2Cure Foundation. "The solution won't be one thing. It'll take a number of clever solutions."



Pillar 6

Sustainability

While pressure is growing for biopharma to prioritize sustainability, progress is slow.

As sustainability has become a strategic priority across industries, biopharma is struggling to truly embrace sustainable practices. The 2025 index reveals a troubling pattern: **while most companies agree that environmental responsibility is important, few are making fast progress**.

- Almost half of biopharma executives (43%) reported that their company is **failing to achieve its sustainability targets**.
- **Almost two-thirds (63%) say their company deprioritizes sustainability initiatives** due to short-term financial pressures and competing business priorities.
- **34% report talent shortages** in sustainability roles.
- Fewer than half believe there is enough **collaboration or policy support** to drive meaningful change.

If we start looking at larger indications, I think we're going to be in trouble, because there are wholly disposable process trains. It's not just plastic; there's chips and all kinds of things for sorting cells. There's going to be a problem, and so the sooner we start addressing this, the better."

Joanne T. Beck, COO of Elektrofi and former CTO of Abata Therapeutics

Competing priorities are holding sustainability initiatives back.

Despite growing regulatory pressure and rising public expectations, many companies still **struggle to balance sustainability with cost and supply chain resilience**. In 2025, **55% of executives** report that sustainability is an increasingly difficult challenge for domestic biopharma manufacturing.

What could be driving the deprioritization of sustainability efforts across biopharma? Share prices tend to respond more strongly to near-term earnings performance (9), whereas the benefits of sustainability tend to be realized over the long term. In fact, executives who say their firm is lagging behind sustainability targets are also more likely to report pressure on profit margins and economic downturns as critical concerns.

But a short-term approach overlooks the long-term business advantages of becoming more sustainable. Executives who said their firms were ahead of their sustainability performance targets were more likely to report that they are also ahead of their revenue targets (40% vs 6%) and exceeding time-to-market targets for new therapies (43% vs 6%).

Our data also revealed that barriers to embracing sustainability are especially apparent in emerging markets, where cost and capacity pressures are higher and environmental regulations may be less consistent.

- **Only 54% of executives in emerging markets** believe that biopharma sustainability standards in their country are aligned with international guidelines, versus 61% in developed markets.
- **Only 43% say there are adequate incentives** (e.g., tax benefits, grants) to encourage biopharma companies to adopt sustainable practices, versus 53% in developed markets.

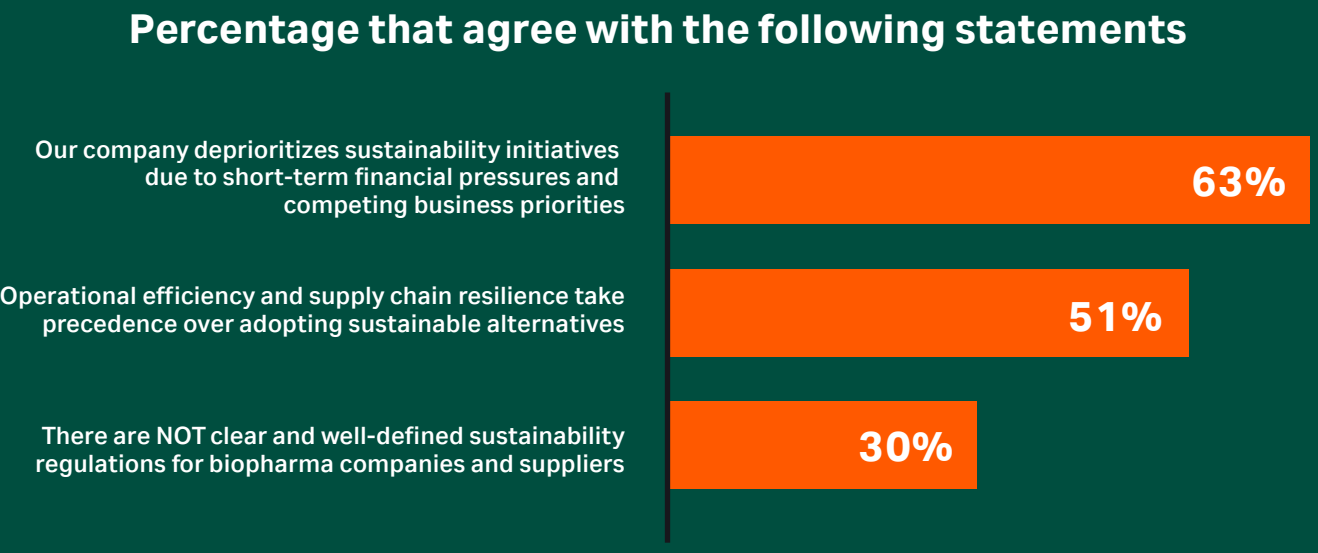


Fig 11. Despite industry buzz, companies are deprioritizing sustainability in favor of other business goals.

Digital tools help accelerate sustainability.

Firms that are ahead on sustainability are more likely to be using **technology to improve the environmental profile of their products and processes. 56% of firms that are ahead on sustainability targets** are using digital tools for this purpose, versus only 46% of firms that are behind target and doing the same. These tools could include:

- Data analytics to monitor energy use and emissions
- AI to optimize supply chain routes and packaging decisions
- Automation to reduce waste in manufacturing and testing

Culture and leadership matter to sustainability success.

Structural changes are essential to driving sustainability progress, but leadership is equally important. Experts we interviewed noted the rise of a new generation of founders, investors, and executives who see sustainability as more than a compliance issue, and a true marker of long-term value. There's further evidence to back this perspective, as firms that perform highly on environmental, social, and governance (ESG) ratings also tend to demonstrate greater financial stability and higher profitability (10).

"Many of the next-gen venture capital firms and CEOs really care about the environment," says LabCentral's Johannes Fruehauf. "So rather than needing regulation to force their hand, they're designing for sustainability from the beginning."

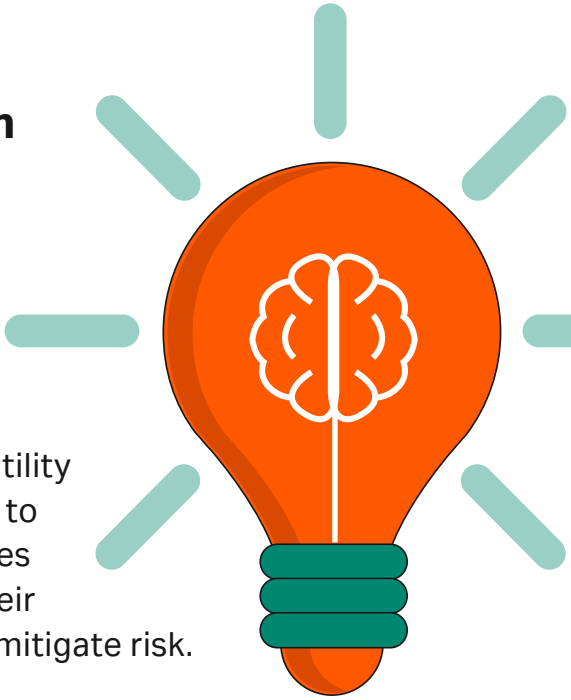
This shift in mindset could be the tipping point. But for now, most companies remain at the start of their sustainability journey.

> **I call it 'closed loop' manufacturing. You have to take into account many different aspects and make it sustainable. Integrating the latest technology, such as AI and automation, help us to achieve this."**
>
> - **Wei Huang**, President, Henlius

Recommendations

5 ways to futureproof biopharma

1. Strengthen supply chain resilience through visibility, redundancy, and diversification.



Insight:

The increasing threat of tariffs, trade restrictions, and political uncertainty is altering the industry landscape and jeopardizing supply chain security. With 76% of firms citing geopolitical volatility as having a major influence on supply chain strategy, the ability to rapidly pivot sourcing and manufacturing is essential. Companies know this and are taking action, as 61% of executives told us their organization is planning onshoring over the next 12 months to mitigate risk.

Businesses are also investing in digital technology to boost supply chain resilience. More than half of executives (56%) said their company is engaged in extensive digitalization to improve supply chain speed, resilience, and security, compared with 45% in 2023. Interestingly, executives who said they were ahead of their targets for manufacturing and supply chain efficiency were more likely to report digitalization efforts.

Actions:

Map end-to-end supply chain risk
Complete multi-tier visibility and risk mapping across active ingredients, excipients, and consumables to identify single points of failure and time-to-recover.

Diversify your supply
Use nearshoring, in-region for-region, and dual-sourcing strategies with trusted suppliers to balance cost, add flexibility, and build redundancy in supply chains.

Build a robust plan
Create playbooks that mitigate regulatory uncertainties, capitalize on policy shifts (e.g., incentives for onshoring), and enable rapid sourcing moves between sites and/or regions.

Automate supply chains
Invest in automation and predictive logistics to optimize supply chains, drive sustainability, and better manage and prepare for demand and disruptions. These capabilities can also help drive toward a future of connected enterprise resource planning systems between suppliers and biopharma companies, so inventory management is optimized on both sides.

Track the right KPIs
Measure on time in full (OTIF), lead-time variability, supplier risk score, and the proportion of dual-sourced stock keeping units (SKUs) to ensure supply chains are operating efficiently.

Learning from leaders
AbbVie is safeguarding its ability to deliver critical drugs to patients by focusing on its supply chains (11). The company has created a network of sites across diverse geographies, implemented an inventory strategy, and is using real-time monitoring to mitigate risk, stay ahead of demand, and remain resilient in the face of unexpected challenges.

2. Build a talent pipeline through strategic recruitment, upskilling, and retention.

Insight:

Despite small gains reflected in our most recent data, talent challenges continue to threaten progress in the biopharma industry. 38% of executives report a severe shortage of specialized talent, especially for newer, more complex modalities such as cell and gene therapies, mRNA, and antibody-drug conjugates (ADCs).

With limited human resources for the next generation of therapeutics, companies would benefit from casting a wide, global net to find those with the skills they need—yet only one-third of executives surveyed feel government policy supports workforce scaling or overseas recruitment.

The industry should act to address these challenges, as our data shows talent is a key differentiator across biopharma: respondents from high-growth firms are more than twice

as likely than low-growth firms to report that they are ahead of talent acquisition and retention targets (81% vs 34%).

Actions:

Go where the resources are
If you're in a position to build capacity and need a workforce to help make it happen, look to regions with central hubs that offer a deep pool of biopharma talent. These areas like Ireland, Singapore, and areas of the US like Boston and San Francisco are bolstered by government support and incentives for corporate development and talent building.

Build a capability hub
Cross-industry, government, and/or academic collaborations can help align skills to unmet needs in regions where talent or infrastructure is lacking. Gary Lye of UCL explains,' "Universities can't do this on their own, and industry can't do this on their own. You've got to have the partnership to make sure the training is relevant and that it gets delivered at scale." As an example, University College London (UCL) and Cytiva have come together to create the Centre of Excellence supporting training in real-time monitoring, LNPs, and cell-free synthesis (12).

Retain your talent
Create development pathways, flexibility, and cross-skilling opportunities to keep an evolving and satisfied workforce. Putting extra care toward retention can be especially valuable during organizational changes to ensure operational continuity.

Focus on upskilling
Organizations across biopharma should focus on advancing the skills of the resources they have, especially in areas like digital, automation, and advanced bioprocessing. The pharma sector spent $4.2 billion on upskilling in 2022 and 2023, and more than half of employees say these efforts improved productivity (13). Also consider leveraging AI to help retain institutional knowledge. The Centre for Cell, Gene and Tissue Therapeutics at the Royal Free Hospital is piloting AI-generated GMP training (videos/ podcasts) to improve onboarding and comprehension.

Learning from leaders
In a tough talent market, Joanne T. Beck, COO of Elektrofi and former CTO of Abata Therapeutics, emphasizes that "plasticity" and adaptability matter more than deep specialization in unicorn skills. If you can't find someone with the expertise you need, find someone with the potential to develop that expertise, and provide the training to help them get there.

3. Tap digital tools to further accelerate biopharma innovation.

Insight:

Biopharma is in the midst of an innovation boom, but almost 40% of firms still report that they're missing targets around pipeline strength and innovation. Interestingly, our data found a link between those who are ahead of their targets and companies that are leaning into digital technology across the ecosystem. So, is digital the secret helping the industry push past its recent performance decline?

Digital solutions are broadly influencing the biopharma industry and have the potential to drive progress even further—and faster—at every stage. For R&D, they allow researchers to develop a deeper understanding of cell biology and disease pathways, helping to identify and develop new drug targets and treatment strategies quickly. Downstream, AI, automation, real-time monitoring, in silico process development, and electronic batch records are optimizing biopharma manufacturing. These tools are leading to more effective quality assurance, analytics, regulatory review, and process control to speed up scaling, streamline production, and reduce the risk of batch failures—all of which help to deliver critical medications to patients more efficiently.

Actions:

Validate new technologies with efficiency
When implementing digital solutions, use a validation strategy that is minimally disruptive to your workflows but still with the highest quality in mind. Qualify use cases to ensure functionality and then scale applications more broadly to avoid extensive downtime or delays.

Use a pilot-to-scale approach
Implement digital early and carry it through from discovery to development and manufacturing. Having these technologies as part of your growing process allows for quicker scaling and faster speed to market.

Standardize data pipelines
Digital solutions deliver large amounts of information, which can be overwhelming to manage. Start by collecting and organizing data to build a solid foundation for AI and machine learning technologies to be deployed in the future. Then, create common digital data models and interfaces across your systems, instruments, and network so process knowledge flows seamlessly.

Learning from leaders

The semiconductor industry offers a compelling vision for biopharma's future. Faced with high complexity and risk, it has embraced AI, automation, and digital twins to streamline design, optimize manufacturing, and reduce defects. Many semiconductor fabrication facilities now operate under a "lights-out" model—fully automated, self-monitoring facilities that run 24/7 with minimal human intervention.

A notable example is the collaboration between SAP, IBM, and PDF Solutions, which created an integrated AI-powered platform that enables real-time monitoring, predictive maintenance, and cognitive guidance for workers (14). This has led to improved quality, reduced downtime, and faster decision-making across global supply chains.

For biopharma, adopting similar digital-first strategies—from discovery through manufacturing—could unlock faster development cycles, more resilient operations, and more reliable delivery of therapies to patients.

4. Embed sustainability as a strategic pillar, not an afterthought.

Insight:

The biopharma industry is slipping on sustainability. With the capability available to dedicate toward sustainable practices, why are we falling short?

The talent crunch spills into sustainability progress, with 34% of firms reporting talent shortages in supporting this particular area. 63% of firms are also deprioritizing sustainability in favor of cost and operational resilience, a pivot likely due to a focus on short-term financial gains in a volatile economic climate. However, executives who told us their firm is ahead of its sustainability targets are also significantly more likely to report that they are ahead of all other business targets, from clinical trial success rates to talent acquisition and retention.

These findings should give the biopharma industry good reason to find the resources needed to refocus and restore its sustainability efforts, which are good for business and the planet. Those who stay on top of their sustainability game are set to be in a winning position for both performance and reputation.

Actions:

Digitize your environmental footprint
Use digital analytics, automation, and AI to measure energy usage, reduce waste and packaging, and verify suppliers' sustainability performance.

Prioritize sustainability from the top
Launch leadership-driven programs with allocated budget, milestones, and targets to facilitate organization-wide initiatives.

Wire sustainable measures into performance
Put sustainability metrics into talent, resilience, and commercial KPIs to align day-to-day choices with long-term environmental goals.

Mobilize your network
Extend sustainability standards and targets to partners and CDMOs via clear disclosure of requirements, agreements, and collaborative frameworks.

Learning from leaders
Real change is possible, as can be seen by the actions taken by key industry players. For example, AstraZeneca Ambition Zero Carbon achieved a 68% emissions reduction via biomethane transition and renewable energy (15). Additionally, Novo Nordisk embeds circular-economy practices (e.g., low-waste device design) and requires suppliers to meet minimum environmental standards, such as emissions disclosure, collaboration on greener practices, and clear decarbonization initiatives (16).

5. Engage actively with trade associations and regulatory bodies to shape policy clarity.

Insight:

More than one in 10 respondents rate the national regulatory agency in their country as "poor" across key areas such as speed, technical capacity, or openness to innovation. The industry also feels that governments are failing to support policies in favor of sustainability efforts, with around half of those surveyed saying that sufficient guidance for the biopharma industry to transition towards a more circular economy is lacking.

Coordinated, evidence-led engagement is needed to help close these gaps, with all players

aligning on platform technology designations and piloting regulatory innovation that reduces uncertainty along the development pathway.

Actions:

Speak to regulators with one voice
Join trusted industry groups to consolidate and strengthen biopharma's regulatory position and provide clear, data-driven insights to policymakers. Host and coordinate workshops and targeted training for agencies in novel, innovative areas to accelerate regulator learning curves.

Promote transparency
If intellectual property considerations allow, share evidence, case studies, and data broadly so other industry players don't have to rechart the regulatory roadmap and agencies can calibrate rules to real-world impacts.

Embrace regulatory precedent and innovation
Where available, use designated platform technology, prior reviews, expedited review programs, and agency meetings to derisk new modalities and shorten time to decision and approval. When possible, work with regulators to pilot new pathways.

Rise to the highest standards
When navigating a disjointed global regulatory landscape, it can be challenging to find the best path forward for doing business in different areas of the world. Consider rising to meet the standards of the most stringent agencies, such as the US, EU, and China. As the biopharma industry continues to evolve, the region with the most robust, effective regulatory requirements will lead the rest.

Learning from leaders
"Baby KJ" stands as a powerful example of cross-industry collaboration and early regulatory engagement accelerating innovation in healthcare (17). Danaher operating companies—including IDT and Aldevron—joined forces with the University of Pennsylvania, Children's Hospital of Philadelphia (CHOP), Acuitas, and the FDA to pioneer the world's first personalized CRISPR-based therapy. By leveraging existing regulatory frameworks and engaging stakeholders early, the team streamlined development and reduced uncertainty in the regulatory pathway. This coordinated, multi-stakeholder approach enabled faster planning, de-risked clinical translation, and ultimately delivered a bespoke gene-edited therapy to a critically ill infant—demonstrating how shared data, aligned incentives, and regulatory openness can drive transformative outcomes in precision medicine.

Building a brighter future for biopharma

Where biopharma goes next is a choice, and the potential is huge. The science is advancing at an unprecedented rate, but performance will only follow if we strengthen the ecosystem that turns discovery into impact.

This year's *Global Biopharma Index* shows the industry what matters most: countries that balance investment across the six pillars—supply chain, talent, R&D, manufacturing agility, policy and regulation, and sustainability—host a higher number of high-growth firms.

For decision makers, the necessary actions are clear:

- Design resilient networks. Build optionality into sourcing and technology transfer, and digitize supply chains for best forecasting and end-to-end visibility.
- Recruit for potential, look to upskilling existing resources, and proactively work to retain the knowledge you create.
- From R&D to commercialization, make digital the default. Standardize data flows across networks and systems, and automate for reduced batch failures and increased efficiency.
- Engage the rule-makers. Share insights to shape regulatory guidance and pilot new approval pathways with regulators.
- Make sustainability "business as usual." Use analytics to cut waste and energy and hit environmental targets, and demand the same from vendors and suppliers in your network.

No single organization can enact change alone. The fastest progress comes when governments, academia, biopharma innovators, and CDMOs work together to align incentives, share data, and scale what works across the industry. The index can be treated as a compass: use your country's scores to focus investment, pick collaborators that close your biggest gaps, and track improvement year over year.

If biopharma commits to building stronger ecosystems as rigorously as it builds pipelines, we can shorten time-to-therapy, increase success rates, and expand access to lifesaving therapeutics, while growing the industry sustainably. The leaders who act on these findings now will define the future of biopharma.

Let's get moving.

cytiva

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