

NOVEMBER 2025



The Next Era of Chemicals Innovation

2025 Update

Declining and stagnant growth



Geopolitical uncertainties



Shifting market dynamics



The chemicals industry has faced numerous downcycles in the past

1970s – Oil crisis resulted in high feedstock and energy costs

1990s – Asian financial crisis impacted global supply chains

2008 – Global financial crisis impacted everyone

2020 – COVID led to plummeting demand

2023 to today – A little bit of everything

The collage features four news snippets:

- swissinfo.ch**: "Clariant slashes hundreds of jobs in Switzerland". The Clariant specialty chemicals group announced a loss for 2009 on Tuesday and said it would cut 500 jobs, 400 of them in Switzerland. February 16, 2010 - 10:32. 1 minute.
- BioSpace**: "DuPont Lays Off 200 Researchers as Two R&D Divisions Get Guttled". January 7, 2016 | 3 min read.
- c&en**: "Pinching Pennies". Chemical firms plan a 25.1% capital spending cut and a 1.8% drop in R&D spending in 2009. by Marc S. Reisch. February 16, 2009 • 9 min read. A version of this story appeared in Volume 87, Issue 7.
- Plastics News**: "Lanxess cuts 1,000 jobs in new restructuring". EUROPEAN PLASTICS NEWS. September 24, 2013 02:00 AM.

“ ”

The chemicals industry didn't build itself on quarterly thinking — it was built on patient capital and long-term R&D investments.

Traci Purdum, Editor-in-Chief
Chemical Processing Magazine





Innovation is the most reliable
driver **for long-term resilience.**

Agenda

01 | Shifting innovation priorities in uncertain times

02 | Looking beyond technology to unlock innovation success

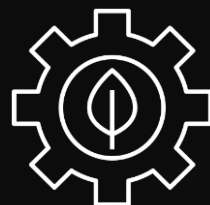
03 | Enabling the next era of innovation-fueled growth

Chemicals innovation priorities



Defossilization of Raw Materials

Transform existing value chains through the integration of new sources of carbon to continuously meet product demand.



Decarbonization of Operations

Propel operations toward zero-emissions and zero-waste with innovative technologies and processes.



Future Materials

Accelerate the design, development, and deployment of future materials to enable new technologies and applications.



Uncovering New Market Opportunities

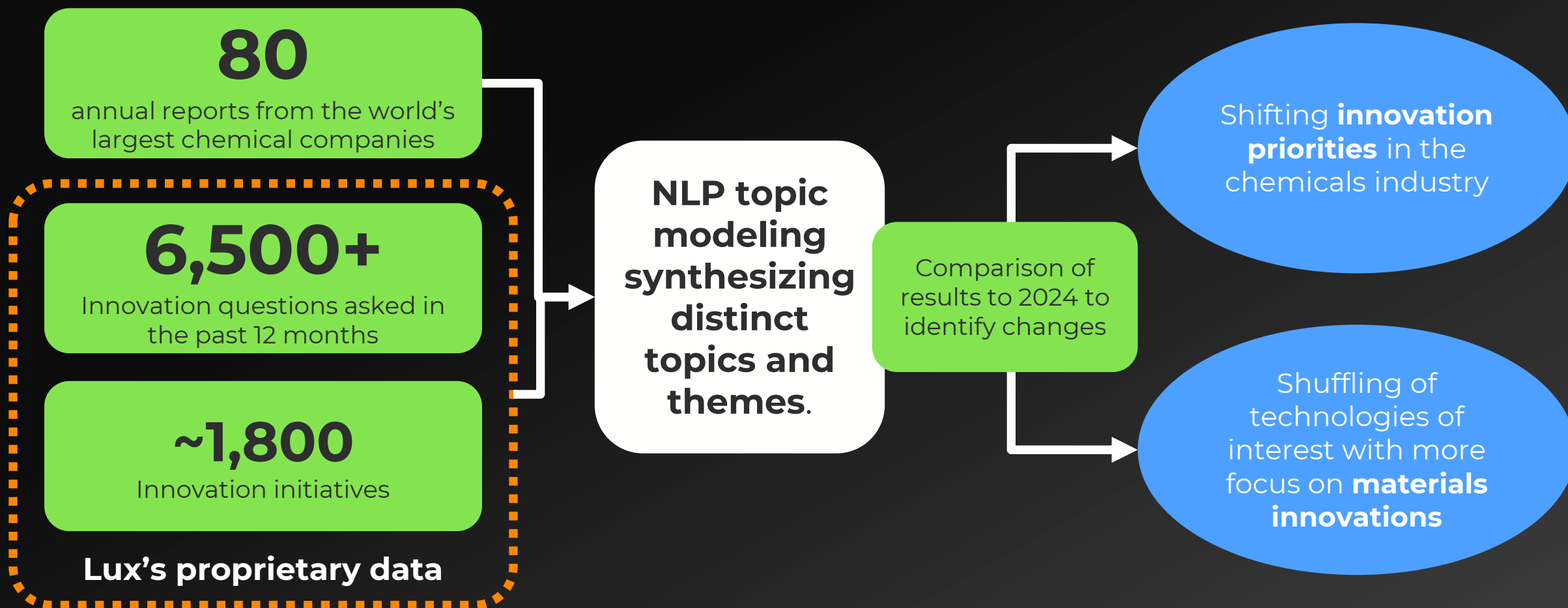
Discover and capitalize on the unmet materials needs of technologies and solutions on the rise.



Harmless Chemicals

Design products minimizing health and environmental impacts while aligning to human-centric needs.

Looking back at the last 12 months



2024: Year of decarbonization

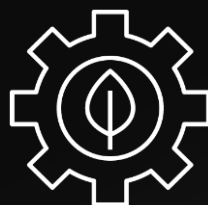
77%



Defossilization of Raw Materials

Transform existing value chains through the integration of new sources of carbon to continuously meet product demand.

93%



Decarbonization of Operations

Propel operations toward zero-emissions and zero-waste with innovative technologies and processes.

40%



Future Materials

Accelerate the design, development, and deployment of future materials to enable new technologies and applications.

53%



Uncovering New Market Opportunities

Discover and capitalize on the unmet materials needs of technologies and solutions on the rise.

74%



Harmless Chemicals

Design products minimizing health and environmental impacts while aligning to human-centric needs.

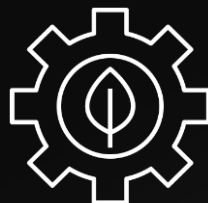
2025: Sharpened focus on materials science

77%



Defossilization of Raw Materials

93%



Decarbonization of Operations

40%



Future Materials

53%



Uncovering New Market Opportunities

74%



Harmless Chemicals

59%

75%

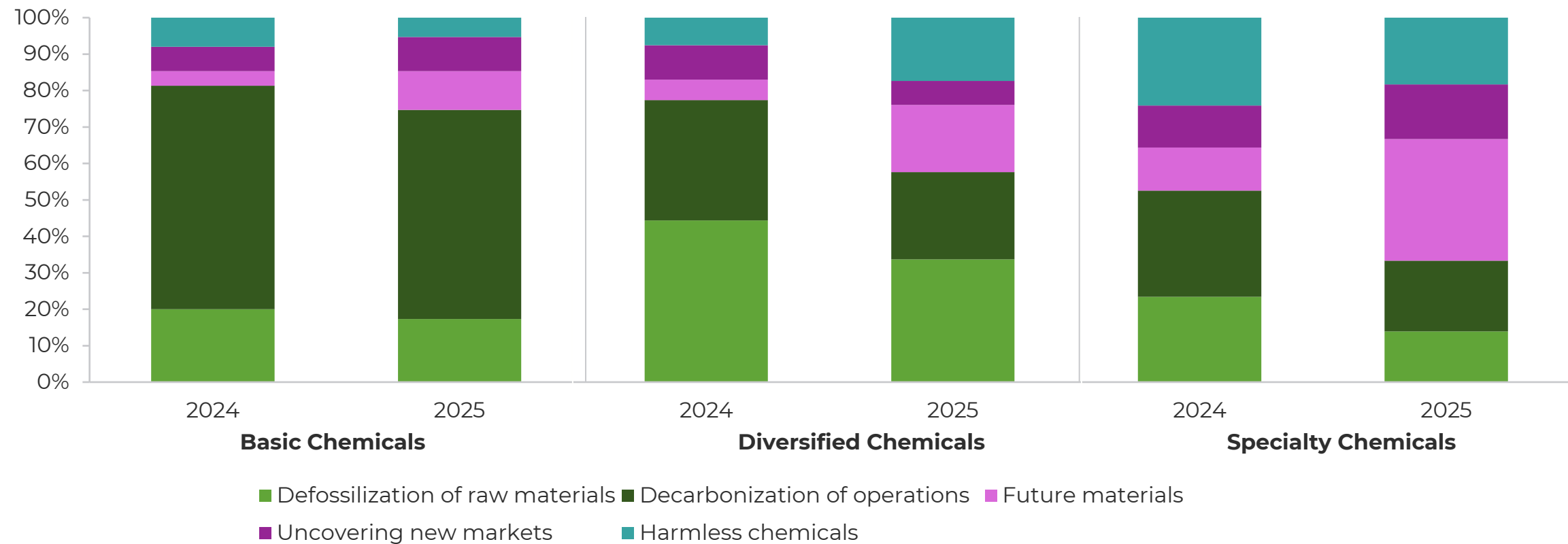
73%

52%

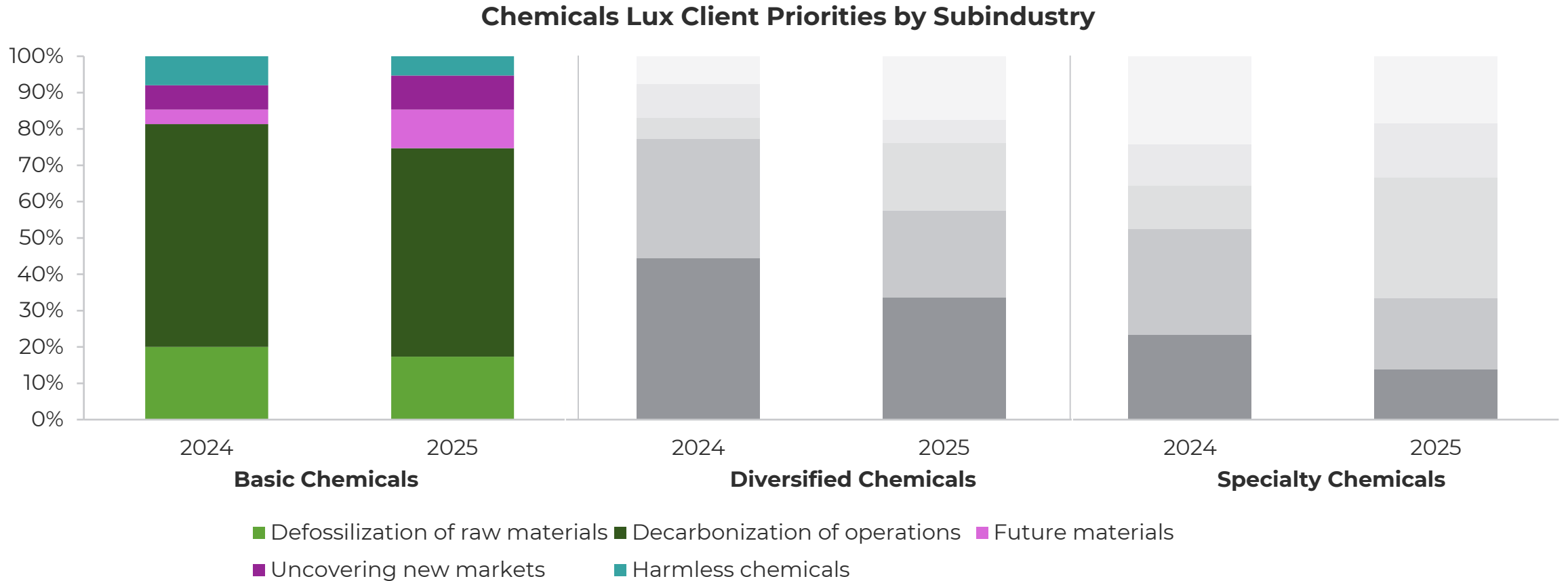
66%

Distinct priorities across subindustries

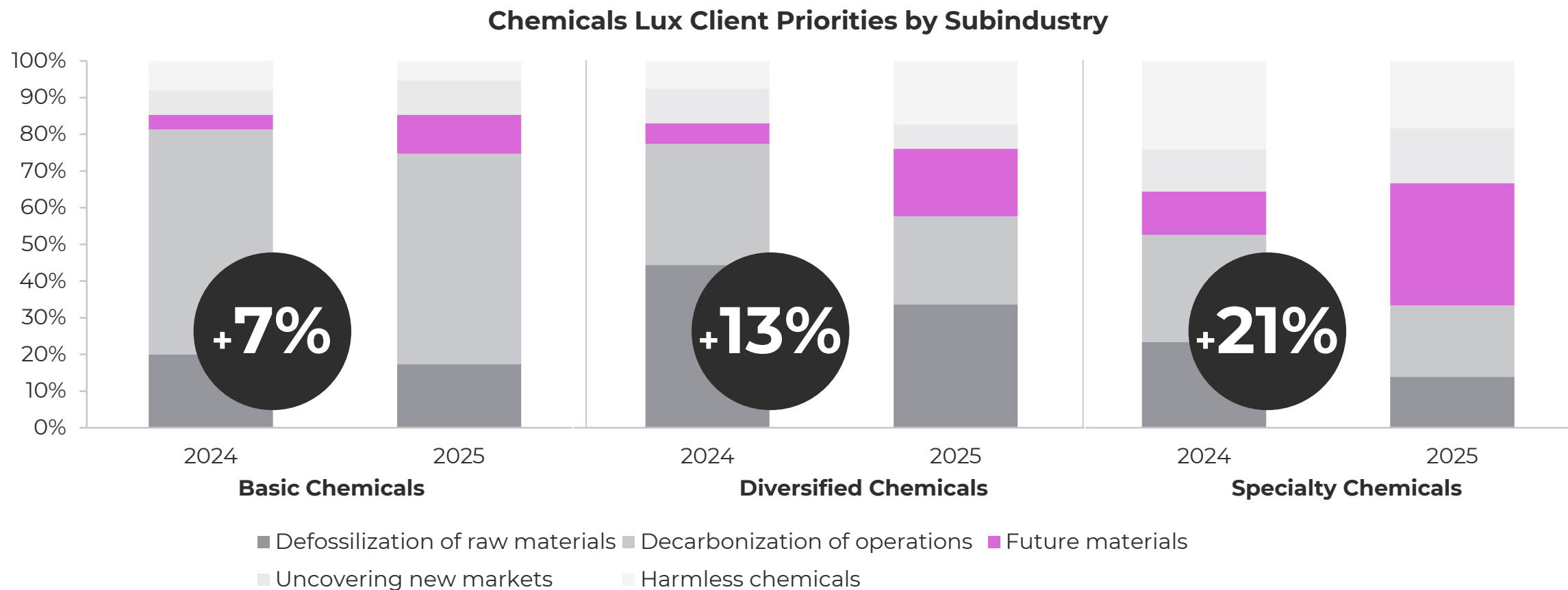
Chemicals Lux Client Priorities by Subindustry



Defossilization and decarbonization remains foundational for basic chemicals

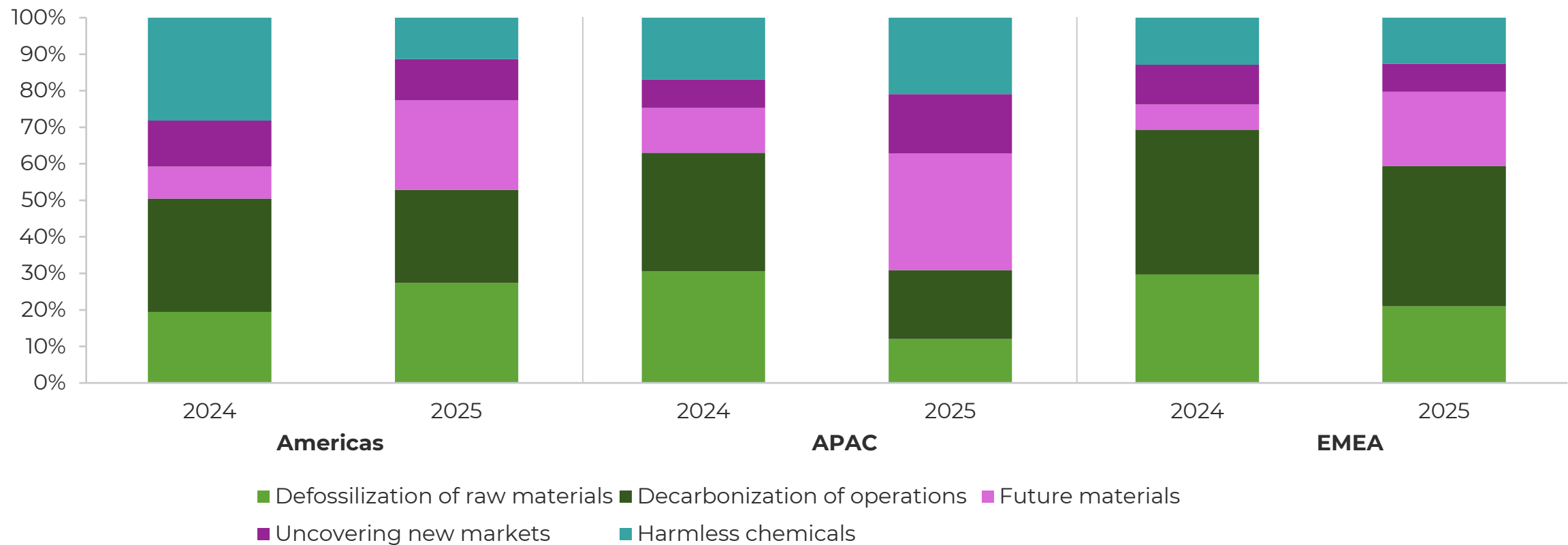


Future materials have increased across all subindustries

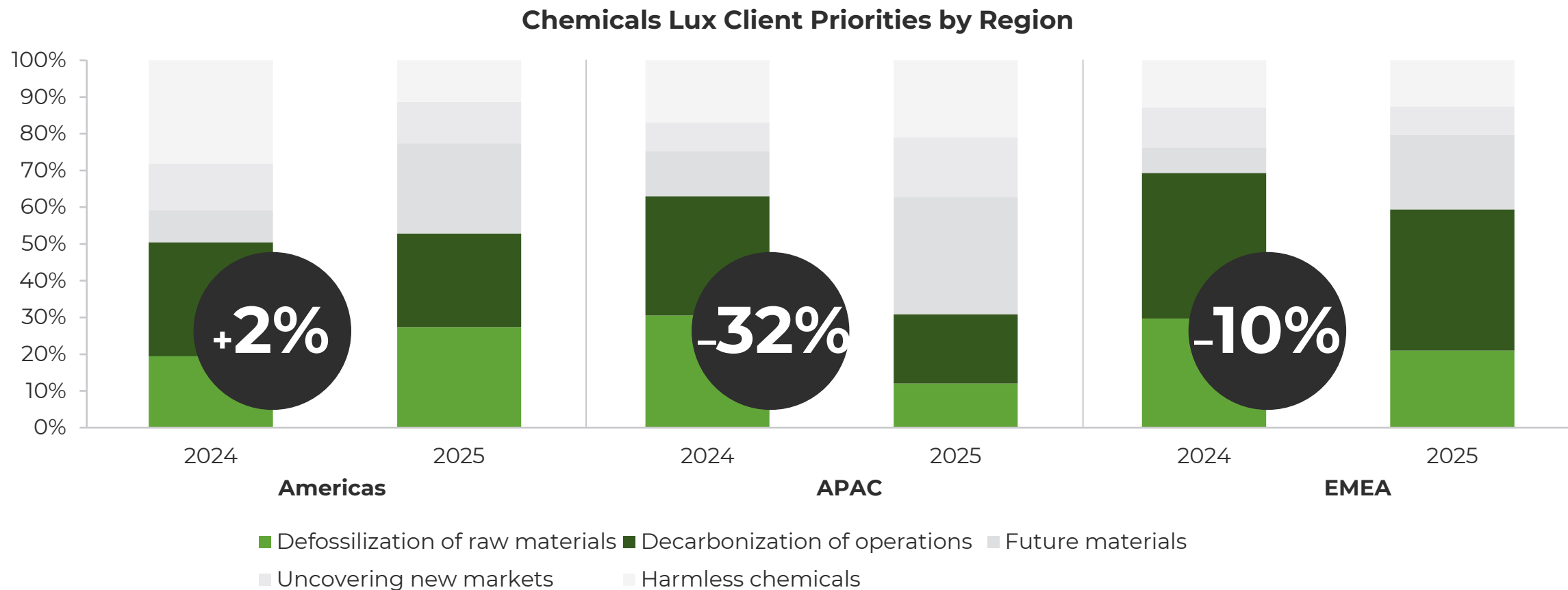


Regional variations become more defined

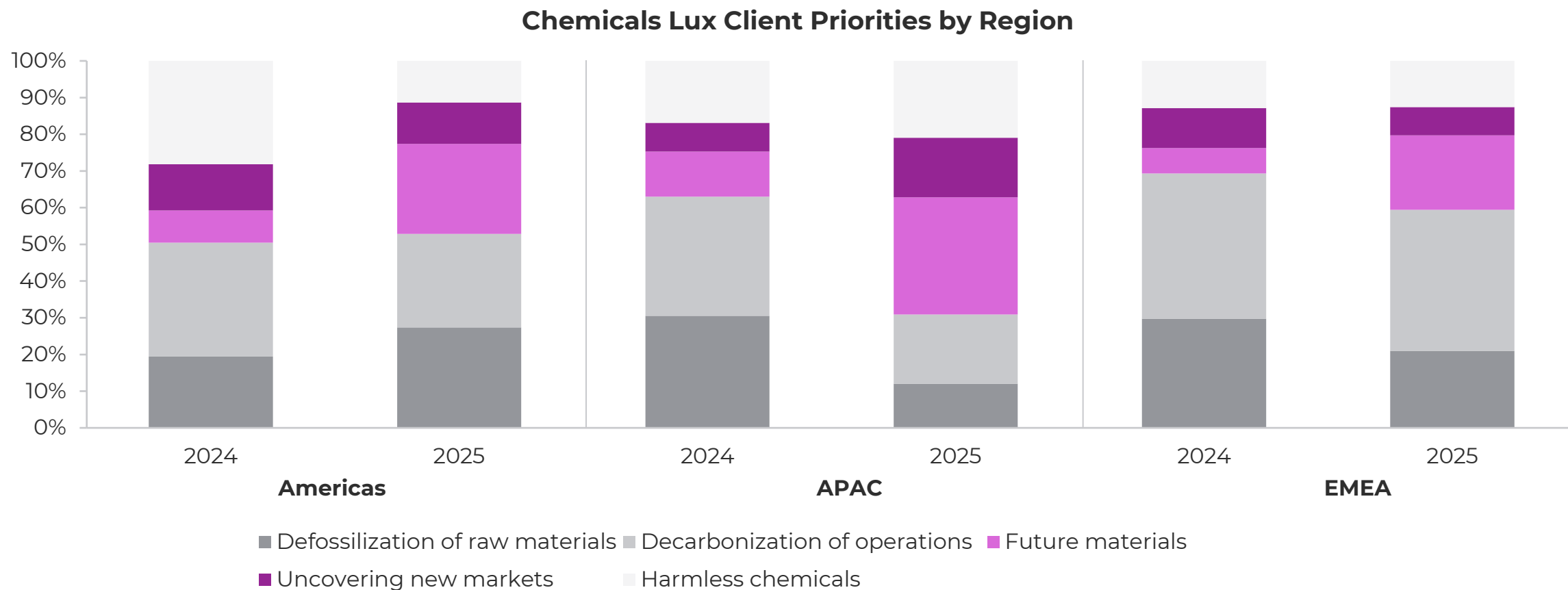
Chemicals Lux Client Priorities by Region



Defossilization and decarbonization are entering different phases regionally



Future materials increase while new market opportunities are largely stagnant



Technologies of strategic interest span a wide range of competencies

TECHNOLOGY TOPIC	BASIC CHEMICALS	DIVERSIFIED CHEMICALS	SPECIALTY CHEMICALS
Advanced Plastic Recycling			
Biobased Chemicals			
CO ₂ Utilization			
Advanced Coatings			
Advanced Composites			
Novel Electronic Materials			
Photonic Materials			
Thermal Management Materials			
Consumer Packaging Materials			
Synthetic Biology			
Advanced Membranes			
Industrial Wastewater Management			
Structural Performance Materials			
Materials Informatics			

“Future of carbon” technologies remain foundational to chemicals companies

TECHNOLOGY TOPIC	BASIC CHEMICALS	DIVERSIFIED CHEMICALS	SPECIALTY CHEMICALS
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Synthetic Biology			
Advanced Membranes			
Industrial Wastewater Management			
Structural Performance Materials			
Materials Informatics			

Novel and advanced materials emerge to hold prominent positions

TECHNOLOGY TOPIC	BASIC CHEMICALS	DIVERSIFIED CHEMICALS	SPECIALTY CHEMICALS
Advanced Plastic Recycling			
Biobased Chemicals			
CO ₂ Utilization			
Advanced Coatings			
Advanced Composites			
Novel Electronic Materials			
Photonic Materials			
Thermal Management Materials			
Consumer Packaging Materials			
Synthetic Biology			
Advanced Membranes			
Industrial Wastewater Management			
Structural Performance Materials			
Materials Informatics			

The Five Factors of Innovation Success



Product

The function, differentiation, and potential role of the technology relative to existing solutions.



Technology Readiness

The technology maturity indicated by advancements and technical milestones.



Market Organization

How structured the market is for deployment, including regulatory and value chain dynamics.



Market Readiness

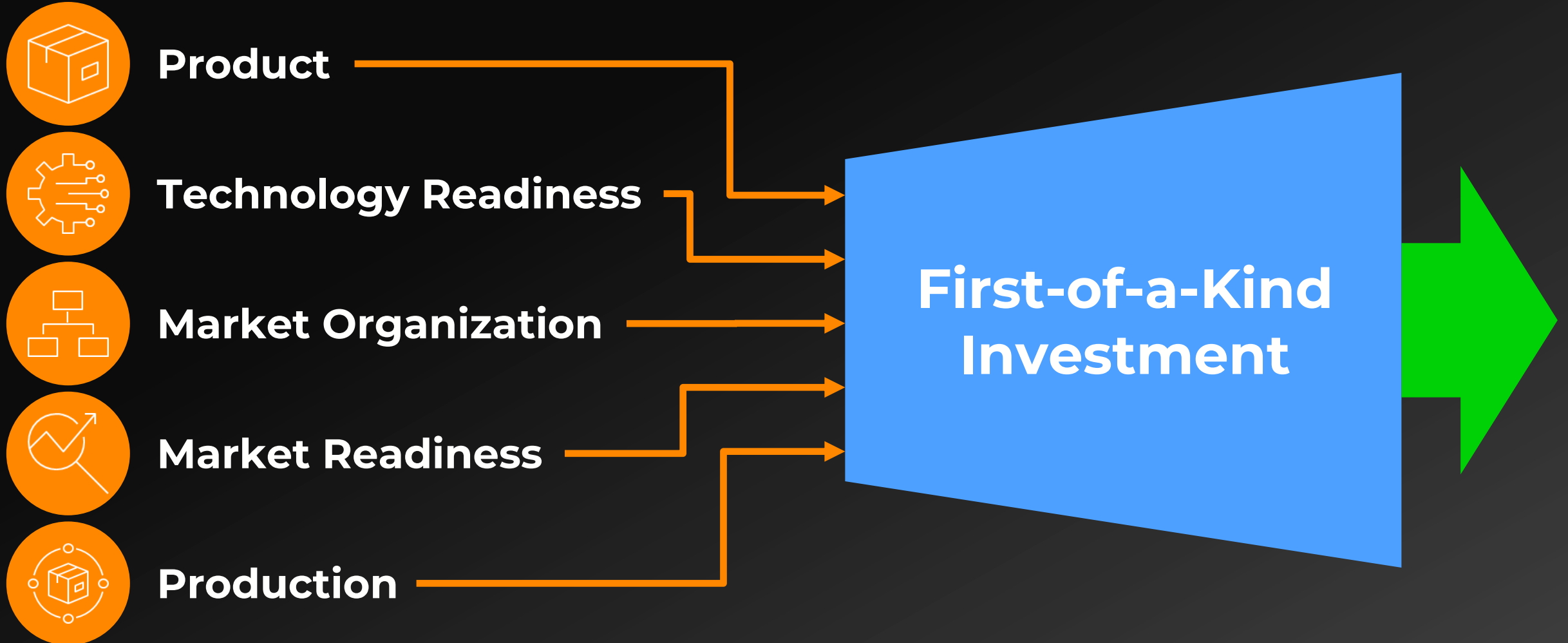
Current market needs and overall appetite for the technology



Production

Manufacturing scale-up and offtake agreements indicating real-world adoption.

Innovation success depends on the convergence of all five factors



Defossilization of Raw Materials

Transform existing value chains through the integration of new sources of carbon to continuously meet product demand.



Adoption of alternative carbon sources remains a strategic priority, as shifting trade flows heighten feedstock concentration risk and supply vulnerability.

Focus on localized deployment of proven carbon technologies to enhance resilience and advance downstream markets supporting commercialization.

INNOVATION IN ACTION

Topsoe will supply a 55-MW solid oxide electrolyzer system for Forestal's **e-methanol project** in Spain, demonstrating the integration of SOEC and methanol synthesis and advancing large-scale electrochemical chemicals production.

Defossilization of Raw Materials



“

How do **advanced plastic recycling** outputs compare to virgin resins in performance, purity, and compatibility?

”



“

What **biomass gasification** technology has demonstrated the most reliable operations under varied feedstock inputs?

”



“

How can companies form the most viable **CO₂ utilization** business ecosystem?

”



“

Which customer segments show credible near-term demand for **low-carbon methanol**?

”



“

Which **bioplastics** facilities are scaling up, and which products are they targeting?

”

Decarbonization of Operations

Propel operations towards zero-emissions and zero-waste with innovative technologies and processes.



Chemicals companies maintain net-zero commitments, shifting near-term decarbonization from innovation to operations as transformational technologies await scalability.

Advance decarbonization roadmaps to future-proof capital-intensive assets, reducing dependency on imports and strengthening long-term operational and financial resilience.

INNOVATION IN ACTION

Air Liquide's FID for a EUR 500 million, 200-MW electrolysis plant in Rotterdam illustrates a subsidy-enabled, cross-border hydrogen model for **industrial and chemicals decarbonization**, setting a blueprint for future projects.

Decarbonization of Operations



“ Which **point-source carbon capture** technology provides the necessary efficiency for CO₂ streams in the chemicals sector? ”



“ What technical milestones must be achieved for **low-carbon heat** to demonstrate repeatable deployments? ”



“ How are partnerships across product, storage and transport, and utilization forming in the **low-carbon hydrogen** value chain? ”



“ What business models are **low-carbon heat** solution providers utilizing to lower adoption for industrial users? ”



“ What industrial chemical complexes have integrated **low-carbon hydrogen** into site operations and at what scale? ”

Future Materials

Accelerate the discovery, design, development, and deployment of future materials to enable new technologies and applications.

Future materials innovation is central to competitiveness, enabling emerging applications where incumbent materials have reached their performance and functionality limits.

Adopt a two-pronged strategy — accelerate materials discovery and design while targeting market gaps defined by material limitations and evolving consumer needs.



INNOVATION IN ACTION

Periodic Labs' USD 300 million seed round marks a major step in the era of **AI-driven materials informatics**, combining machine learning and lab automation to potentially accelerate materials discovery and breakthroughs.

Future Materials



“ Which **metamaterials** deliver differentiated functionality without compromising integration with existing products? ”



“ How are regulations driving innovation developments for **advanced coatings** and **advanced composites**? ”



“ Which **PFAS-free coatings** have secured customer pilots that resulted in production scaleup? ”



“ Has the integration of AI in **materials informatics** led to substantial improvements or enhancements of material discovery capabilities? ”



“ Which market segments show the strongest demand for the adoption of novel **thermal management materials**? ”

Uncovering New Market Opportunities

Discover and capitalize on the unmet materials needs of technologies and solutions on the rise.



Rapidly evolving value chains demand proactive monitoring of emerging technologies and customer needs to uncover unmet materials opportunities and maintain competitiveness.

Develop agile product roadmaps that translate technological and market signals into timely pivots, enabling rapid entry and scaling in emerging markets.

INNOVATION IN ACTION

Sion Power's 75-MWh pilot line for Li-metal batteries signals meaningful progress toward EV-scale manufacturing, advancing energy density, durability, and safety as commercialization of **next-generation battery architectures** accelerates.

Uncovering New Market Opportunities



“

What new materials enabling **advanced sensors** address unmet needs for industrial applications?

”



“

Which variation of **solid-state batteries** have demonstrated performance metrics in real-world operational conditions?

”



“

Which partnerships are essential to accelerate the technical and commercial readiness of **quantum technologies**?

”



“

Which market segments are best positioned for **alternative packaging systems** and what are the underlying drivers behind adoption?

”



“

Which manufacturers for **sodium-ion batteries** and **flow batteries** have expanded nameplate capacity or opened new production lines?

”

Harmless Chemicals

Design products minimizing health and environmental impacts while aligning to human-centric needs.



Rising consumer awareness and regulatory scrutiny make developing harmless chemicals essential for compliance, brand integrity, and long-term market credibility.

Prioritize portfolio shifts toward safer chemistries that address genuine consumer concerns, ensuring resilience against regulatory bans and reputational risks.

INNOVATION IN ACTION

The Pentagon's five-year delay in PFAS remediation across 140 sites highlights persistent testing and regulatory hurdles, creating near-term opportunities for innovators in **detection, in situ treatment,** and **destruction** technologies.

Harmless Chemicals



“ Which **biopesticides** and **alternative crop nutrition** inputs achieve equivalent or superior efficacy while reducing environmental impact? ”



“ What partnerships are being formed across the value chain to deliver turnkey **industrial wastewater management** solutions? ”



“ Which **synthetic biology** producers and CMDOs are building out upstream capacity and downstream processing lines? ”



“ Which performance metrics for **synthetic biology** define readiness for demonstration-scale green chemistry? ”



“ How are chemicals companies incorporating **advanced membranes** into their processes to handle micropollutant waste streams? ”

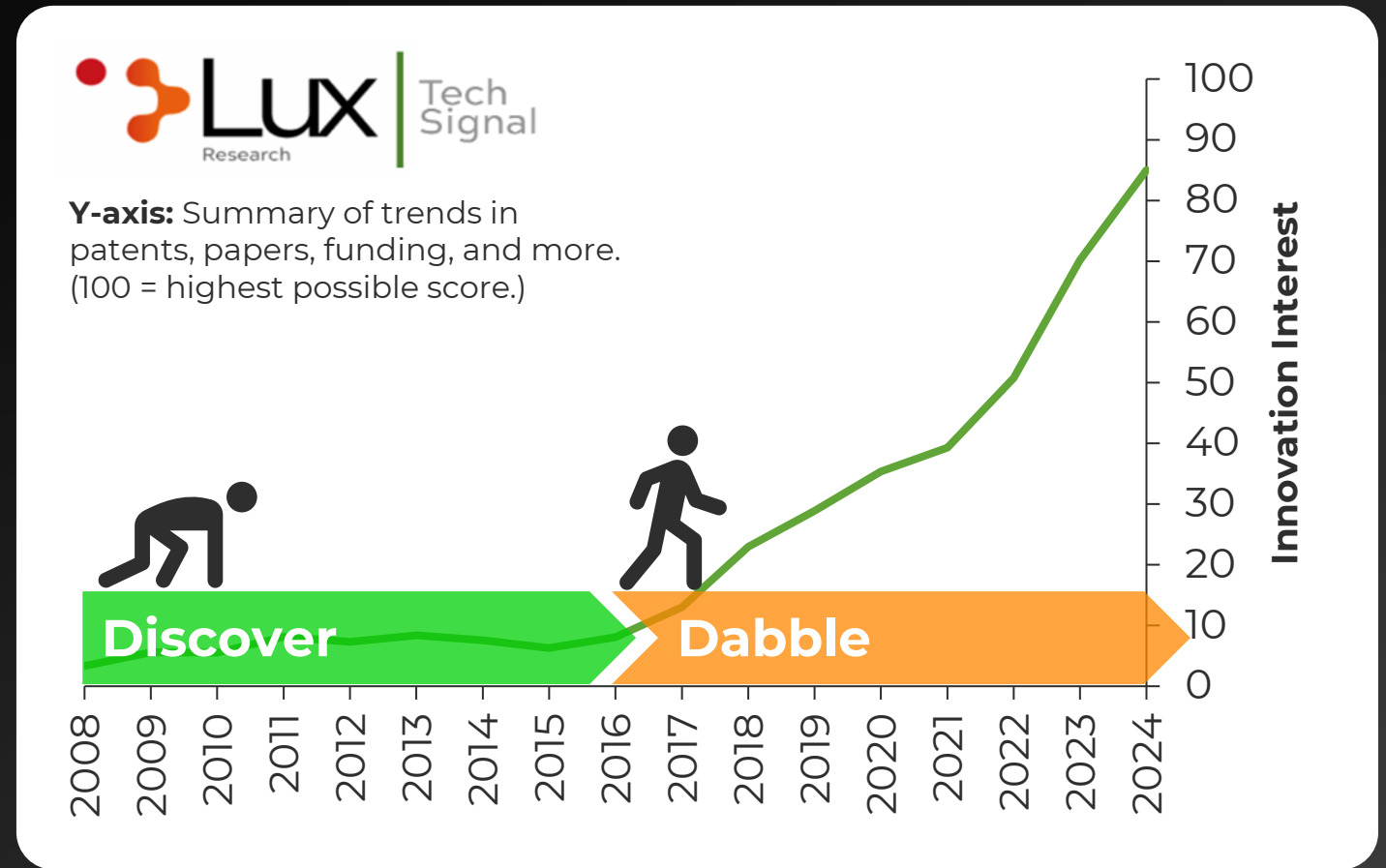
Enabling the next era of innovation-fueled growth



Track the start of the conversation from scientific discovery to inventive dabbling

The Lux Tech Signal provides an integrated signal of science, investment, and commercialization.

Dabbling takes you in all directions and gives you direct insight on the potential impact of a scientific breakthrough.



Detect, interpret, and act on disruption systematically through weak signals

The heart of a forward-looking innovation strategy lies in the ability to detect weak signals.

Companies can transform noisy market data into actionable insights, positioning themselves for disruptions that competitors may miss.



IMAGINE



LISTEN



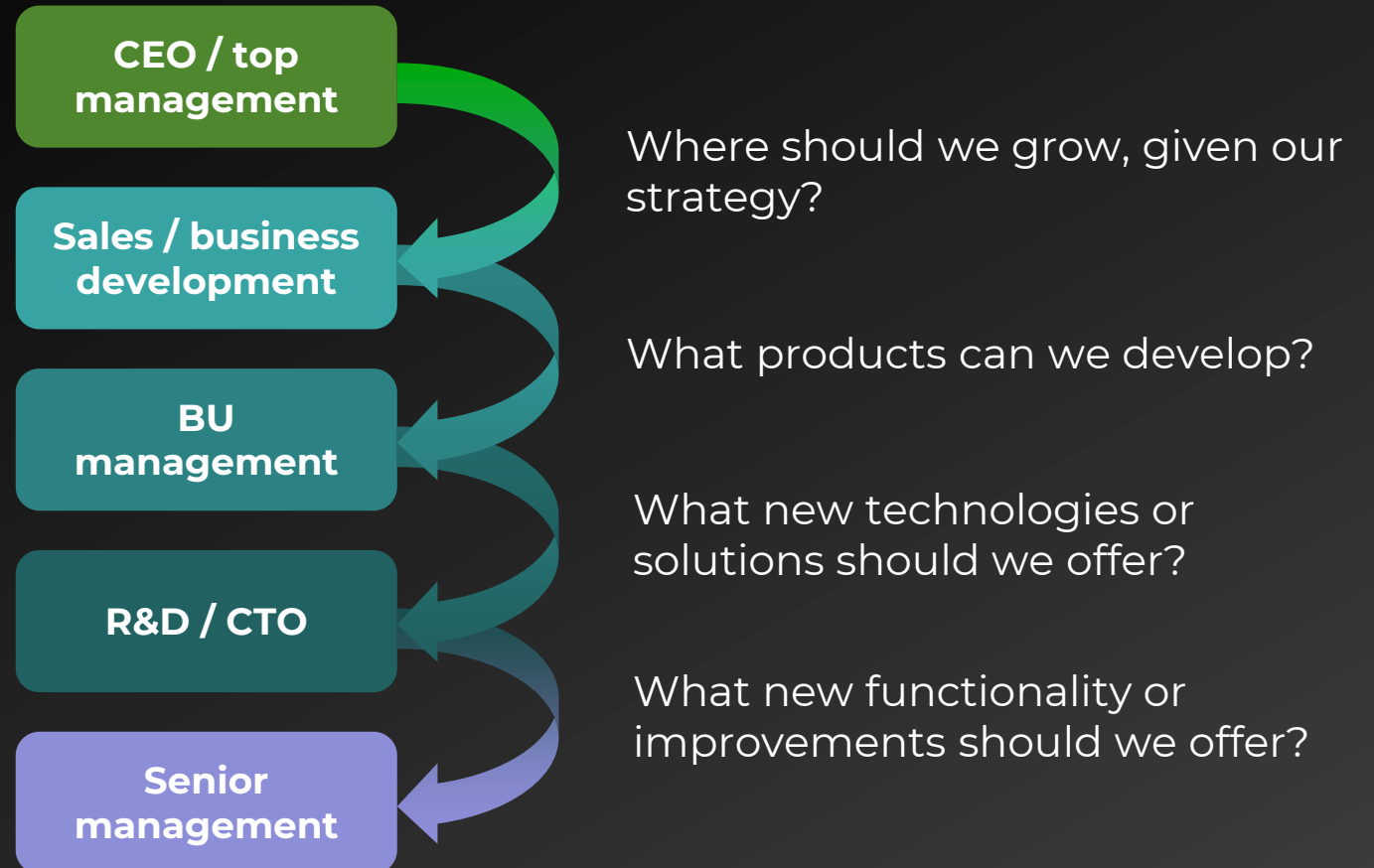
AMPLIFY

Use innovation roadmaps to bridge communication breakdowns

Poor communication is one of the most persistent barriers of innovation as teams are speaking different “languages.”

Innovation roadmaps help bridge that divide by creating a unified structure to serve as a communication platform.

Backcasting the strategy by articulating the right questions

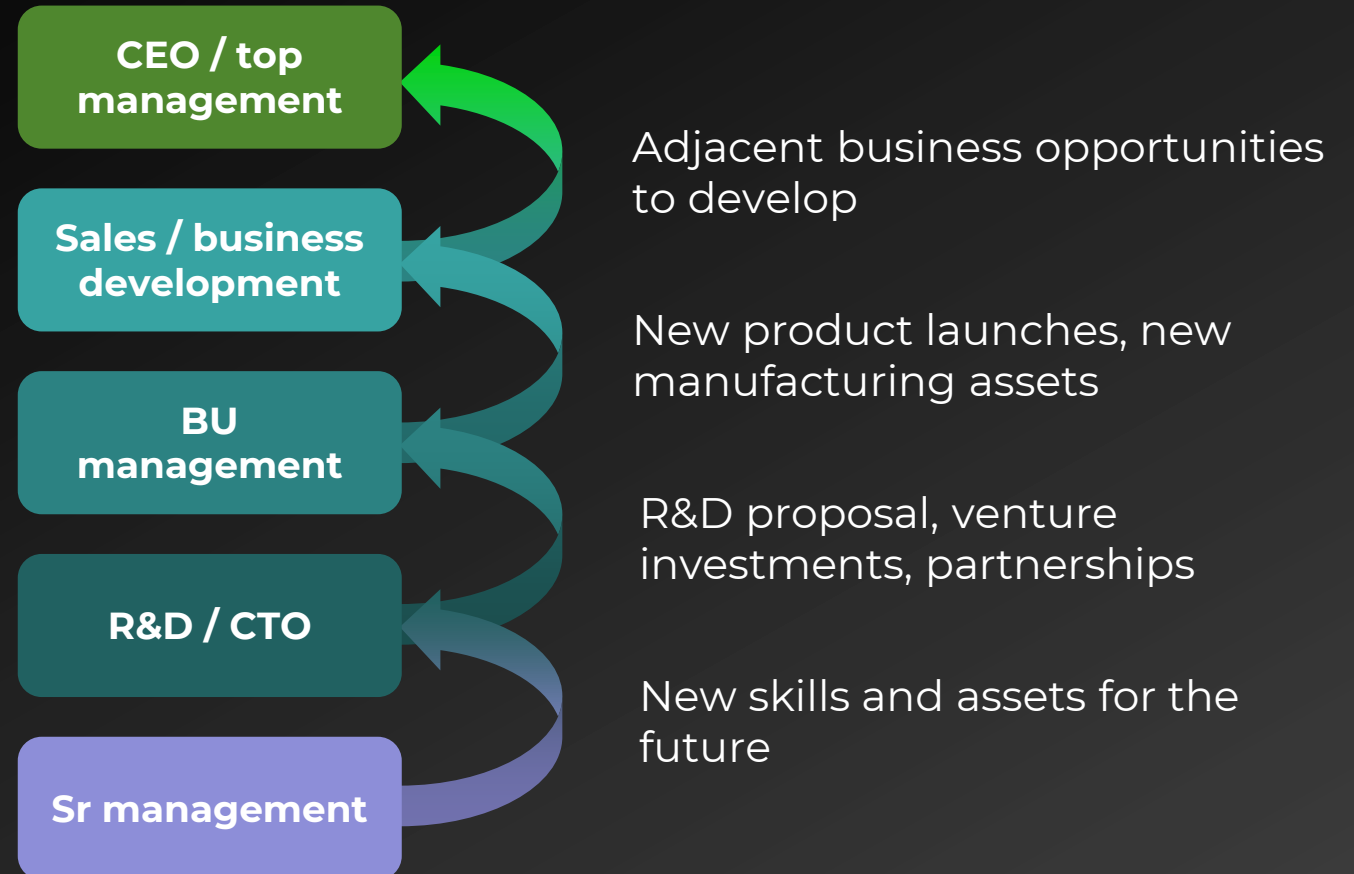


Use innovation roadmaps to bridge communication breakdowns

Poor communication is one of the most persistent barriers of innovation as teams are speaking different “languages.”

Innovation roadmaps help bridge that divide by creating a unified structure to serve as a communication platform.

A productive dialogue to make coherent choices



Key takeaways

1

Fill out the front end of your innovation funnel.

Do not lose sight of technological developments gaining momentum and proactively fill the innovation funnel with noteworthy breakthroughs.

2

Assess innovations beyond technological momentum.

Monitor developments across the five factors of innovation success to dial in timing, size of innovation bets, and the strategic actions needed.

3

Create organizational alignment for your innovation initiatives.

Leverage innovation roadmaps as a platform for innovation dialogue by involving all stakeholders across the organization.



Thank You



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About Lux

Lux Research fuels innovators to not only imagine what's possible in the future but also operationalize innovation success in the near term. We deliver research and advisory services to inspire, illuminate, and ignite innovative thinking that reshapes and grows businesses. Using quality data derived from primary research, fact-based analysis, and opinions that challenge traditional thinking, our experts focus on finding truly disruptive innovations that are also realistic and make good business sense.

The “Lux Take” is trusted by innovation leaders around the world, many of whom seek our advice directly before placing a bet on a startup or partner — our clients rely on Lux insights to make decisions that generate fantastic business outcomes. We pride ourselves on taking a rigorous, scientific approach to avoid the hype and generate unique perspectives and insights that innovation leaders can’t live without.

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