THE 2025 EUROPEAN DEEP TECH REPORT

March 2025

LAKE STAR

(W)C Walden Catalyst

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Executive Summary

1. DEEP TECH (MIS)CONCEPTIONS

Deep Tech is often misunderstood. It focuses on applying scientific and engineering breakthroughs to products for the first time. It is the origin of venture capital and has historically shaped regional sovereignty by catalysing transformative technology trends. Although more capital is typically required, most of it is invested in building IP moats rather than in advertising. Longer development timelines delay initial revenue, but once the technology matures, revenue growth often accelerates. While companies like Northvolt have made headlines, Deep Tech companies fail at rates comparable to others, albeit with a distinct risk profile that investors must understand. The exit landscape remains too immature but overall returns suggest that Deep Tech portfolios outperform conventional tech.

2. THE EUROPEAN DEEP TECH OPPORTUNITY

Europe has the potential to be a global Deep Tech hub. It boasts top-tier research with 6 of the top 20 universities and 9 of the top 25 research institutes. While its research landscape spans across a breadth of technologies, Europe lacks the entrepreneurial, risk-taking culture. Europe should focus on select centres of excellence like Oxford, Cambridge, ETH, EPFL or TUM. Additionally, while the US benefits from a strong founder flywheel with companies like SpaceX, Palantir, and OpenAI, Europe's founder ecosystem remains largely limited to shallow tech.

3. FUNDING LANDSCAPE

– *VC Markets:* Deep Tech provides a hedge against momentum investing; in 2024, €15bn flowed into Deep Tech—down -28% compared to 2021 highs—while regular tech fell by -60% versus 2021.
– *Countries:* The 3 most important countries are the UK ($4.2bn), France ($3.0bn), and Germany ($2.7bn); Deep Tech accounts for one-third of all VC money, with London, Paris, and Munich, serving as the main hubs.
– *Stages:* Although ample early-stage funding is available, 50% of growth capital still comes from investors outside Europe.
– *Exit:* M&A activity has increased to $12.2bn, though the two largest exits—Darktrace and Exscientia—were publicly listed firms acquired by US players.

Executive Summary

4. SEGMENT DEEP DIVES

NOVEL AI

$3.0bn (+113%)

Autonomous driving
Wave $1.1bn

Foundational models
Mistral $500m Series B, Poolside, and DeepL $300m; with LLMs making up majority of AI funding

Growth areas: Enhancing AI's understanding of the physical world, developing agents, and applying AI to specialized verticals such as biotech and materials

FUTURE OF COMPUTE

$1.2bn (-4%)

Quantum
Quantinuum $300m, Riverlane $60m Series C

AI Inference
Axelera AI $68m Series B

Photonics

Growth Areas: Advancing AI inference (including edge computing) and deploying AI accelerators and photonic solutions to improve data centre energy efficiency and bandwidth

NOVEL ENERGY

$1.1bn (+75%)

Hydrogen
Sunfire €215m

Nuclear Fission & SMRs
NewCleo €135m Series A

Nuclear Fusion
Tokamak Energy €125m, Marvel Fusion €62.8m Series B

Growth Areas: Increasing interest in nuclear waste recycling and SMRs to power energy-hungry data centres, despite challenges from high LCOE and bureaucratic regulatory hurdles

SPACE TECH

$1.0bn (+20%)

In-space transportation
Exploration Company $160m Series B, D-Orbit $50m Series C

Earth observation
IceEye $125m Series C

Launch vehicles
Isar Aerospace $220m full Series C

Growth Areas: Emphasis on European sovereignty in space with Small Launchers coming online 2025 and realisation that Space is a new critical infrastructure for governments and military

RESILIENCE

$653m (+74%)

AI capabilities for defence
Helsing $450m Series C

Drones
Tekever $74m Series B, Stark Industries $15m

Other unmanned ground and sea vehicles
Maritime Robotics $12m, ARX €9m

Growth Areas: Expanding opportunities driven by rising European defence budgets as the US focuses inward

COMPBIO & CHEMISTRY

$500m (+59%)

AI for drug development and molecule design
Cradle $73m Series B, Basecamp Research $60m Series B, with accolades such as the Nobel Prize for DeepMind's AlphaFold and David Baker's work underscoring potential

Growth Areas: Rapid expansion of AI-generated late-stage pipeline assets despite no AI-derived drug yet approved

ROBOTICS

$700m (+14%)

Humanoids
1X $100m Series B

Quadrupeds
Anybotics $60m

Warehouse robotics
Dexory $56m

Growth Areas: Building foundational models for robotics based on the idea of AI scaling laws; main hurdles are data availability and achieving near-zero fault tolerance in robotic systems

Executive Summary

5. FOUNDER RESOURCES

- **Deep Tech and Venture:** Success relies on milestone-based de-risking that drives valuation. Founders should understand investor priorities, using the Deep Tech Compass for stage-specific guidance.
- **Pitch Deck Structure:** Tell a clear story and use the scientific method: Present hypotheses, test them, and refine.
- **Technology vs. Product Value:** Focus on usability and customer impact—technology alone isn't enough; your product must drive P&L results.
- **Financial Engineering:** Hardware startups must explore beyond equity for CapEx. Learn about venture debt, asset-backed financing, and other instruments.

6. CHALLENGES & RECOMMENDATIONS

- Some of the biggest challenges that remain in Europe are to encourage more entrepreneurs to move into Deep Tech, to harmonise university spinout terms, to form more dense talent / excellence clusters, to increase the LP base and involvement of institutional investors, to stress the importance of governments & corporations as customers, to strengthen the exit channels, and to promote diversity across founders & investors.
- Progress on these issues has been limited; Europe must cultivate a sense of urgency to avoid falling further behind amid escalating geopolitical tensions, an inward-turning US, increasing pressure from China, and Russia's ongoing threat.

About this report

The report aims to align Europe's definition of Deep Tech, examine the characteristics of the European ecosystem, dive deep into key areas of Deep Tech, and lay out ways Europe can enhance its global competitiveness.

Deep Tech has taken the startup and venture capital world by storm the last few years. As software investing inches further into the long tail of unaddressed opportunities, founders and investors are looking for new sources of alpha and ways to make a large global impact.

This has led to a rush of interest into the space, and with it a confusing array of terms, viewpoints, definitions, and inconsistent understanding of the data that underpins the sector. This confusion makes it harder for founders to build and scale and for investors to efficiently communicate with a common language.

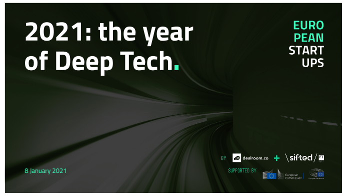
The genesis of this report is to arm the European Deep Tech ecosystem with an aligned set of definitions, deeply researched data, and some perspectives on key areas to help lubricate a common goal of nucleating and growing global Deep Tech champions right here in Europe.

In this report, we will endeavour to expand our common language, address widely repeated misconceptions with data, and dive deep into areas of recent interest within the European Deep Tech ecosystem.

Methodology

Deep Tech is constantly evolving	Some technologies that were once considered novel or 'Deep' have now become mainstream and widely adopted. LLMs are going through this transition currently. This is why certain companies are included in previous reports but not in this year's report. As a result, funding numbers may vary from year to year.
Data cut-off dates	Cut-off dates for data is 31 December 2024 unless stated otherwise on the chart.
Data sources	Dealroom is the primary data provider for this report. References to additional data sources and reports can be found on each slide.

Previous editions of the European Deep Tech Report



2021

2022

2023

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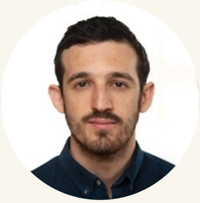

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A special thanks to *Hello Tomorrow* for their expert contributions

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LAKE STAR

European, multi-stage venture capital firm

Lakestar invests with a long-term view across all stages from Seed to Growth. We care about Europe. We understand its regulations and politics. We speak the languages and appreciate its cultures. Yet we have a global mindset and like to build bridges between continents, through our deep relationships in many different ecosystems.

Lakestar's Deep Tech team focuses on novel scientific and engineering breakthroughs that are making their way into companies and products for the first time. We live on the bleeding edge and are constantly looking for contrarian views on how the world is going to change for the better.

constellr · isar aerospace · Auterion · VARDA · Terra Quantum · poolside · LIGHTIUM

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Global venture capital firm dedicated to Deep Tech investments

Walden Catalyst Ventures is helping early-stage companies in the US, Europe, and Israel build the next generation of category-defining businesses in Deep Tech. We back the bold and the daring—trailblazers who are changing the world and making life better for all of us.

Walden Catalyst invests in innovators and entrepreneurs passionate about disruptive technologies and committed to excellence. For startups, this translates into unparalleled access to operational expertise, global reach, and a network of industry captains eager to help build and scale the companies of the future.

AMbotics · Peptone · Rivos · NEARFIELD INSTRUMENTS · ARTERA · AI21labs

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Global startup & venture capital intelligence platform

Dealroom.co is a global intelligence platform for discovering and tracking the most promising companies, technologies and ecosystems. Clients include many of the world's foremost organisations such as Sequoia, Accel, Index Ventures, McKinsey, BCG, Deloitte, Google, AWS, Microsoft, Stripe.

Dealroom partners closely with local tech ecosystem development agencies and enablers, to create a comprehensive multi-dimensional blueprint of the tech ecosystem, including capital, talent, innovation, entrepreneurship and overall economic dynamism.

SEQUOIA · Accel · Index Ventures · LAKE STAR · (W)C Walden Catalyst · NIF · esa · McKinsey & Company · Deloitte. · BCG · Google · Microsoft · stripe · aws

Content

1.
DEEP TECH DEFINED – COMMON (MIS)CONCEPTIONS

There are common (mis)conceptions about Deep Tech

1.

Is Deep Tech an *undefined term*?

2.

Is Deep Tech a *new phenomenon* in venture capital?

3.

Do Deep Tech companies need *more capital*?

4.

Do Deep Tech companies *take longer to achieve revenue*?

5.

Do Deep Tech companies *fail more often*?

6.

Do Deep Tech companies need *more time to exit*?

7.

Do Deep Tech companies have *larger exits*?

8.

Does Deep Tech investing deliver *top returns*?

Deep Tech is defined as

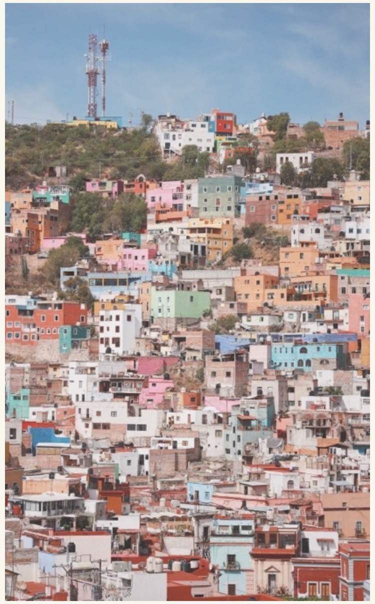
novel scientific or engineering breakthroughs

making their way into
products and companies
for the first time

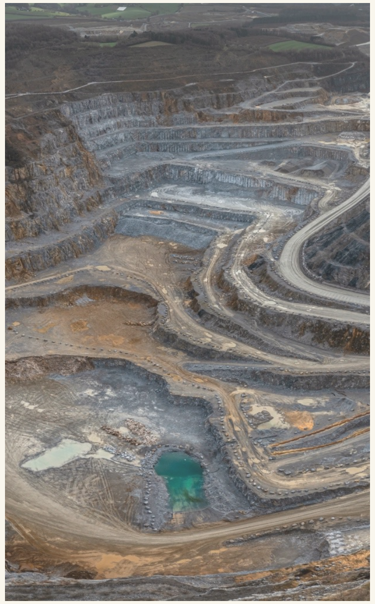
Solving today's largest problems requires fundamentally new scientific & engineering breakthroughs to solve them

Deep Tech is instrumental to tackling today's biggest challenges, from climate change and food security to intractable disease.

POVERTY & INEQUALITY

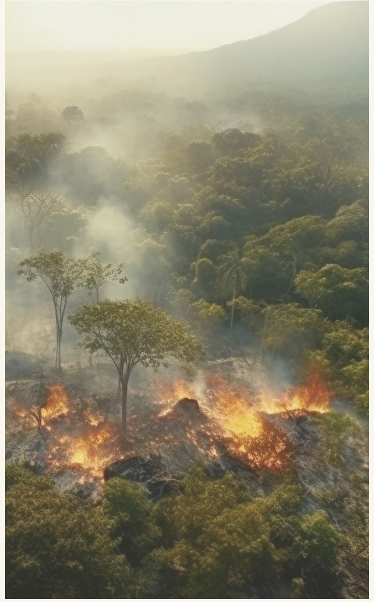


RESOURCE SCARCITY

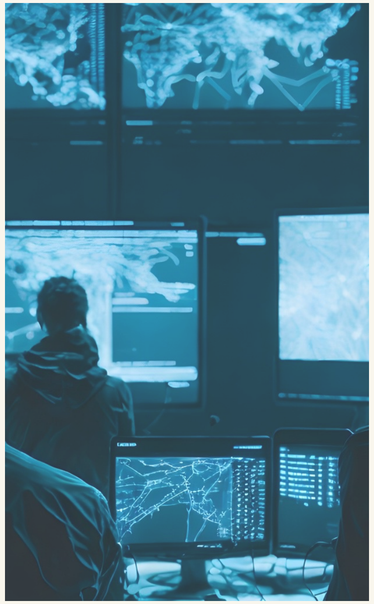


PHYSICAL & MENTAL HEALTH

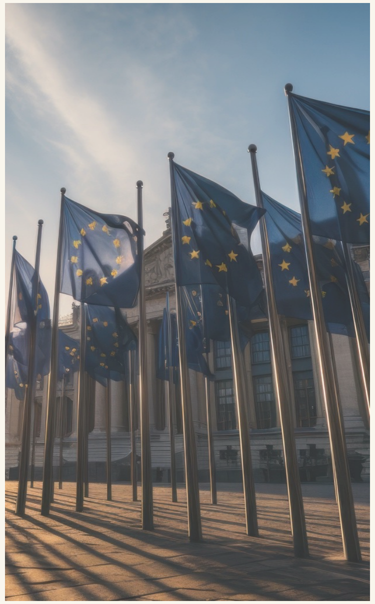
CLIMATE CHANGE



PRIVACY & CYBERSECURITY

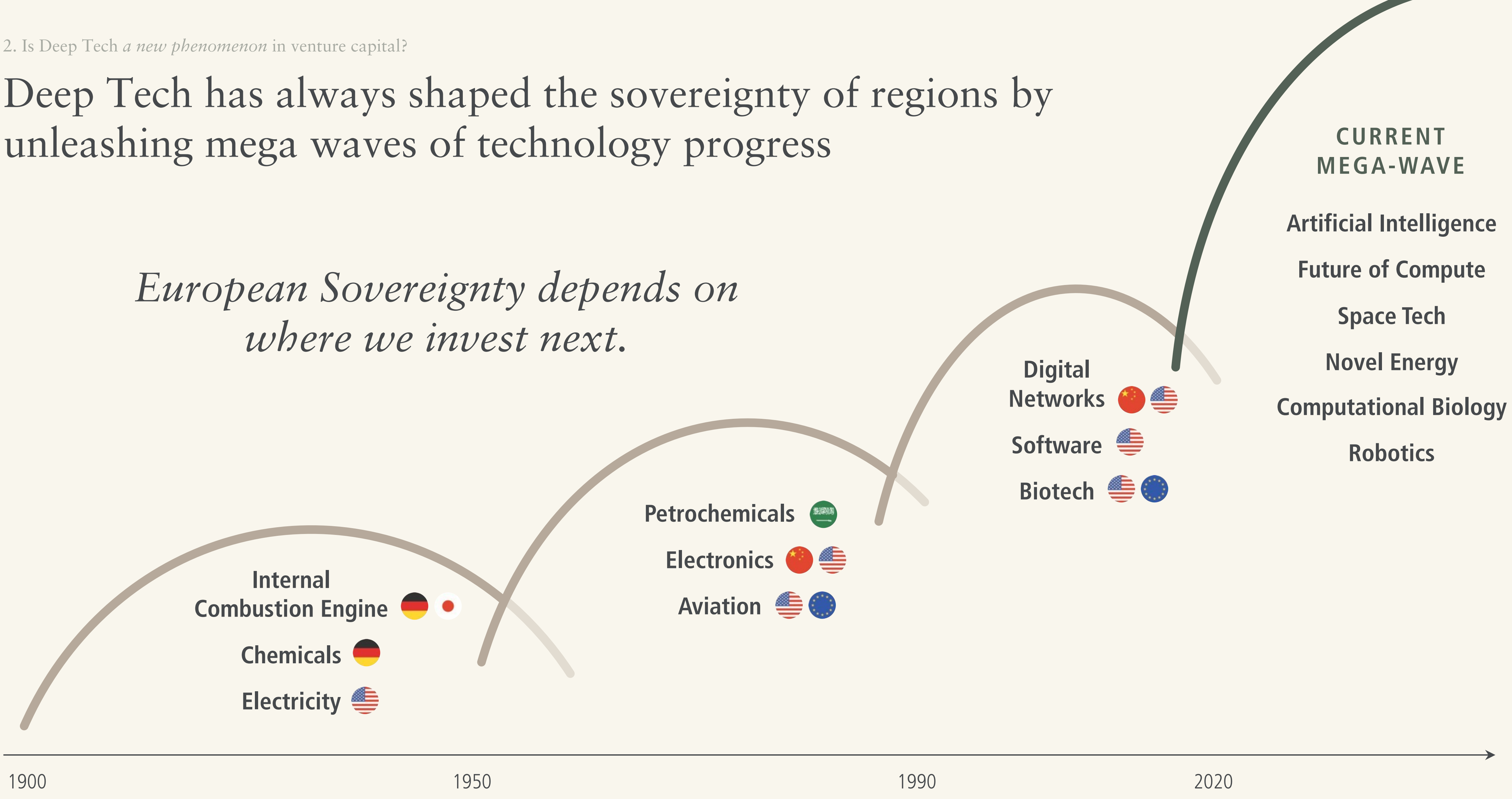


FREEDOM & SOVEREIGNTY



Deep Tech has always shaped the sovereignty of regions by unleashing mega waves of technology progress

European Sovereignty depends on where we invest next.



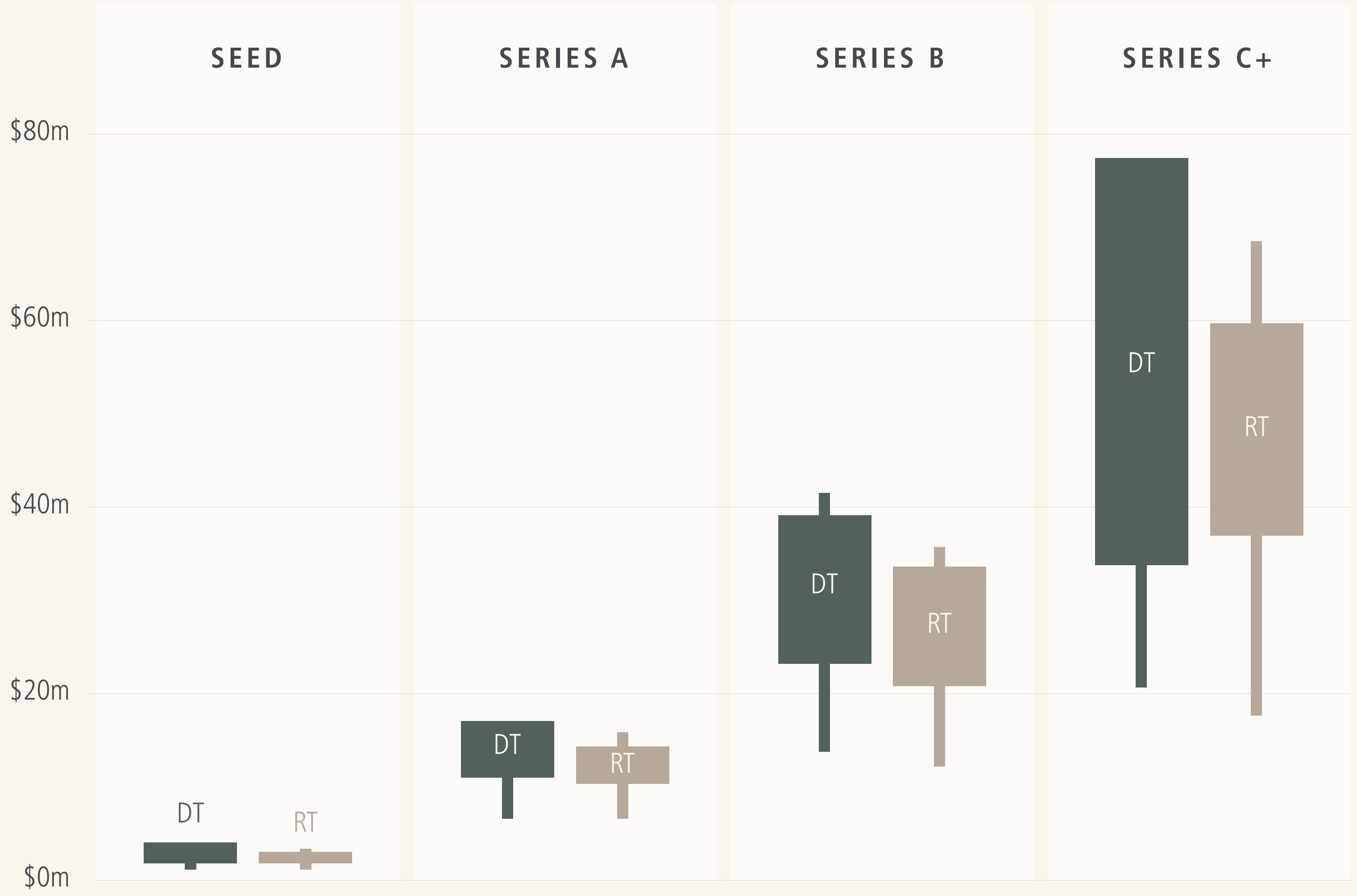
Deep Tech companies raise more capital than Regular Tech. The difference is wider for top quartile startups than the median startup

Overall, Deep Tech startups raise more capital than Regular Tech at every stage.

The difference is wider for top quartile rounds, showing that the top Deep Tech startups raise larger rounds than the top rest of tech startups.

Series C+ is the only exception, where the top quartile still raise 8% larger rounds than rest of tech, but the median is 8% lower.

Round sizes for European Deep Tech (DT) and Regular Tech (RT), 2023-2024



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Deep Tech CapEx investment, when done properly, allows Deep Tech companies to grow bigger for longer than their SaaS counterparts

The conventional wisdom of venture capital investing is to avoid CapEx.

The rationale is that a CapEx heavy business requires more capital investment which dilutes early-stage investors and reduces investment returns. It also assumes that given the risks of raising in unpredictable capital markets, the higher the company's capital needs, the riskier it is that at some point in their journey they will fail to raise and run out of cash. Moreover, historically, CapEx was often fungible, being spent on tools or assembly equipment that anyone could buy off the shelf.

This logic holds true when all else is equal, but what it fails to consider is what happens when the capital raised is used differently than one would typically expect from a SaaS investment.

Between 20-40% of all venture capital dollars invested in SaaS companies is used for advertising.

The reason for this is because when you're building a software product, the speed and low cost that makes it an attractive investment, also reduces the hurdle for competitors to build a substantially similar product. This creates a race to capture market share, and advertising is the fastest and most direct path to do that. When many competitors building similar products are all battling it out for a finite share of wallet, you see inflated ad spend to try and out compete each other.

However, because Deep Tech companies are often the first to figure out how to harness a fundamentally new technology and build a product from it, the competitive pressures tend to be significantly lower. Often the closest competitors are incumbents working with technology from the previous cycle or a small number of Deep Tech fast followers.

Deep Tech companies can invest these funds into infrastructure unique to their new technology that makes it hard for others to compete.

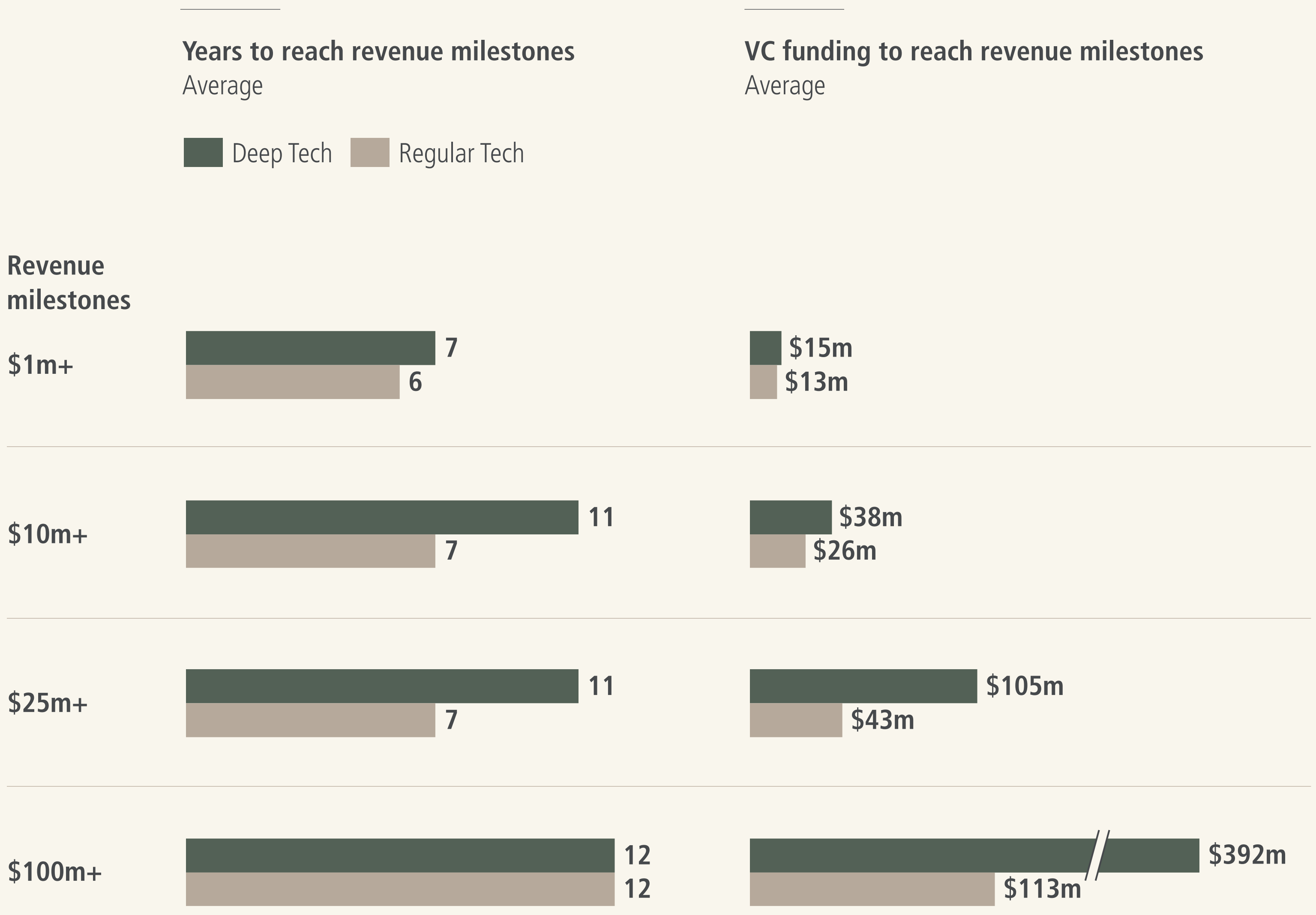
Think Starlink satellites, gigafactories for new battery chemistries, or foundries for cutting edge semiconductor processes. These massive investments become a source of differentiation and defensibility unique to Deep Tech companies.

This type of CapEx investment changes what is typically considered 'burning' 20-40% of cash on ads into an infrastructure investment that increases the value of the company and holds competition at bay.

Deep Tech companies require significantly more time and VC funding than Regular Tech, to reach significant revenues

Early and long-term revenues take about the same amount of time, but mid-stage revenues take longer.

Early revenues don't require significantly more capital but to scale revenues more capital is typically deployed. This capital is often infrastructural investment, however, so the lasting value is much greater as it forms a defensive moat.



Only startups with $1m+ VC funding at the time. Revenue data used are only exact data retrieved from financial filings or news sources, not estimated data.

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Deep Tech and Regular Tech have similar failure rates

Deep Tech conversion rates are mostly in line with Regular Tech.

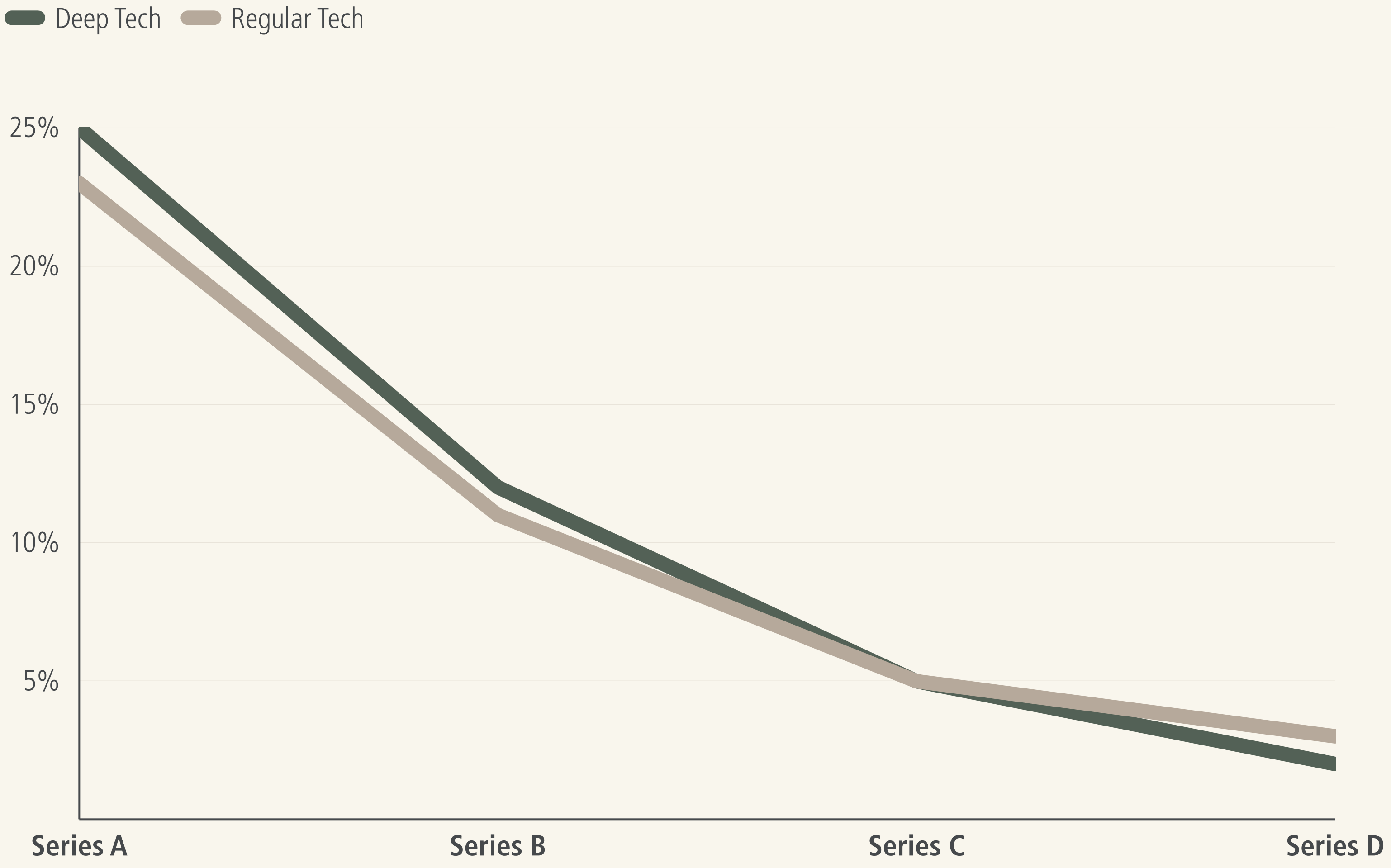
Deep Tech tend to convert more favourably at earlier stages (from Seed to Series B) and then slightly less than Regular Tech.

This could be interpreted as Deep Tech companies needing more time and capital to validate.

- One out of four raises a Series A after Seed
- Half of Series A companies go on to raise a Series B
- Less than half then reach Series C
- Overall, 5% of Deep Tech startups reach Series C+ from Seed

Conversion rates Deep Tech vs Regular Tech

% of seed companies that reach each stage, Seed cohorts 2010-2020



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Research debugs the misconception that Deep Tech companies fail more often

“We believe Deep Tech companies are crucial not only for innovative competitiveness but also transition towards more sustainable economy, since these companies are providing the key enabling technologies for a carbon neutral economy.

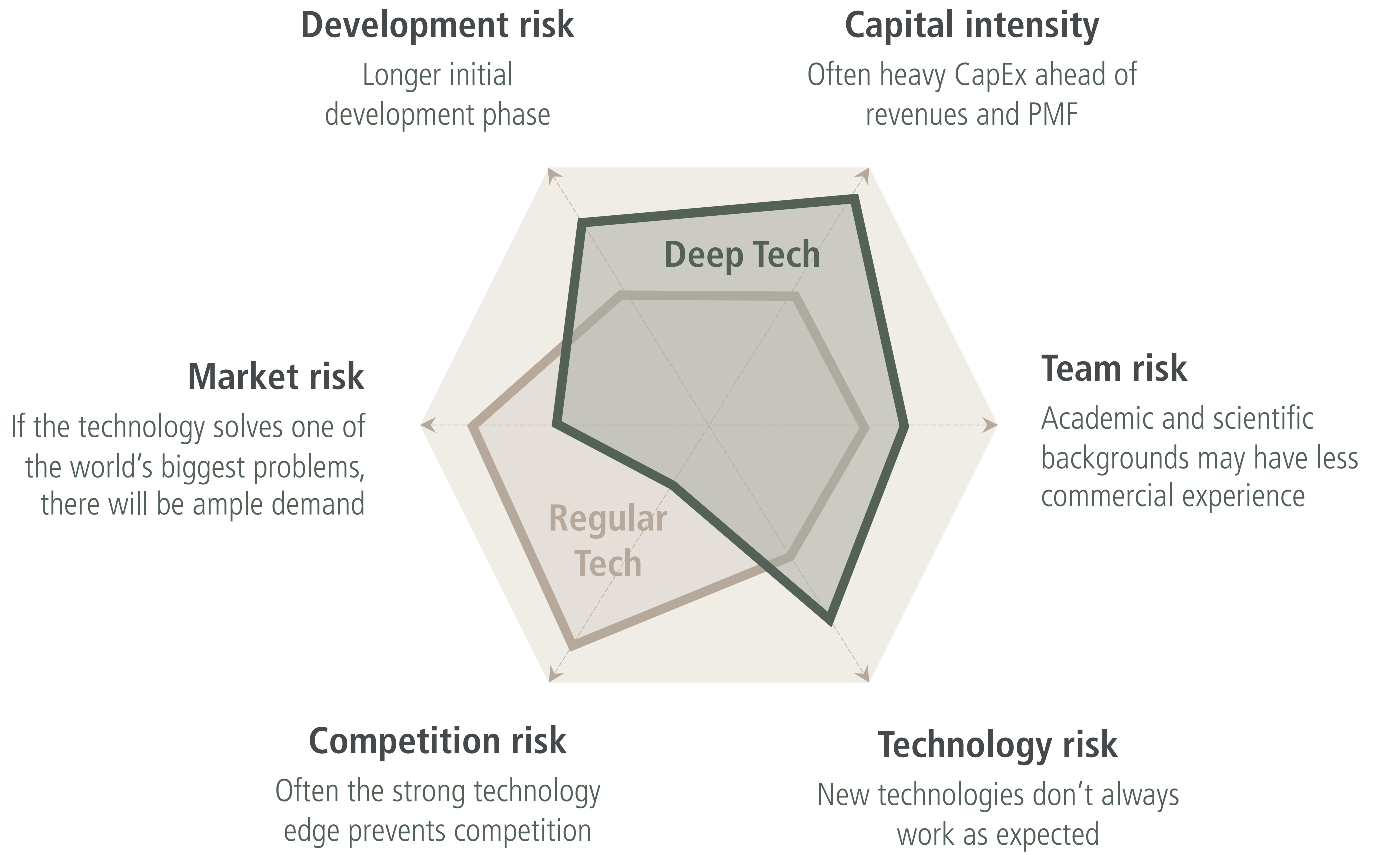
Because these businesses are R&D intensive, the strong blended finance is important for helping this companies to scale. In this regard involvement from VCs and Private Equity firms are crucial. This becomes a challenge in risk-averse cultures since, Deep Tech startups often get a bad rap for being "high-risk" or "too slow”. On the other hand, data does not prove this thesis; research from McKinsey and also our own analysis in investments data debug this misconception, proving that Deep Tech companies are equally or even faster than others in terms of funding speed and they gradually de-risk over time, with failure rates aligning closely to those of regular tech startups as they mature. They also boast greater capital efficiency in the early and growth stages, delivering a stronger ROI compared to regular tech ventures.”

MUSTAFA TORUN
SENIOR DATA SCIENTIST, INVESTNL
INVESTNL

However, Deep Tech companies have different risk profiles that investors need to understand

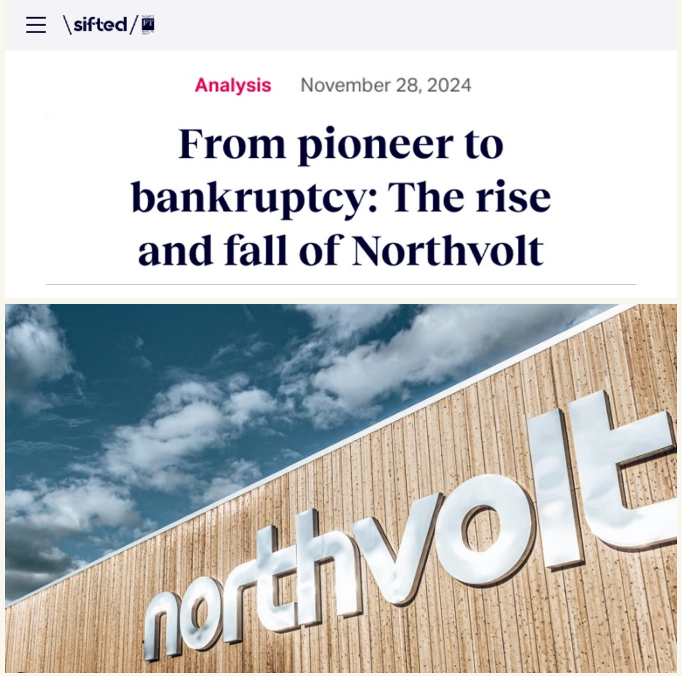
Technology risk is higher, CapEx intensity is often greater and development times are much longer.

Unlike regular startups, Deep Tech companies have a stronger defensibility moat towards competition thanks to their cutting-edge technologies at their core, IP portfolio and teams of technical expertise.



Lessons learnt from *Northvolt:*

What employees and investors said we should learn from Northvolt's high profile journey.



Remain maniacally focused on the core business and don't take on more cash than you need to hit your next milestones

Northvolt aggressively raised a large amount of money. As a result, they took on too many projects and lost focus on the core business. Necessity is the mother of invention.

Build a culture that challenges those in power

The emperor has no clothes. They had a culture of "Yes men" that wouldn't challenge the CEO and senior leadership. You need to design and build a culture that challenges those in power with data and are empowered to do so in a productive way.

Define a clear MVP to prove PMF

Northvolt shot extremely high with their first production battery, and while it was a technical achievement, their competitors built faster, cheaper batteries that won contracts and allowed them to optimize production quality and cost. This won.

Be careful with debt

They took on way too much debt. This also makes navigating their bankruptcy challenging.

Don't follow the equity financing playbook for asset-heavy startups

The dependence on equity financing tied company success to valuation growth. Hence, founders prioritized visionary storytelling to attract investors and pushed relentlessly for growth leading to unsustainable cash burn.

Lessons learnt from *Graphcore:*

What employees and investors said we should learn from Graphcore's high profile journey.

They shot for the moon and landed among the stars

Graphcore started with the ambition to be a $10B+ public company.

They ended up being acquired for under $1B by Softbank to be the AI group at ARM.

While the exit is below hopes for the company, technology and investors, it is still a notable exit.

You need to build a product that is 10x better than existing solutions

It is extremely difficult to compete with an efficient machine, in this case NVIDIA.

Being as good is not good enough.

Von Neumann Machines are ripe for disruption

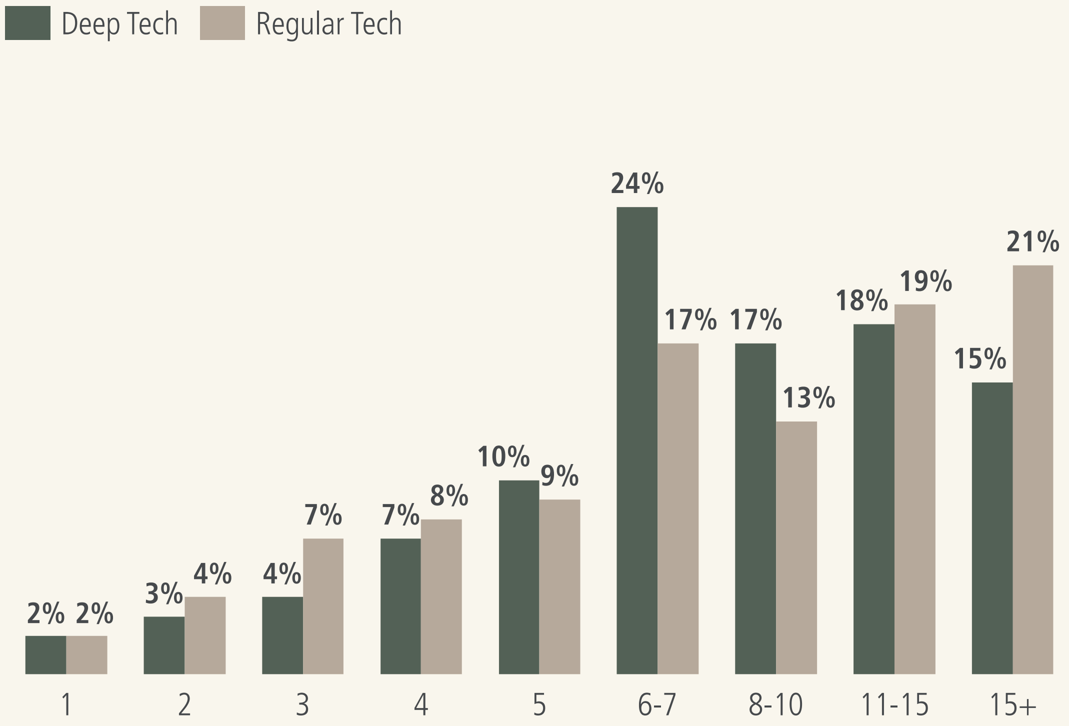
All CPUs and GPUs are Von Neumann Machines today.

In-memory compute will lower power consumption by 100x and hopefully bring about the change that Graphcore could not.

Deep Tech has similar exit timelines compared to Regular Tech with a peak after 6-7 years

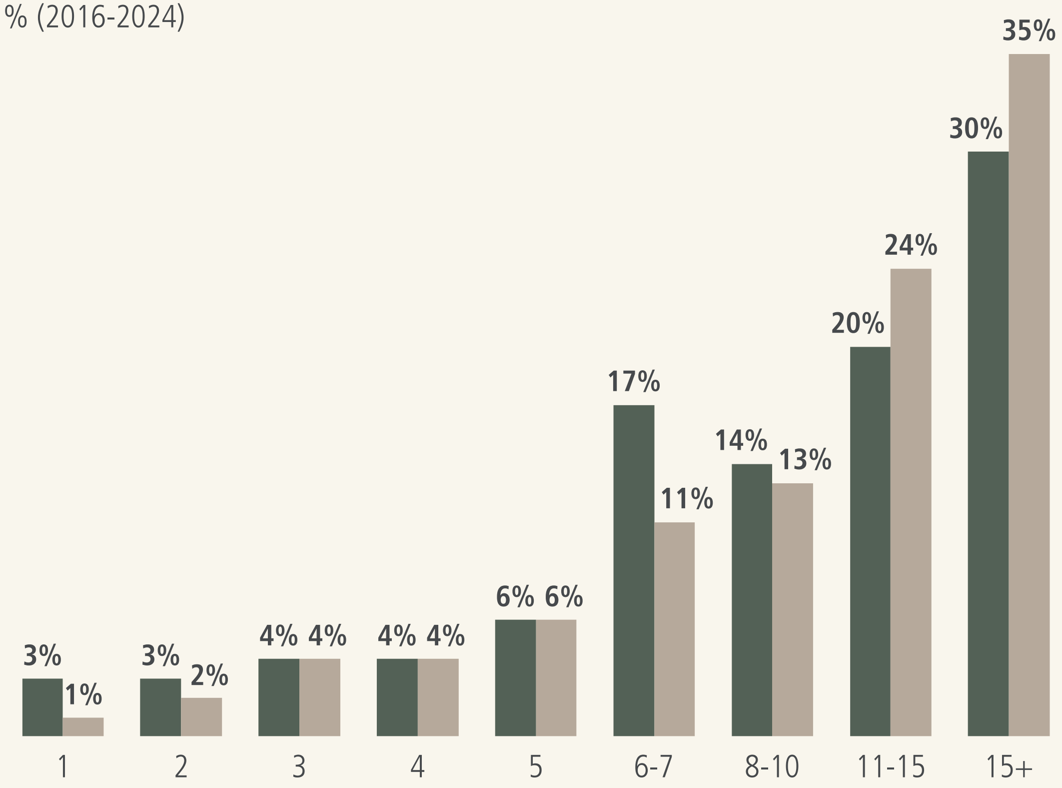
ALL EXITS

VC-backed exits in Europe by time (years) to exit from founding
% (2016-2024)



ABOVE $100m

VC-backed exits in Europe by time (years) to exit from founding
% (2016-2024)



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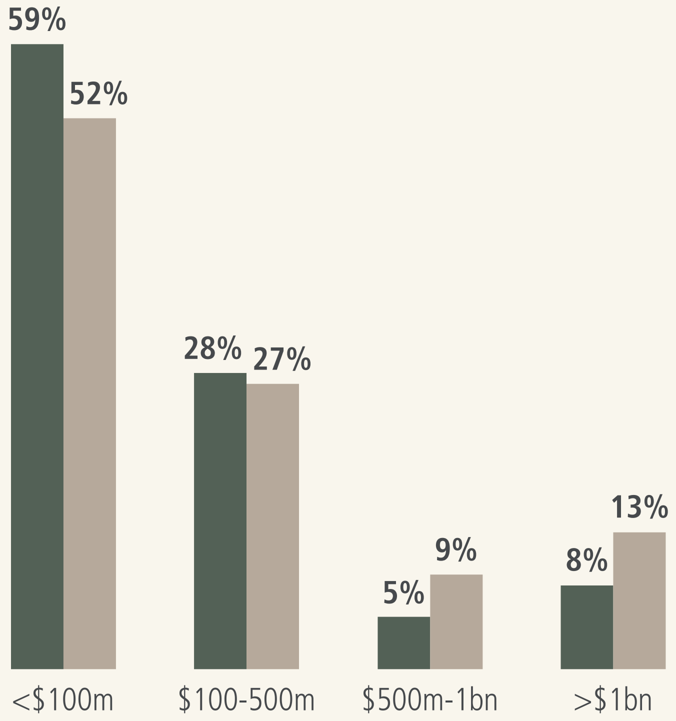
We analysed over VC-backed 6900 exits in Europe in (2016-2024), of which 947 in Deep Tech. Around 20% of these have exact valuation data which have been used for exit size analysis. There have been 70+ $100m Deep Tech exits, and over 540 for the rest of tech.

The European Deep Tech ecosystem needs more large-scale Deep Tech exits to compare

VC-backed exits in Europe by size (2016-2024)[1]

Deep Tech | Regular Tech



Company[2]	HQ	Industry	Round Type	Valuation	Launch year	Exit year	Acquiror	Years to exit
Arrival	UK	Transportation	SPAC IPO	$13bn	2015	2021	CIIG Merger Co.	6
Darktrace	UK	Security	ACQ	$5bn	2013	2024	Thoma Bravo	11
Oxford Nanopore Technologies	UK	Health	IPO	$4bn	2005	2021	-	16
BioNTech	DE	Health	IPO	$3bn	2008	2019	-	11
Exscientia	UK	Health	IPO	$3bn	2012	2021	-	9
Olink	SE	Health	ACQ	$3bn	2004	2023	Thermo Fisher Scientific	19
Sono Motors	DE	Transportation	IPO	$2bn	2016	2021	-	5
Vertical	UK	Transportation	SPAC IPO	$2bn	2016	2021	Broadstone Acquisition Corp	5

1) For the analysis we excluded the 80% of exits with estimated, but not disclosed, valuation; 2) Some of these companies encountered challenges after listing: Arrival declared bankruptcy and some of its assets were acquired by Canoo; Exscientia has been acquired for $688m by Recursion Pharma; Sono Motors declared bankruptcy but managed to attract some funding and found new life focusing on solar business. The percentages are indicative of the relative Deep Tech vs Regular Tech, but not to be read in absolute number.

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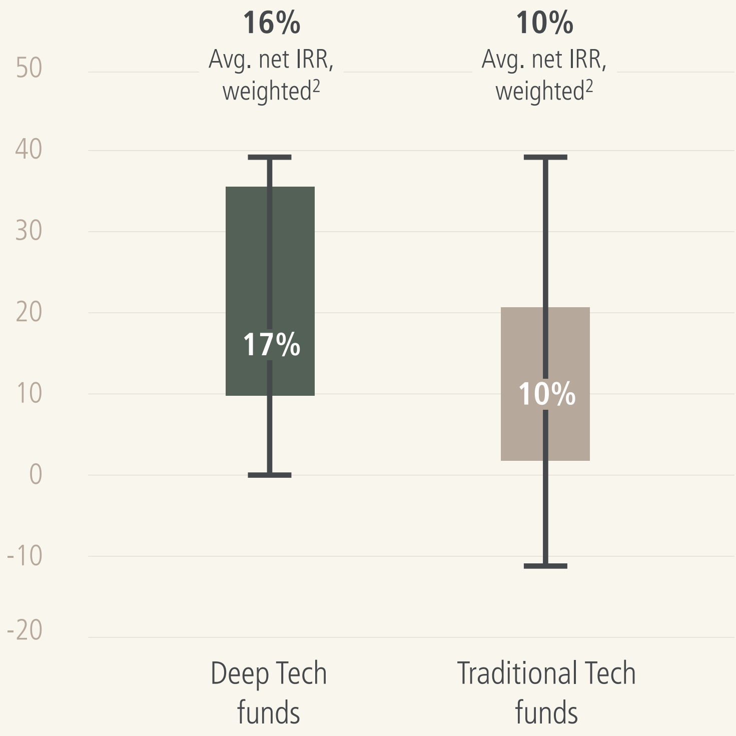
Deep Tech funds tend to generate similar to above average returns

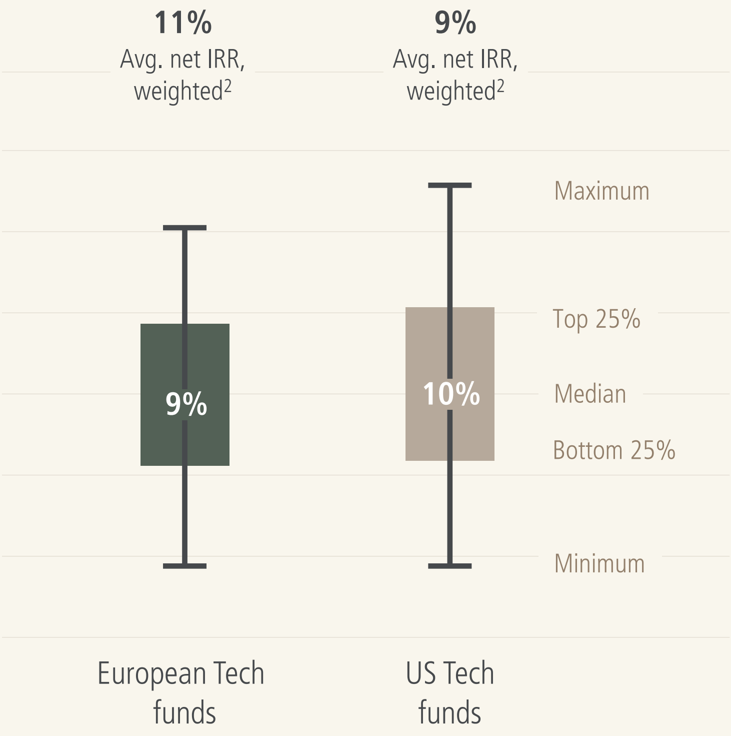
There is a clear trend showing Deep Tech-focused funds have outperformed traditional tech funds since 2003.

While Europe has not seen many Deep Tech-focused funds closing and reporting IRR, the expected performance should be in line with US-based benchmarks historically, driven by similarly attractive regional characteristics for Deep Tech and similar net IRR performance for the broader tech funds.

Net IRR for Deep Tech-focused and traditional funds[1]
%



Net IRR for European and US technology funds[1]
%



1) Based on 115 Deep Tech-focused funds and 1,572 traditional funds in Europe and North America, with vintage/inception year between 2003 and 2020
2) Calculated by weighting each fund's net IRR with its final fund closing size, i.e., large funds have more impact on the weighted IRR than small funds
Source: McKinsey, Preqin database (self-reported data on net IRR)

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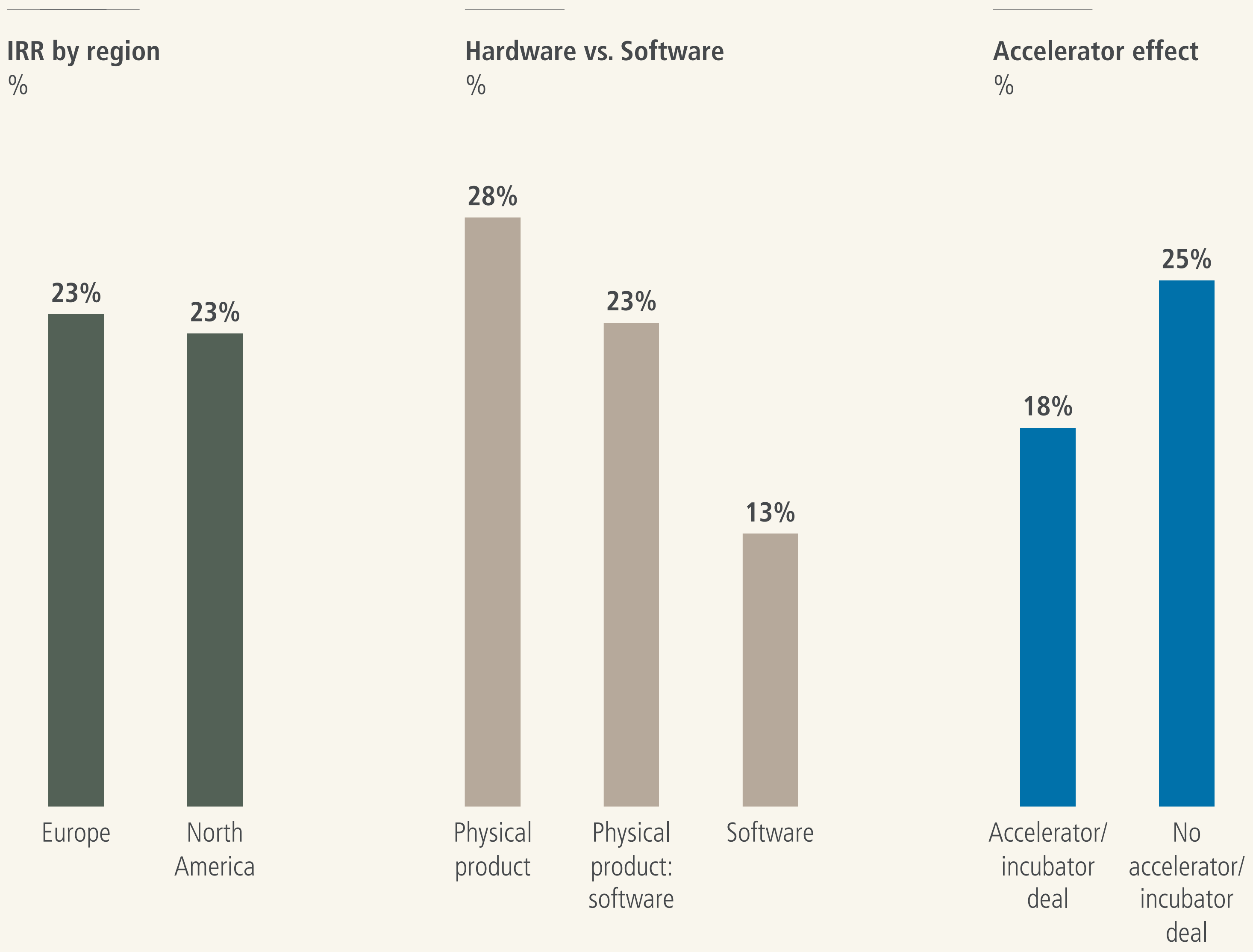
Hello Tomorrow survey confirms higher IRRs in Deep Tech

European Deep Tech startups slightly outperform their North American counterparts over an 8-year IRR.

Hardware startups outperform software startups.

Startups that didn't participate in accelerator/incubator programs outperformed those that did.



Source: Hello Tomorrow database analysis

Deep Tech is the backbone of European sovereignty

"Deep Tech will be the engine of Europe's next wave of innovation, driving breakthroughs from autonomous systems to space technologies.

If European defence spending rises to the estimated 3.5% of GDP, we expect around 10% of that – roughly €61bn per year – to be directly invested in European Deep Tech. With an assumed 4x revenue multiple, this would translate to an annual market impact of €245bn. This investment will extend far beyond pure-play defence applications, fuelling advances across the entire Deep Tech ecosystem and reinforcing Europe's technological sovereignty and global competitiveness."

KLAUS HOMMELS

FOUNDER OF LAKESTAR AND
CHAIRMAN OF THE NATO INNOVATION FUND

LAKE STAR NIF

LAKE STAR (W)C Walden Catalyst dealroom.co hello tomorrow

There are common (mis)conceptions about Deep Tech

1.

Is Deep Tech an *undefined term*?

NO

Deep Tech is novel science being shipped in a first of a kind product

2.

Is Deep Tech a *new phenomenon* in venture capital?

NO

Deep Tech venture financing has always existed and shaped sovereignty of nations

3.

Do Deep Tech companies need *more capital*?

YES

But often money is spent on building moats

4.

Do Deep Tech companies *take longer to achieve revenue*?

YES & NO

True in the early years, false at later stages

5.

Do Deep Tech companies *fail more often*?

NO

Similar failure rates compared to Regular Tech

6.

Do Deep Tech companies need *more time to exit*?

NO

Similar exit timelines compared to Regular Tech

7.

Do Deep Tech companies have *larger exits*?

INCONCLUSIVE

While some large outcomes exist, Europe needs more big exits

8.

Does Deep Tech investing deliver *top returns*?

YES

Some data shows higher IRRs than Regular Tech

2.
THE EUROPEAN DEEP TECH OPPORTUNITY

Strong European universities and research institutes ignite success stories

Europe's *universities* are 30% of top Computer Science institutions globally, with UK and Switzerland at the top

Computer Science ranking (THE 2024)

1. Oxford	UK	11. National University of Singapore	Singapore
2. Stanford	US	12. Tsinghua (Beijing)	China
3. MIT	US	13. Caltech	US
4. Carnegie Mellon	US	14. Cornell	US
5. ETH	Switzerland	**15. TU Munich**	Germany
6. Harvard	US	16. Peking University	China
7. Cambridge	UK	**17. EPFL (Lausanne)**	France
8. Imperial College London	UK	18. University of Washington	US
9. Princeton	US	19. University of Illinois at Urbana-Champaign	US
10. Berkeley	US	20. Nanyang Singapore	Singapore

Engineering ranking (THE 2024)

1. Harvard	US	**11. ETH**	Switzerland
2. Stanford	US	12. Georgia Tech	US
3. MIT	US	13. Nanyang Singapore	Singapore
4. Oxford	UK	14. Peking University	China
5. Cambridge	UK	15. Tsinghua (Beijing)	China
6. Berkeley	US	**16. Delft University**	Netherlands
7. Caltech	US	17. UCLA	US
8. Princeton	US	18. Yale	US
9. National University of Singapore	Singapore	19. University of Michigan-Ann Arbor	US
10. Imperial College London	UK	**20. EPFL (Lausanne)**	France

Europe is home to 40% of the top 10 world-class *research institutes;* Germany and France most prominent due to greater public funding

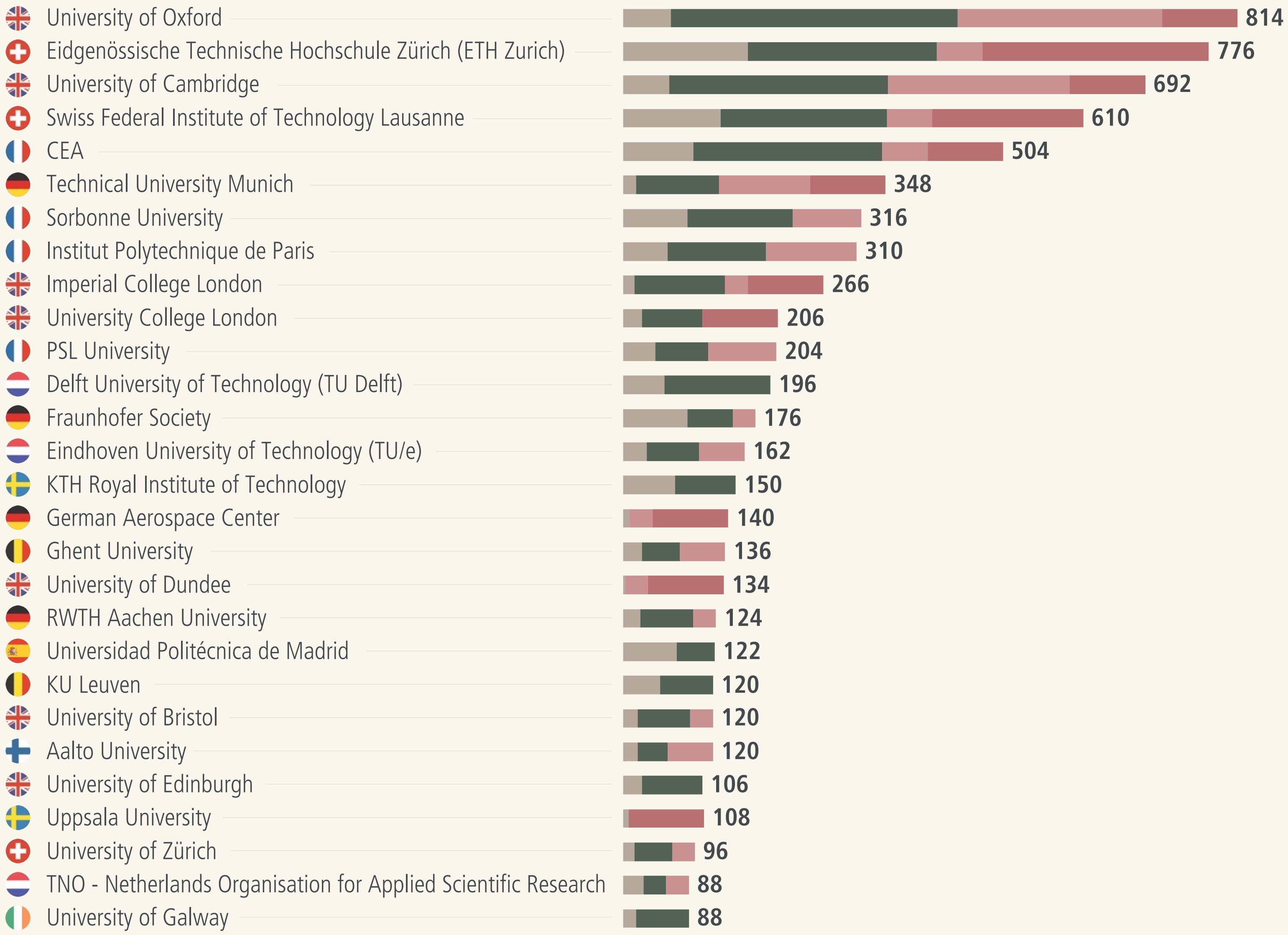
Rank	Institute	Country	Size	Visibility	Rich Files	Scholar
1	National Institutes of Health	US	1	2	2	6
2	National Aeronautics and Space Administration	US	7	3	19	18
3	**Centre National de la Recherche Scientifique CNRS**	France	**23**	**31**	**93**	**2**
4	**Max Planck Gesellschaft**	Germany	**45**	**21**	**3**	**4**
5	Chinese Academy of Sciences CAS 中国科学院	China	32	25	593	1
6	Centers for Disease Control and Prevention	US	73	4	28	42
7	US Department of Veterans Affairs	US	53	15	56	7
8	**Consejo Superior de Investigaciones Cientificas CSIC**	Spain	**26**	**60**	**11**	**6**
9	National Oceanic and Atmospheric Administration	US	30	6	22	68
10	**Consiglio Nazionale delle Ricerche CNR**	Italy	**22**	**56**	**15**	**9**
11	Lawrence Berkeley National Laboratory	US	37	26	5	21
12	Smithsonian Institution	US	14	11	31	71
13	US Geological Survey	US	25	12	32	66
14	National Institute of Standards and Technology	US	42	14	21	83
15	Commonwealth Scientific and Industrial Research Organization	Australia	20	32	16	27
16	**Karlsruher Institut für Technologie**	Germany	**15**	**38**	**24**	**35**
17	US Environmental Protection Agency	US	19	8	83	151
18	**Institut National de Recherche en Informatique et en Automatique**	France	**31**	**43**	**36**	**50**
19	**Institut National de la Santé et de la Recherche Médicale**	France	**108**	**175**	**13**	**8**
20	Argonne National Laboratory	US	162	54	18	48
21	Oak Ridge National Laboratory	US	240	46	23	54
22	**Fraunhofer Gesellschaft**	Germany	**90**	**28**	**87**	**67**
23	**Istituto Nazionale di Fisica Nucleare**	Italy	**62**	**121**	**1**	**40**
24	University of Texas M.D. Anderson Cancer Center	US	518	111	4	24
25	Sloan Kettering Memorial Cancer Center	US	368	107	6	26

Source: Dealroom.co; webometrics.info

Oxford, ETH, and Cambridge have the highest university spinout value

European universities which created most Deep Tech spinout value[1]

- Number of VC-backed startups (x2)
- Number of Series A+ startups (x10)
- Number of future unicorns (x30)
- Number of unicorns (x100)



1) Spinouts policies vary from country to country. Countries like France and Sweden are hard to compare due to the professor privilege model, where universities have no stake in any research innovation coming out of the research. The definition of spinouts and their comparison with other countries like UK, Germany and Switzerland is therefore challenging. Some organizations such as BPIFrance, Sorbonne, PSL, KTH collaborated in sharing detailed data for a fair comparison. The ranking might evolve with better involvement of more universities. Please reach out to Dealroom.co if interested in collaborating.

“Having worked with many Deep Tech ventures that most often originated in research labs and were run by scientists, I sense their openness of learning from other disciplines like business and entrepreneurship.”

ESCP BUSINESS SCHOOL

MARTIN KUPP

PROFESSOR FOR ENTREPRENEURSHIP AT ESCP BUSINESS SCHOOL AND CO-FOUNDER OF RENAISSANCE FUSION

“As a seasoned LP transitioning to a GP role, and in an increasingly unstable global context, it is evident that Deep Tech is fundamental to sourcing and fostering critical disruptive technologies that will enable Europe to remain at the forefront of innovation.

While striving to enhance technological sovereignty and independence by identifying and supporting world-class researchers and entrepreneurs who will drive change to make the world safer and more sustainable, we must also aim to achieve the highest financial returns. This requires supporting the transition from laboratories and research centres to the market.

The combination of these objectives is the only way to ensure that Europe remains competitive and attractive, allowing it to retain its position as a leading global entity.”

DAVID DANA

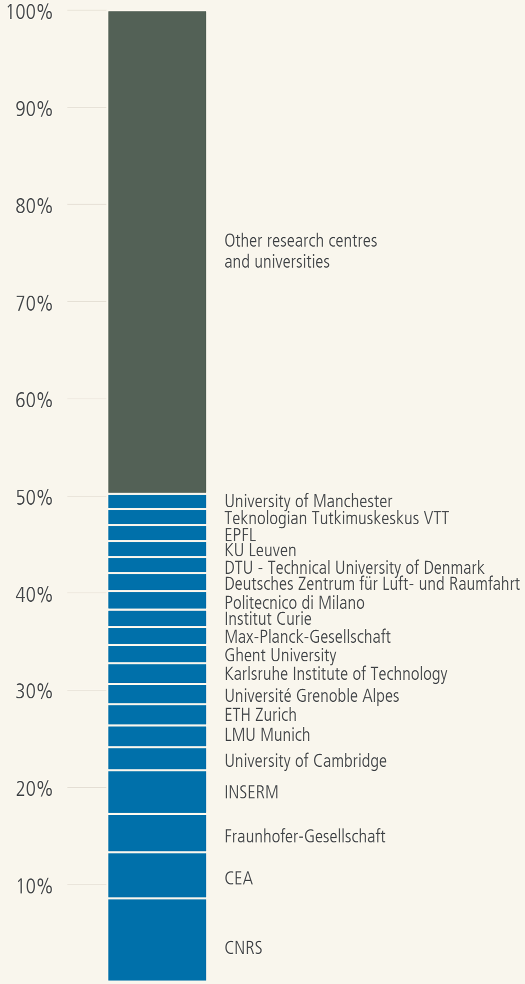
GENERAL PARTNER AT EXPANSION VENTURES AND FORMER HEAD OF VC INVESTMENTS DEEP TECH EIF

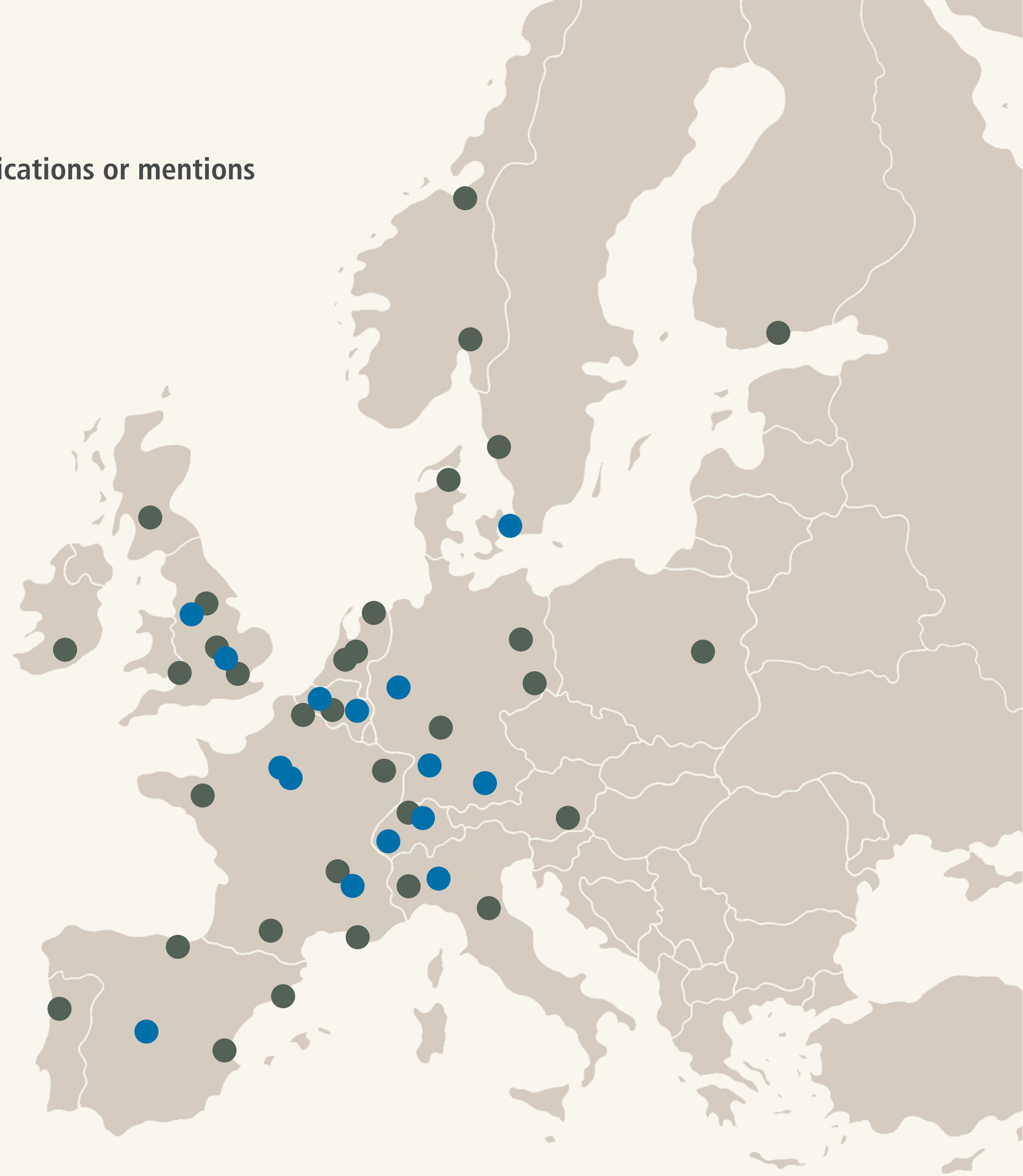
EXPANSION AEROSPACE VENTURES

Europe has a wealth of research hubs

In addition to the well-known major research centres, +150 other universities and research centres working with Deep Tech SMEs across Europe have been identified.

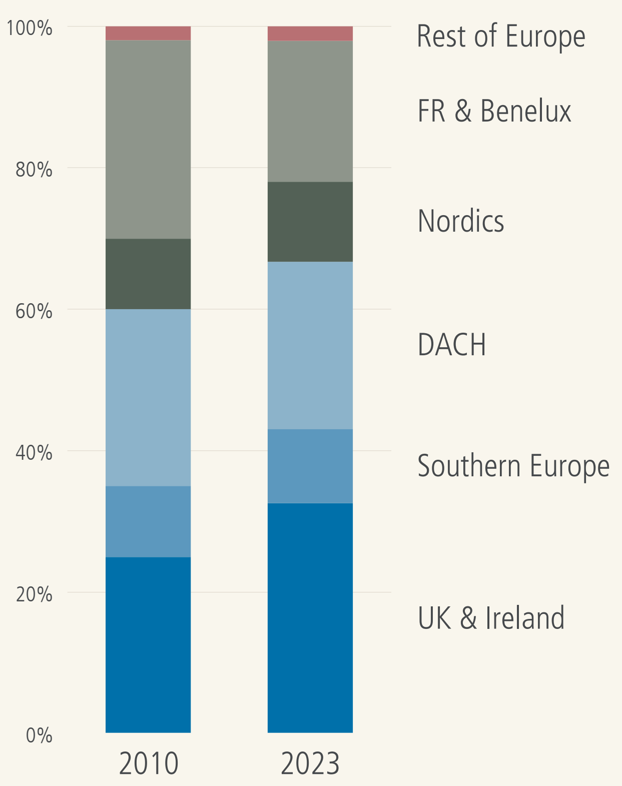
Distribution of the # of joint patents publications or mentions

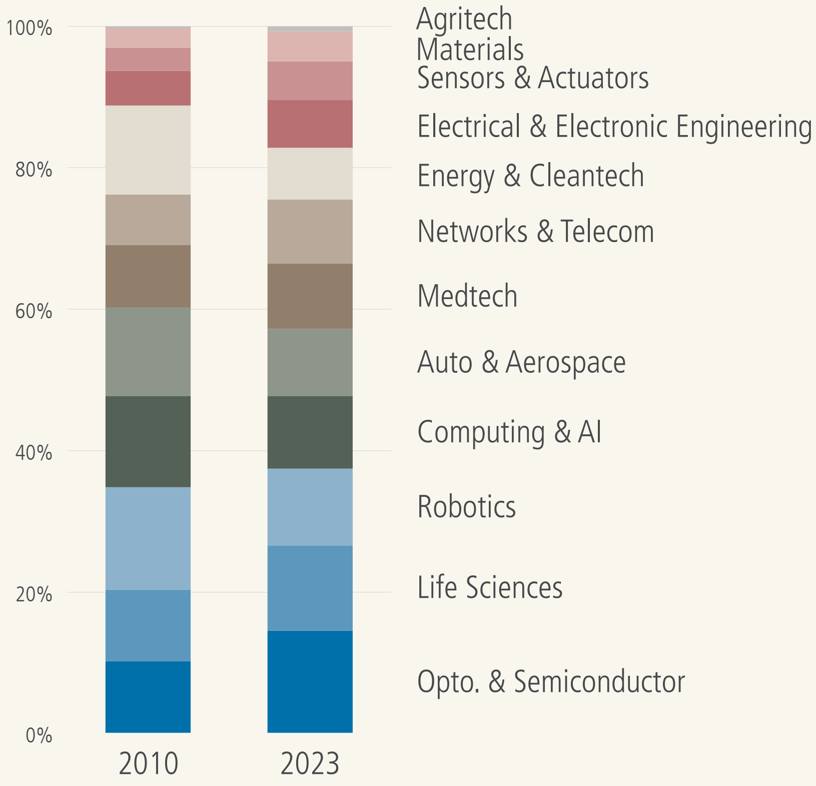




With a balanced patent activity across countries and technologies

Cumulative number of active patent filed by geography and domain exposure
%





Source: Jolt Capital

"IP, especially patents, are poorly understood by many people, and this ignorance is unfortunately growing. Patent families are no different from real estate portfolios: a genuine asset, set in stone and tradeable. Even Elon Musk, a man who often does things where his mouth isn't, is advising entrepreneurs to not file patents.

Do patents need a better seal of approval? As an investor in growth Deep Tech, we are adamant that innovations protected by a solid group of patents encapsulate huge value: it buys time to build the business, and it forces to formalize what's special about an innovation. That's why our proprietary AI JoltNinja rummages day and night through millions of patent files, to squeeze out every bit of insight possible about company value, but also about competitive landscapes, complex value chains, or tech trends."

JEAN SCHMITT

PRESIDENT & MANAGING PARTNER JOLT CAPITAL

Europe continues to be a hub of world-class innovation in Deep Tech

“Europe continues to be a hub of world-class innovation in Deep Tech, excelling in AI, semiconductors, quantum computing, energy, and robotics. Despite exceptional technical talent and groundbreaking research, the region has produced few global leaders in these transformative fields. To bridge this gap, increased late-stage capital, a focus on global leadership—not just regional excellence— and a strong support ecosystem are crucial to translate cutting-edge research into market-leading solutions.

WCV has a proven track record in Deep Tech investments, backing European companies like Darktrace, Nearfield Instruments, ANYbotics or Peptone. With Europe’s strong academic foundations, an expanding base of seasoned operators, and increasing public-private support, we believe the region is well-positioned to produce the next wave of Deep Tech global leaders. We remain fully committed to driving this transformation, and are more excited than ever about the opportunities ahead.”

YOUNG SOHN

FOUNDING MANAGING PARTNER WALDEN CATALYST VENTURES
CHAIRMAN OF HARMAN INTERNATIONAL
CHAIRMAN OF THE ADVISORY BOARD OF SAMSUNG SEMICONDUCTOR

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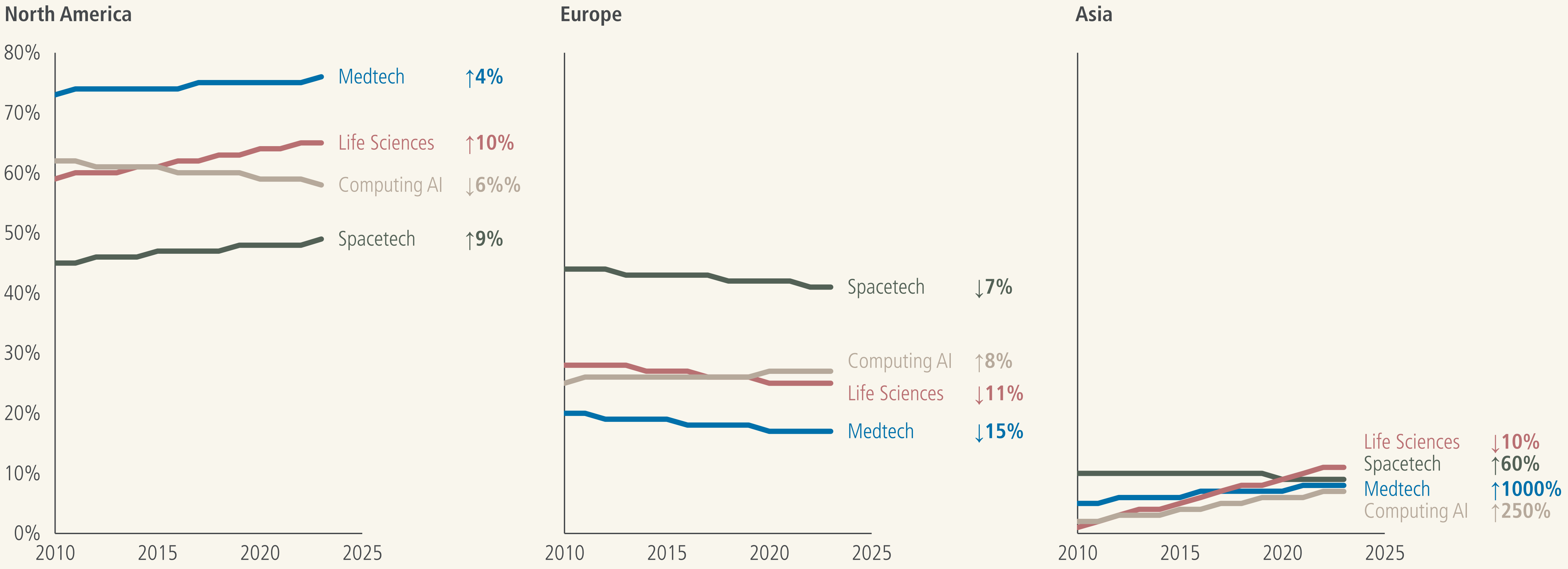
However, on an international level, Europe needs to fight for its share

Top percentile of patents filed by technology, ↑↓ change 2010-25



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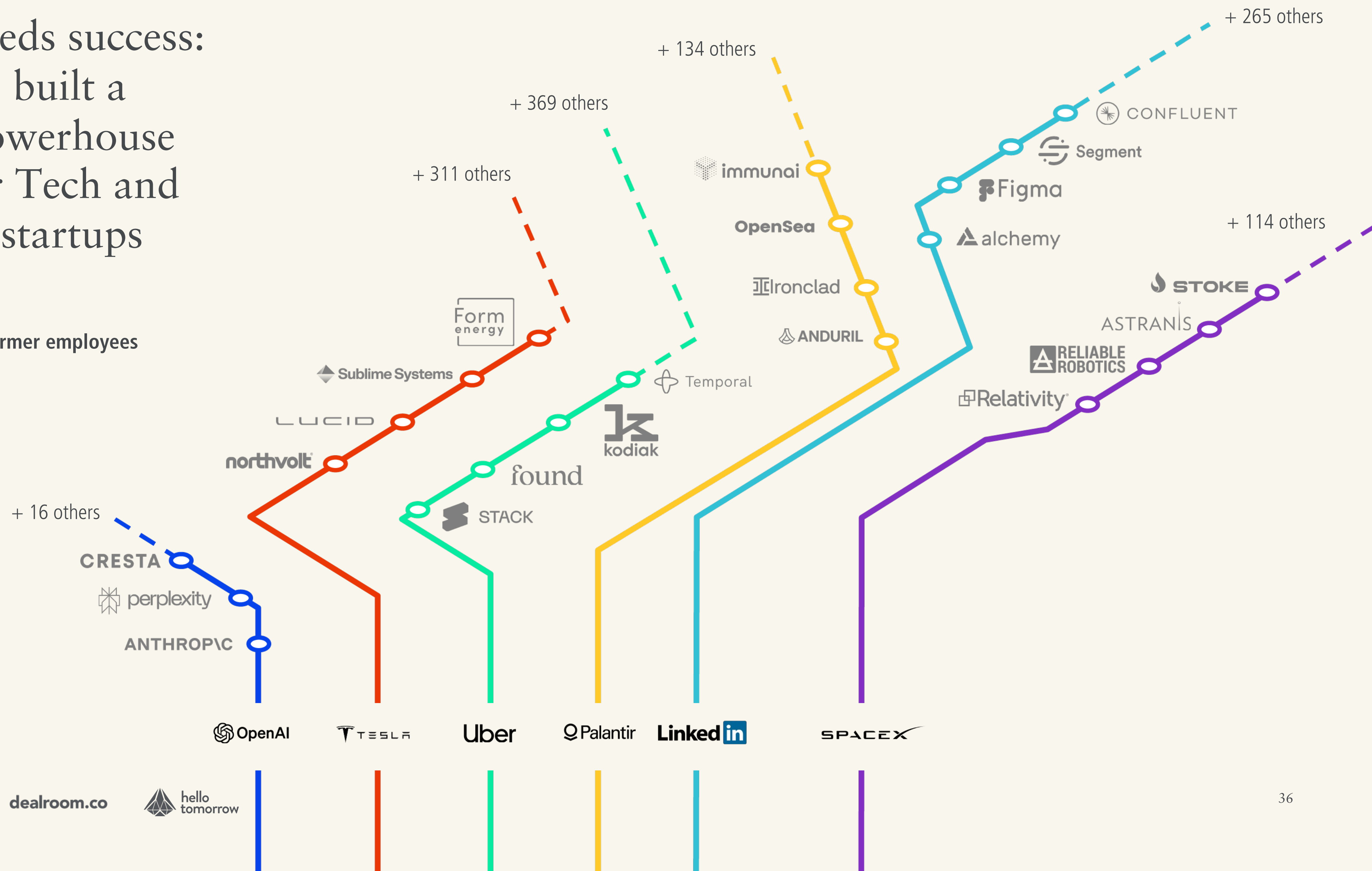
Success breeds success: The US has built a flywheel powerhouse for Regular Tech and Deep Tech startups

Startups founded by former employees of US scaleups



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Europe's flywheel is mostly driven by shallow tech companies so far

Shallow tech unicorns have spun out by far the most founders, but *less than 5% are starting Deep Tech ventures*.

Yet, most ingredients now also exist in Europe:

1. Increased allocation of VC funding to Deep Tech category
2. Emergence of high-profile Deep Tech startups "made in Europe"
3. Sophisticated Deep Tech Angels and early-stage investors

Startups founded by former employees of European scaleups

Company	Startups founded
Spotify	41
Delivery Hero	38
zalando	37
CRITEO	35
Revolut	34
Klarna	32
N26	31
Glovo	29
deliveroo	27
wise	27
BlaBlaCar	27
WiX	25
Playtika	22
skype	22
King	19
babylon	17
Doctolib	17
JUST EAT	17
monzo	17
Payoneer	16
Skyscanner	15
celonis	14
conduit	13
sumup	13

Source: Dealroom; Accel

In Deep Tech, the flywheel is only starting to spin in Europe

Select European Deep Tech spin-outs (click to view live version)

DeepMind
Combined funding $ 1.7B

Mistral AI, H Company, Isomorphic Labs, Orbital Materia, Kyutai, Latent Labs, Iconic AI, Glyphic AI, Human Native..., Runa AI, Haiper AI, Story Protocol, Adia, Aggero, Dayhoff Labs, Open Climate Fi, TinyURL, Abante AI, Segments.ai, EquiLibre Techn, Elefant AI, Reliant AI, Finster AI, Phare Health, Inductiva

Celonis
Combined funding $ 46M

NXRT, Kranus Health, Edgeless System, Presize.ai, remberg, InfinitiBit, Welcomy, Wearr, Helical, Penzilla, Company Shield, Zenesis, VESTIGAS

Owkin
Combined funding $ 128M

Bioptimus, Raidium, Entalpic, Comand AI, CURE51, Hapni, Sarus, Paire, AlephD

Darktrace
Combined funding $ 29M

Senseon, Astron Systems, PryvX, Modat, Slip (Informati, Prevalent, Benjee, Daisy App

Northvolt
Combined funding $ 32M

Volta Greentech, Rebaba, Nrlyze, Deepc, Infinion

Climeworks
Combined funding $ 31M

Neustark

Graphcore
Combined funding $ 3.2M

Xonai

Stability AI
Combined funding $ 28M

Black Forest La

Agile Robots
Combined funding $ 20M

Hivetop, Unlikely

Volocopter
Combined funding $ 1.5M

Alpine Eagle, SPiNE

Methodology used comes from Accel & Dealroom report series "Europe and Israel's founder factories". A startup is considered to be part of a unicorn's "mafia" or snowball effect when a founder has held a full-time position at the parent company for more than five months. The end date of the experience at the unicorn should not have been more than six years prior to the launch of the new tech-enabled company. The list excludes agencies and consultancies. The list also excludes startups which never raised any VC financing or scaled beyond the founder, but it does include newer active startups which might be scaling up. It also excludes companies founded by people who were at the founders' factories as consultants / interim / advisory roles. Includes only startups founded in Europe.

The European Deep Tech ecosystem is maturing

“Over the past decade, the entrepreneurial culture in Europe has grown far beyond Deep Tech, fostering a generation of seasoned founders. At the same time, the Deep Tech ecosystem has matured, becoming clearer, more structured, and more accessible.

Now is the time to make it truly attractive to these entrepreneurs—so they can tap into cutting-edge technologies, apply their expertise, and build world-class startups.

With strong political momentum at both national and European levels, the conditions have never been better to accelerate this shift.”

DAVID BOUJO

DEEP TECH DEPUTY DIRECTOR, BPIFRANCE

bpifrance

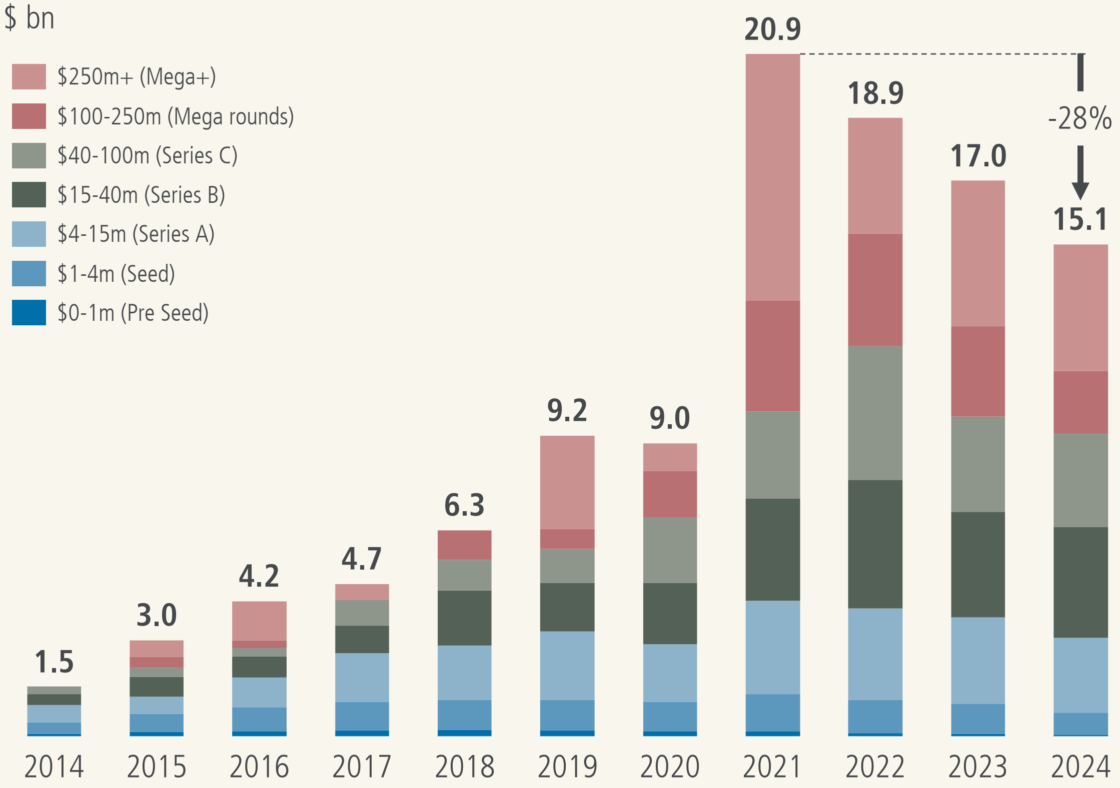
3.
FUNDING LANDSCAPE

Deep Tech provides a hedge against momentum-investing: While Regular Tech is down 60% from its 2021 all-time highs, Deep Tech is down only 28%

DEEP TECH

VC funding in European Deep Tech startups by stage

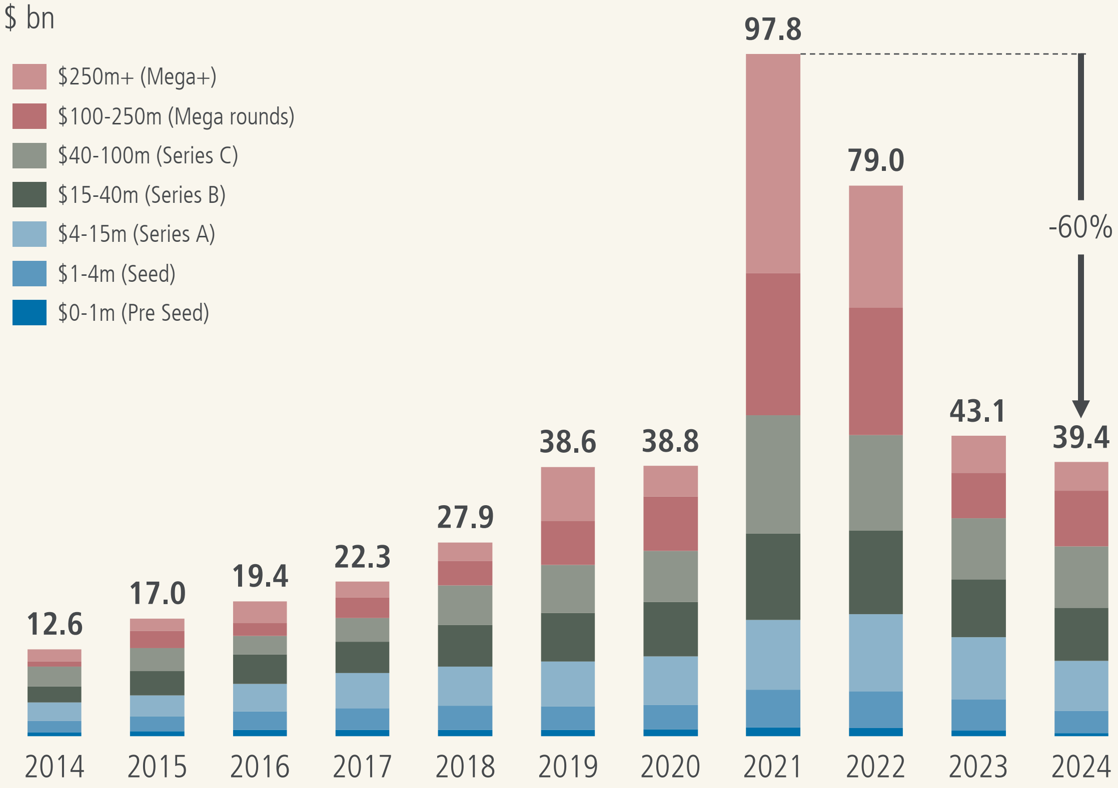
$ bn



REGULAR TECH

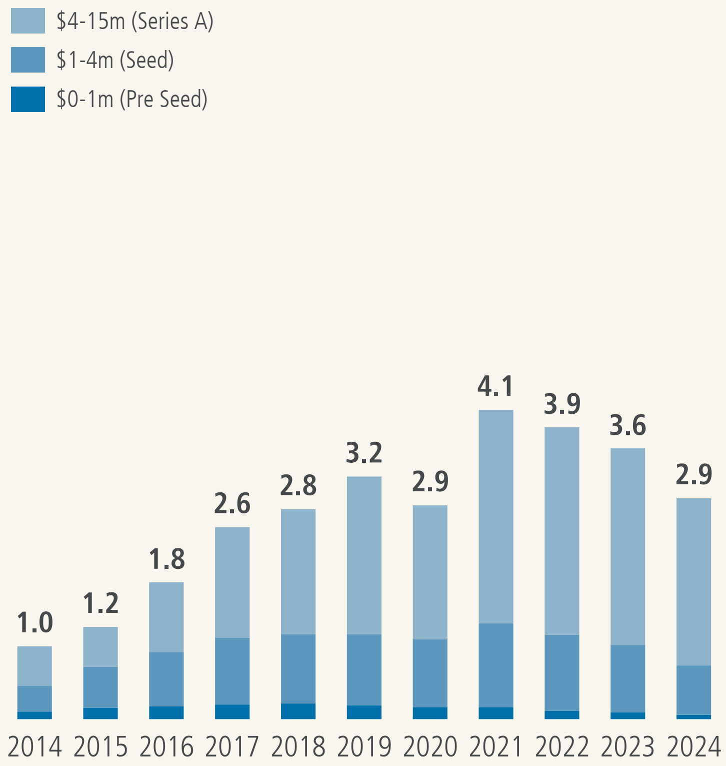
VC funding in European Regular Tech startups by stage

$ bn

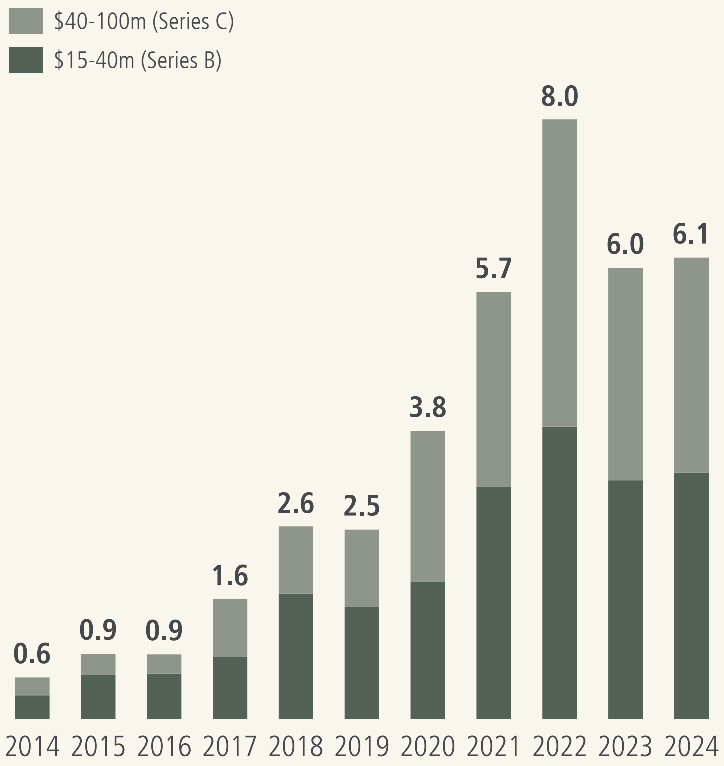


Growth-stage funding had its second most active year and slightly up from 2023. Early and late-stage are down 30% and 50% respectively since their peak in 2021

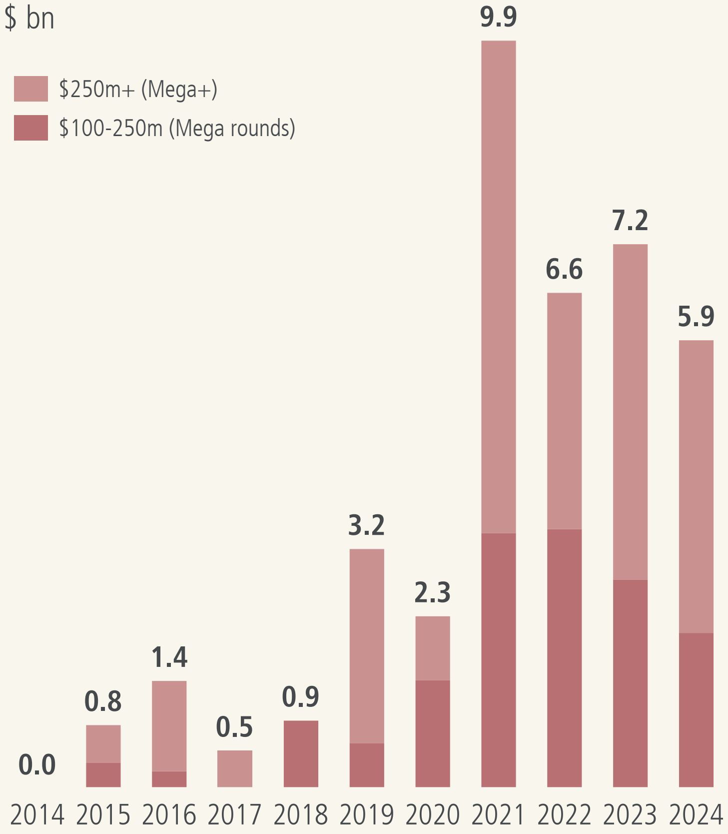
Early-stage Deep Tech rounds
$ bn



Growth-stage Deep Tech rounds
$ bn

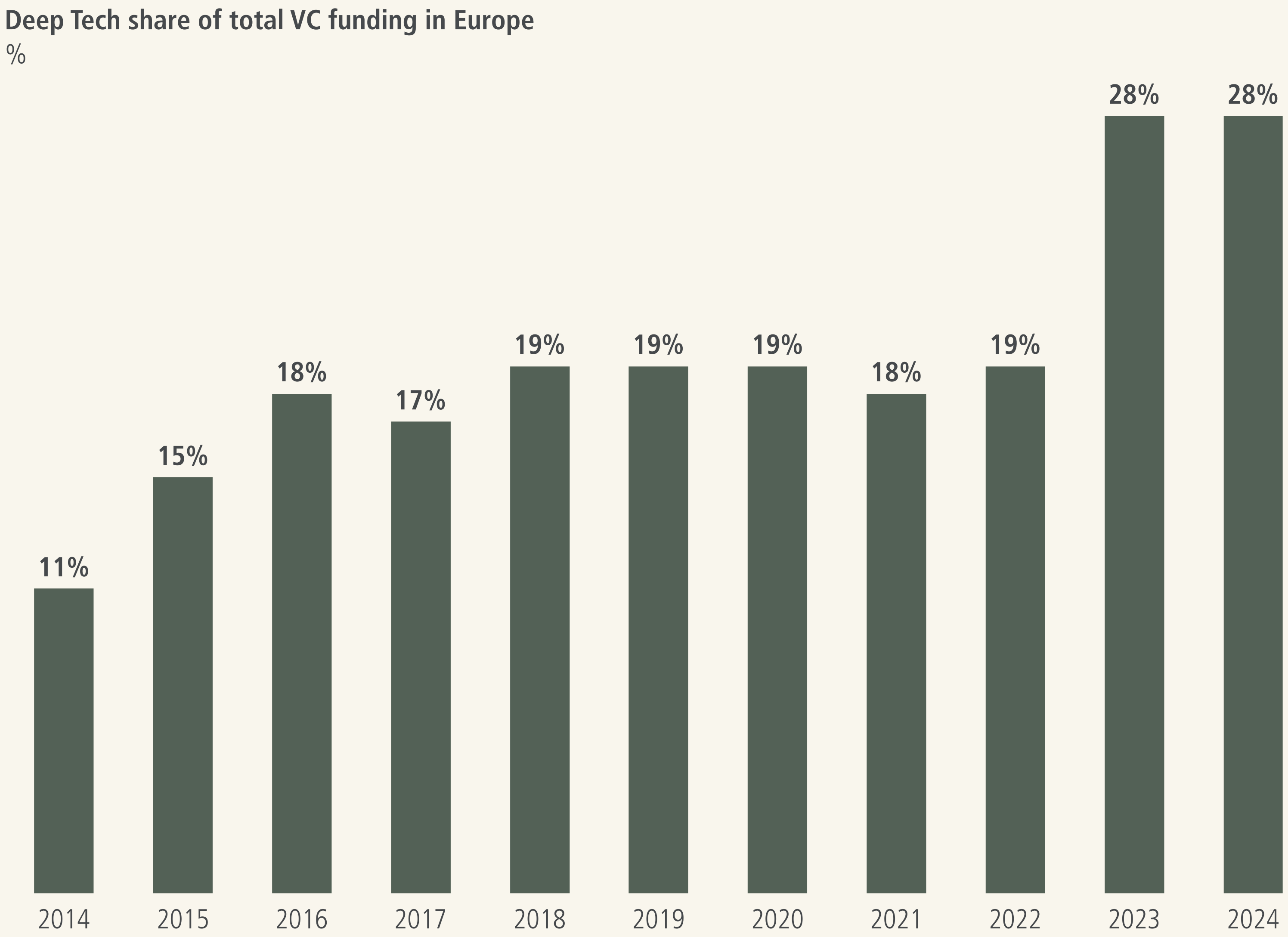


Late-stage Deep Tech rounds
$ bn



Deep Tech is attracting a record share of VC funding in Europe since 2023 – Nearly one third

The share of funding going to Deep Tech is also up 2.5x in the last decade.



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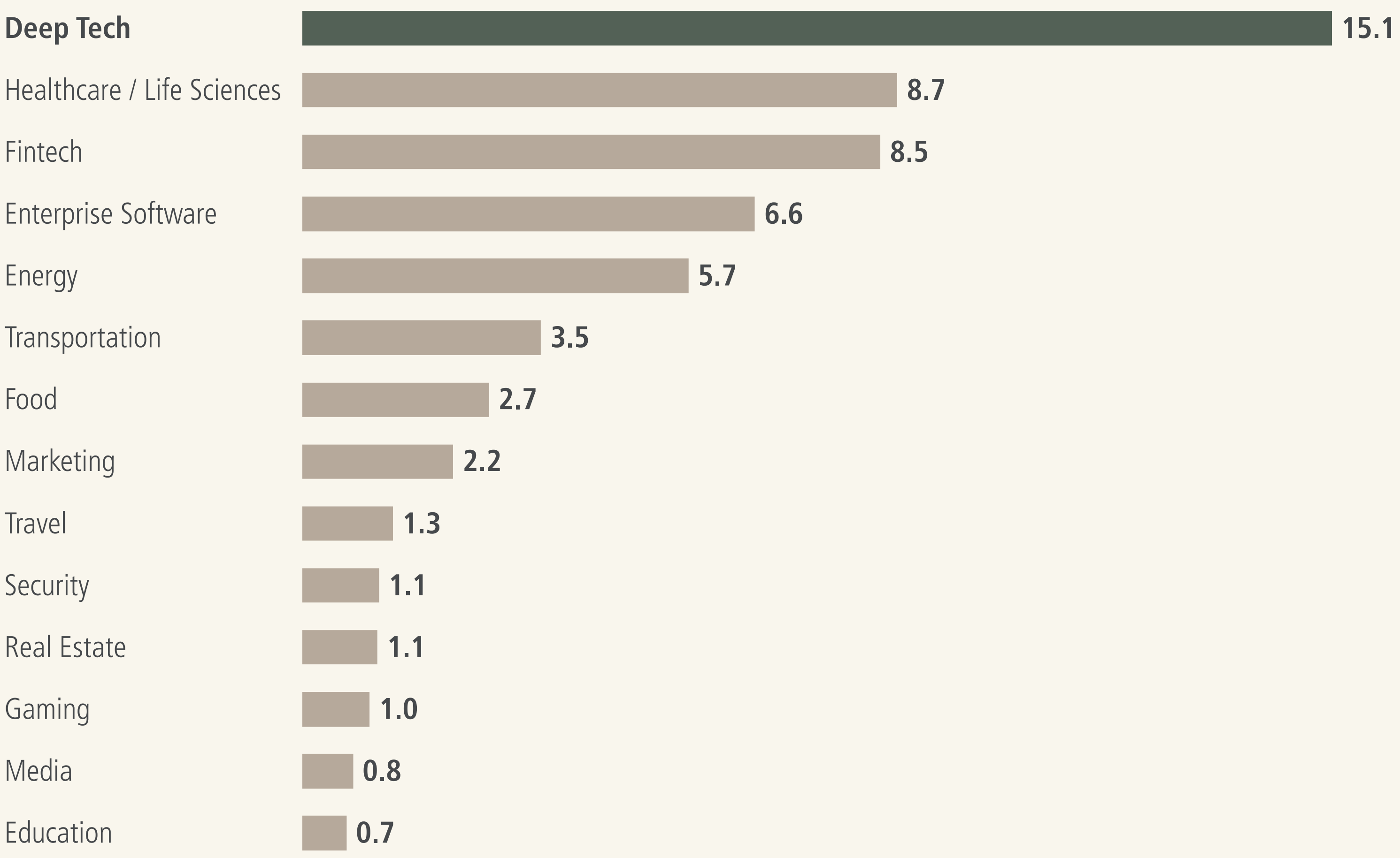
Data of 7 January 2025

Deep Tech attracted significantly more funding than any other sector in 2024

Followed by Healthcare / Life Sciences and Fintech.

Comparison of VC funding by industries in Europe 2024 (excluding Deep Tech from the other industries[1])
$ bn



1) This means that energy here is intended as Energy not Deep Tech, so excluding sectors like nuclear fusion and fission, next generation batteries and so on. The same applies to the other industries shown. There can also be overlap between segments, like health insurance being both in health and fintech for instance.

Data of 7 January 2025

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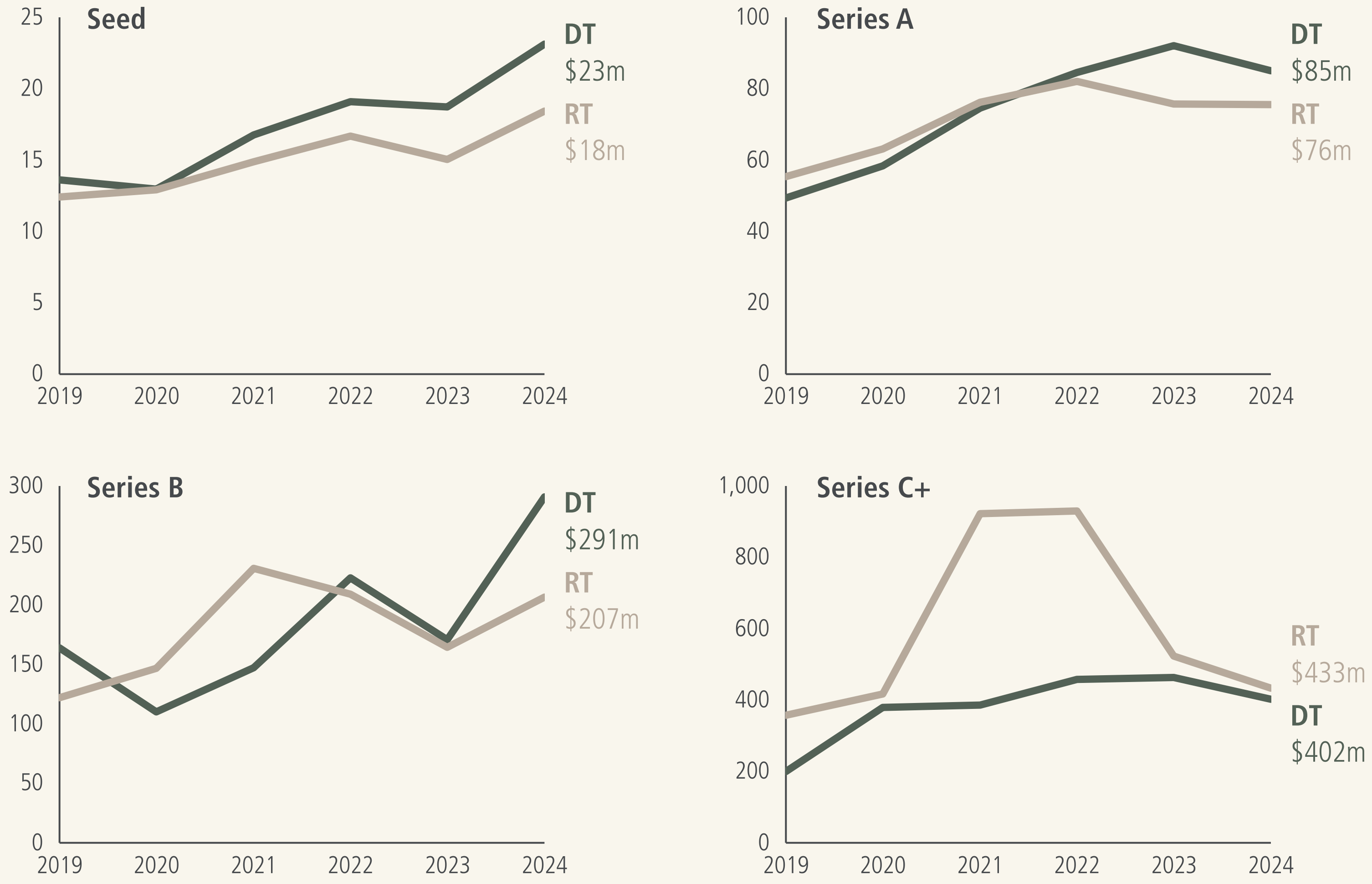
Seed valuations are increasing

Valuations for Deep Tech are increasing at early and early-growth stages, with the most significant rise at Seed and Series B.

At the late-stage & pre-IPO rounds valuations remain relatively stable for Deep Tech, while the rest of the tech sector has seen a significant decline from all-time highs in 2021.

Average valuation by round type, Deep Tech (DT) vs Regular Tech (RT)
$ m



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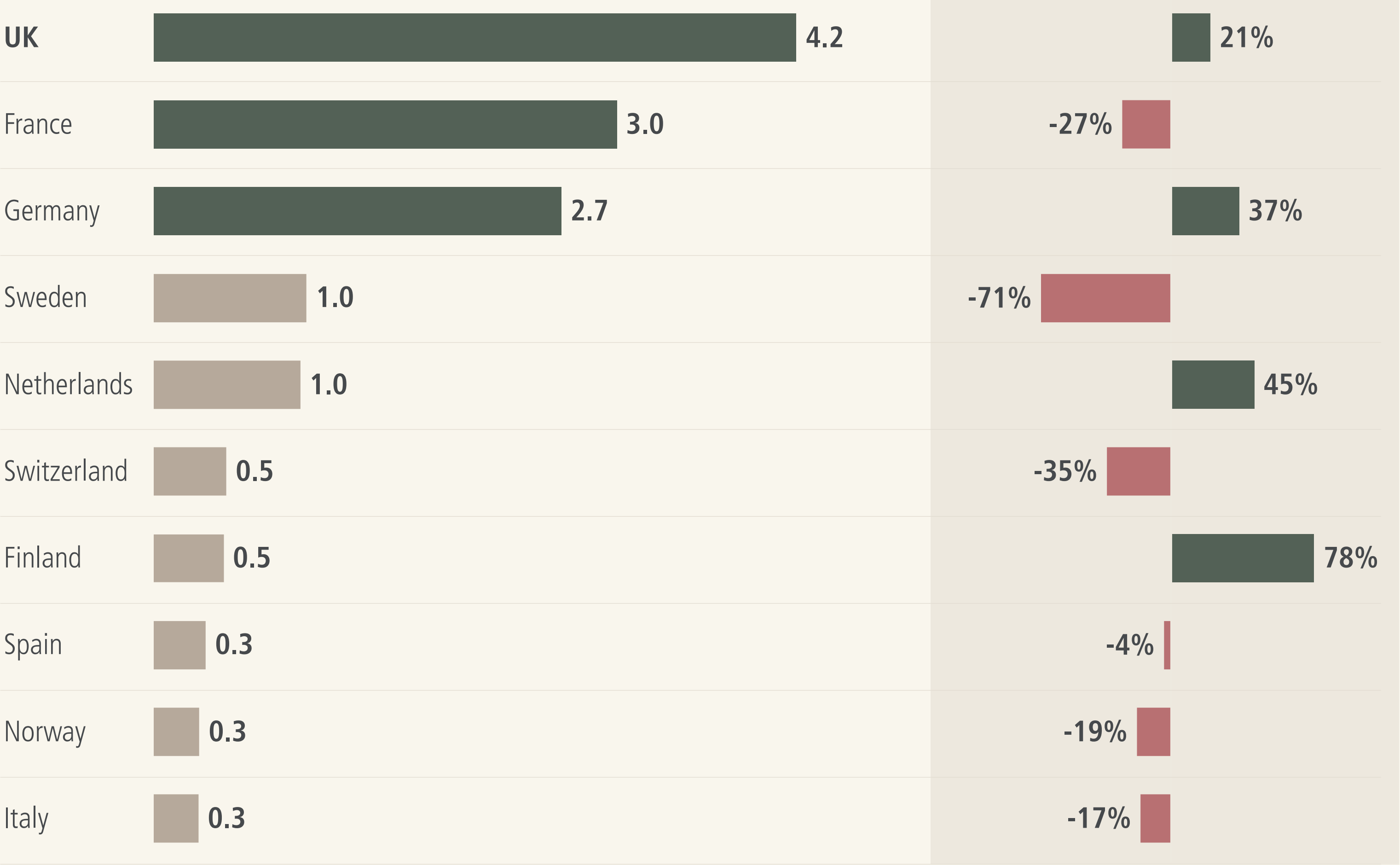
The UK attracted the most Deep Tech funding in 2024

France comes second but shows the strongest slow down among the big three.

Sweden comes fourth but largest drop among the top countries, while neighbouring Finland shows strongest growth.

Deep Tech VC funding by country in Europe 2024
$ bn

YoY growth
%



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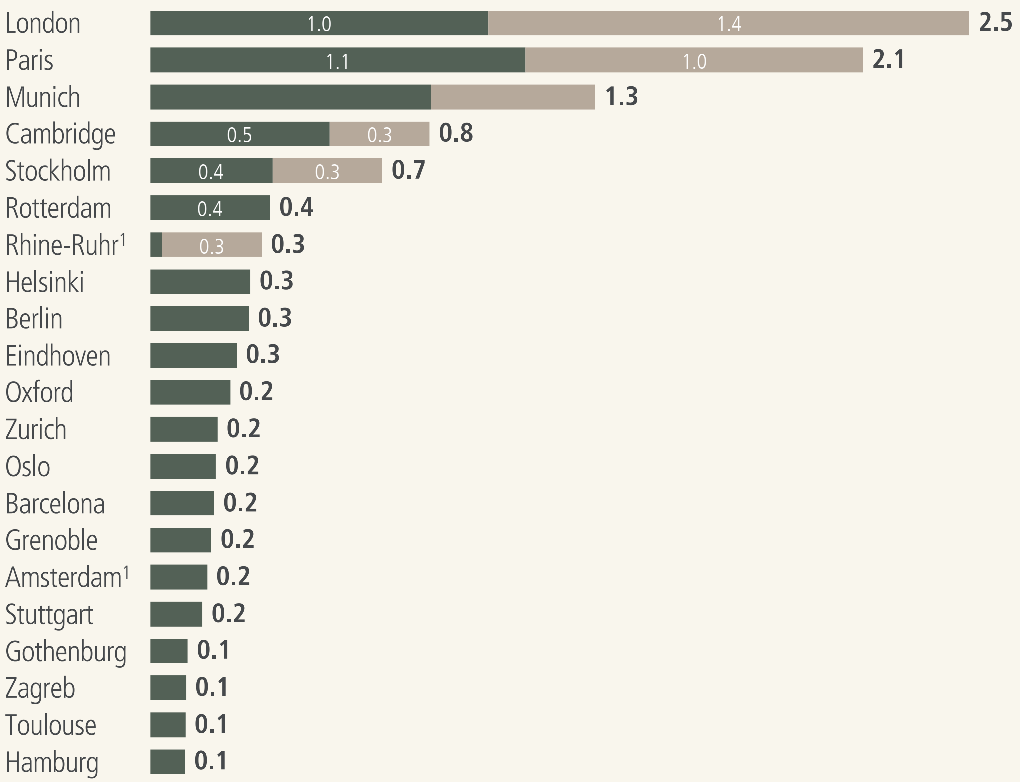
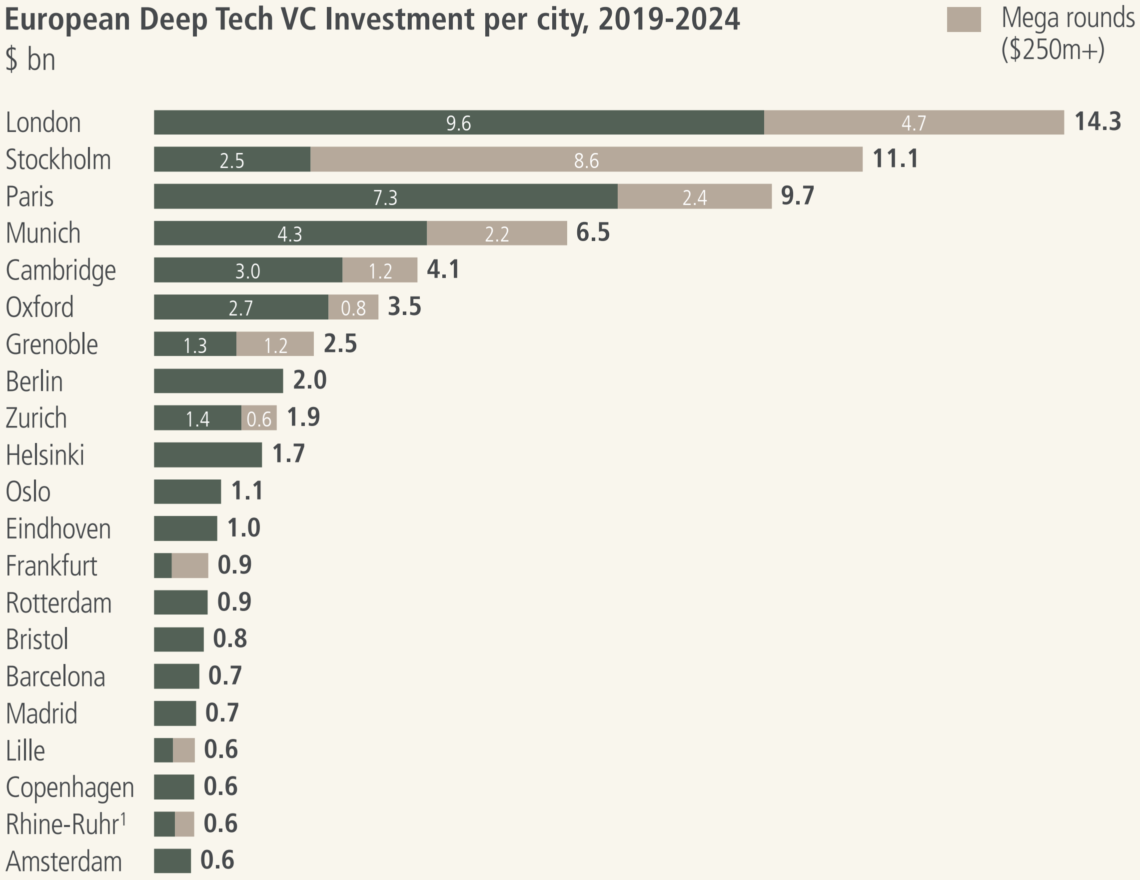
Data of 7 January 2025

London, Paris, Munich, Cambridge and Stockholm continue to be the main Deep Tech hubs in Europe

European Deep Tech VC Investment per city, 2024
$ bn



European Deep Tech VC Investment per city, 2019-2024
$ bn



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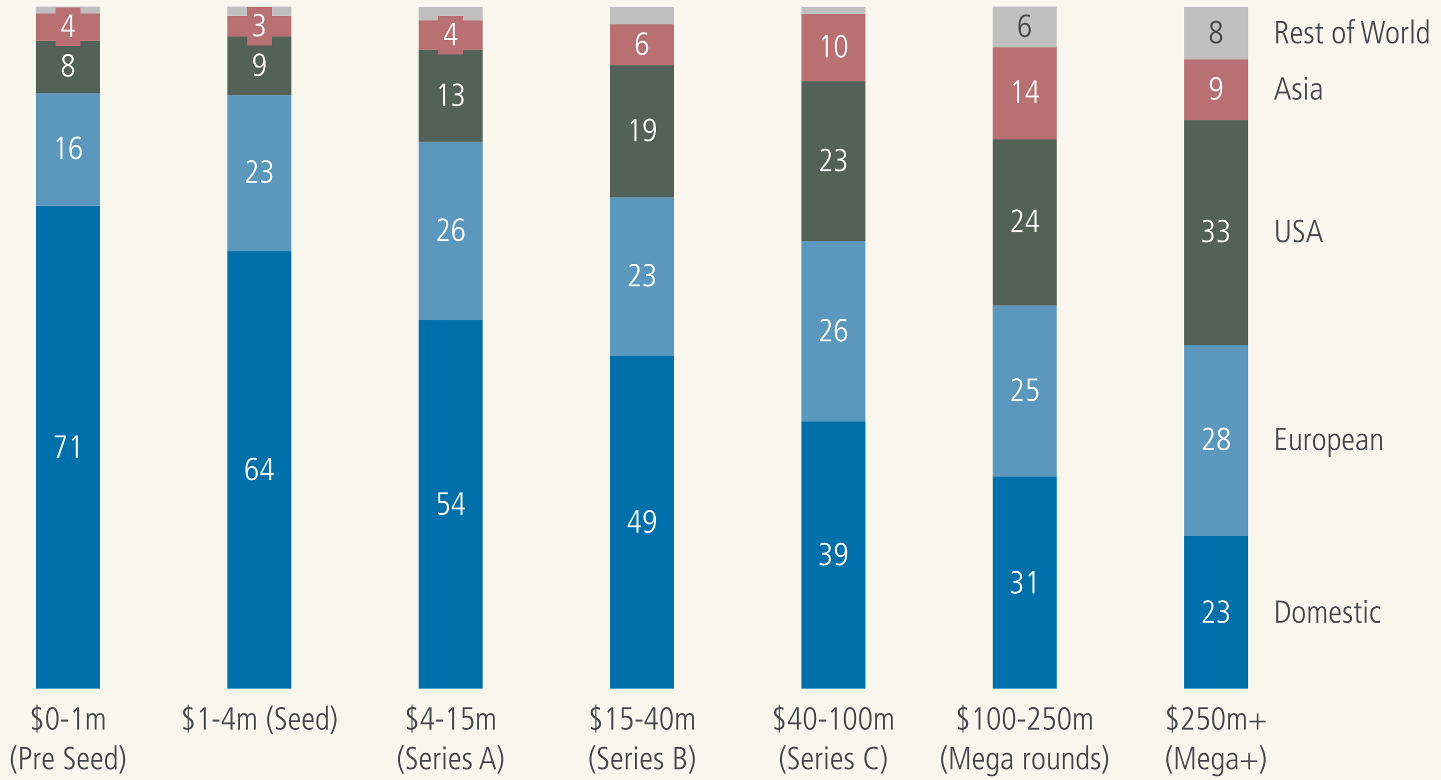
1) Cologne and Dusseldorf
Note: Cities here include their metropolitan area e.g., London is Greater London, Berlin is Berlin/Brandenburg Metropolitan Region

However, half the money is coming from non-European investors at late stage

VC investment in European Deep Tech by source of funds, 2023-2024

%



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Data of 7 January 2025

"Compared to a decade ago, when we hosted the first edition of the Hello Tomorrow Summit, Deep Tech in Europe has matured significantly. Today, founders speak the language of business, not just science; investors are increasingly drawn to this promising asset class; and Deep Tech is widely recognized as key to tackling major challenges, from climate change to global health.

But Europe's Deep Tech ecosystem still has a long way to go. Companies often turn to the US or the Middle East to secure large funding rounds for scaling, and Europe still lacks the risk appetite and "venturing mindset" essential for pioneering new technologies and businesses.

I hope that the current geopolitical turmoil will at least serve as a wake-up call. If we want to shape our own future, we must recognize that scaling Deep Tech companies in Europe is not just an opportunity—it's a necessity."

ARNAUD DE LA TOUR

CO-FOUNDER & CEO
HELLO TOMORROW

hello tomorrow

In Europe, a wide range of VC funds actively invest in Deep Tech

For a more comprehensive list [click here]

	Dedicated Deep Tech European funds	Sector agnostic European funds	Corporate investors	Global investors active in Europe
Series C+ (Growth)	Jolt Capital, British Patient Capital, Super Nova Invest, OMNES	Baillie Gifford, EQT Ventures, Eurazeo, lightrock	Tencent, Marubeni, swisscom, aramco, novo	SoftBank, BlackRock, Mubadala, Temasek Holdings, Insight Partners
Series A/B (Early)	b to v, Amadeus Capital Partners, UVC Partners, Singular Capital, matterwave ventures, FORWARD.one, Parkwalk Investing in Innovation, Innovation Industries, INNOVACOM	Lake Star, Atlantic Bridge, DEMETER, Balderton capital, atomico, Sofinnova partners, Index Ventures, HV Capital, octopus ventures, EARLYBIRD, Molten	Vopak, G/, TRUMPF, M12, ABB, equinor, Sony Innovation Fund, Bosch Ventures BOSCH, Airbus Ventures, M. Ventures, imec xpand, Shell Ventures	Walden Catalyst, Founders Fund, Eclipse, General Catalyst, iqt In-Q-Tel, khosla ventures, Lux, DCVC
(Pre-)Seed	ipgroup, Seraphim, Apex Ventures, Air Street Capital, Quantonation, elaia, SFC, hoxton ventures, Voima Ventures, Deeptech Labs, 7percent ventures, IQ Capital, Oxford Science Enterprises, High-Tech Gründerfonds, Chalmers Ventures, vsquared ventures, University of Cambridge enterprise, conceptionx, Singular., Atlantic Labs, European Innovation Council, Unruly Capital, bpifrance, Cambridge Innovation Capital	Speedinvest, mercia asset management, Entrepreneur First, techstars_, MAKI.VC, kima ventures, Verve Ventures	imec, wayra, intel Ignite	Y Combinator, SOSV, EZMC, Type One Ventures

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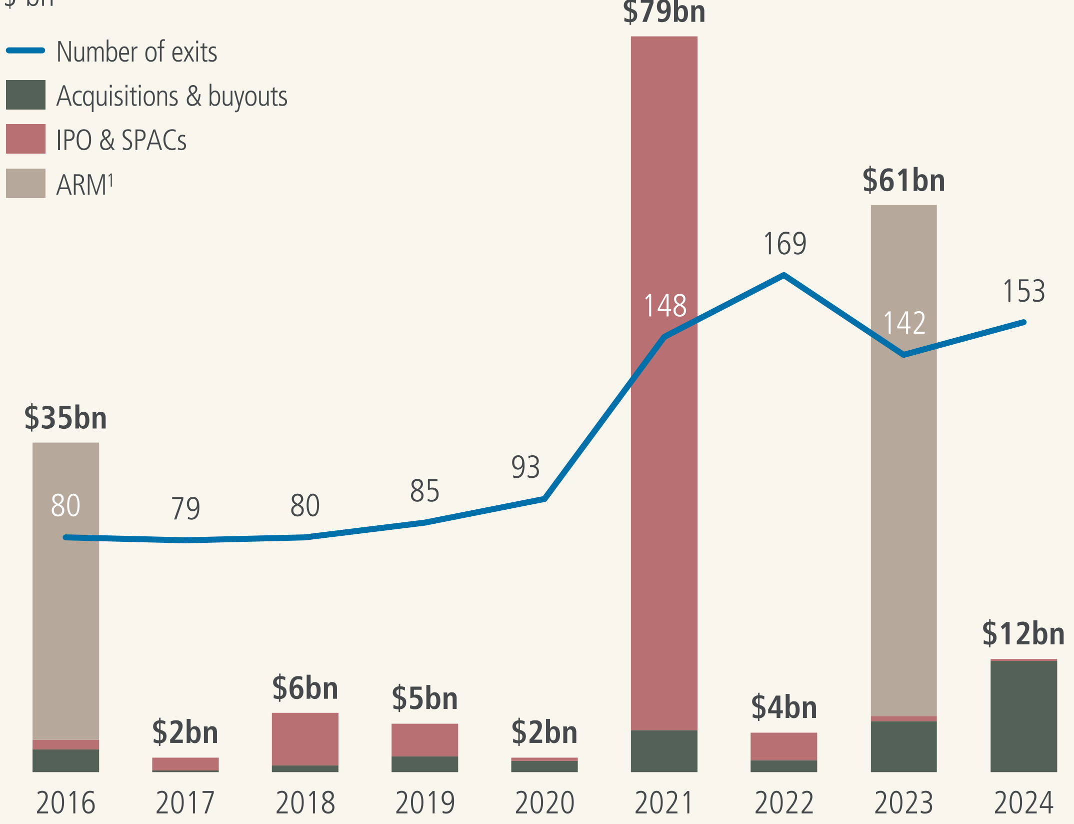
Funds selected based on number of rounds and amount invested in 2023-2024, % of rounds in Deep Tech and qualitative considerations. Investors are shown only at the most common entry stage point. Global investors investing in Europe based Deep Tech startups.

M&A activity remains strong, but the two largest exits, Darktrace and Exscientia, were publicly listed European Deep Tech firms acquired by US players

Combined value of European Deep Tech exits

$ bn



Select European Deep Tech exits in 2024

Startup	Sector	Acquisition type	Acquiror	Value at exit
DARKTRACE	AI-driven cybersecurity	Buyout[2]	Thoma Bravo	$5.3bn
Exscientia	AI drug discovery	Acquisition[3]	Recursion Pharma	$688m
SILO AI	AI research lab	Acquisition	AMD	$665m
GRAPHCORE	AI chips	Acquisition[4]	Softbank	$600m+
NIL TECHNOLOGY	Meta-optics design and production	Acquisition	Radiant Opto-Electronics	€250m
PRELIGENS	AI for aerospace and defence	Acquisition	Safran	€220m

Includes also exits of companies founded in Europe but relocated abroad.
1) ARM had been previously acquired by Softbank for £24bn in 2016; 2) Darktrace previously listed on LSE in April 2021 at £1.7bn. The buyout came as a 44% premium on the 3-month average; 3) Exscientia previously listed on Nasdaq at $2.9bn; 4) Graphcore was last valued $2.8bn in a Series E round in Dec 2020

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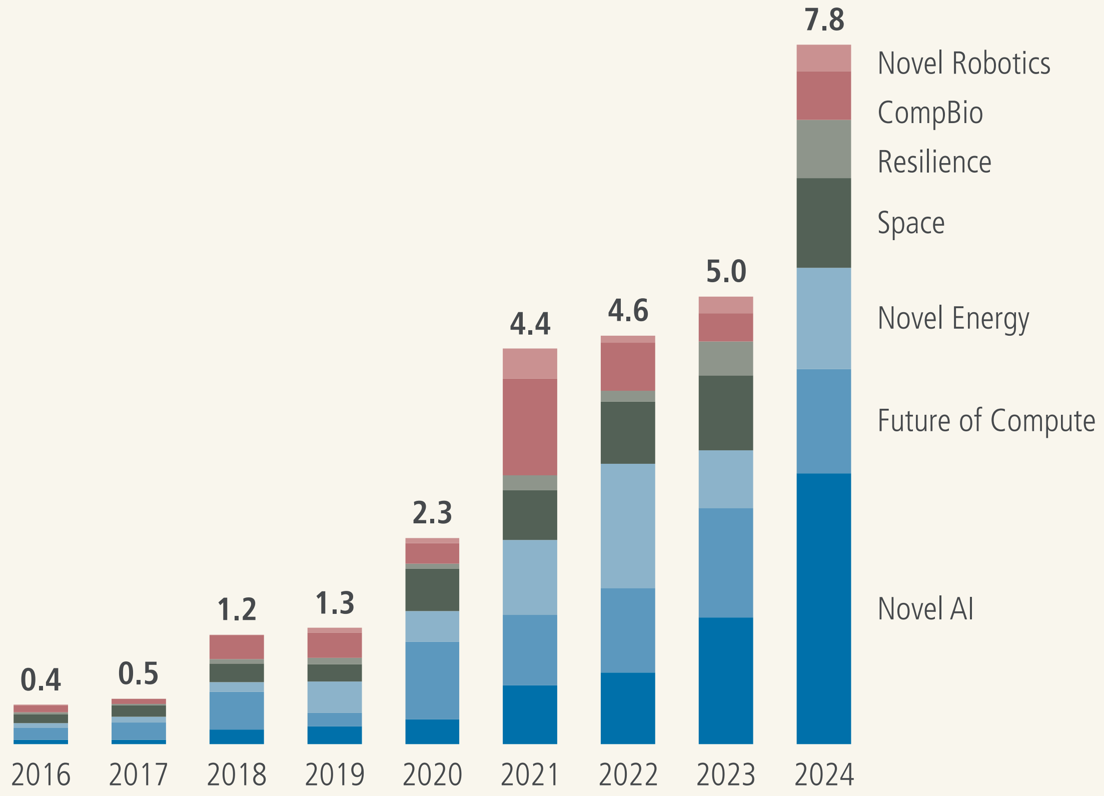
4.
SEGMENT DEEP DIVES –
BIGGEST TRENDS

Deep Tech segment overview and what to expect from this year's report

NOVEL AI	Deep dive LLMs deep dive
FUTURE OF COMPUTE	Deep dive Photonics deep dive
NOVEL ENERGY	Deep dive Nuclear Fission deep dive
SPACE TECH	Overview
RESILIENCE	Deep dive
COMPUTATIONAL BIOLOGY & CHEMISTRY	Overview
ROBOTICS	Deep dive
ADVANCED MATERIALS	Not covered in this report
SYNTHETIC BIOLOGY	Not covered in this report
OTHER	Not covered in this report

VC funding at all-time-high with $7.8bn (+56%) for Novel Deep Tech segments

VC funding in European Deep Tech startups
$ bn



Select Novel Deep Tech VC-rounds in 2024

Startup	Funding round	Focus
1X	$100m Series B	Novel Robotics: Humanoids
BASECAMP RESEARCH	$60m Series B	CompBio: AI discovery of biological compounds
Helsing	€450m Series C	Resilience: AI x Defence
The Exploration Company	€158m Series B	Space: In-space transportation
newcleo Futurable Energy	€135m Series A	Novel Energy: Nuclear fission (SMRs)
QUANTINUUM	$300m Late VC	Future of Compute: Quantum computing
WAYVE	$1.1bn Series C	Novel AI: Autonomous Driving

Deep Tech unicorns in Europe

		Headquarters	Founded	Industries	Valuation	Stage
BIONTECH	BioNTech	Mainz	2008	Techbio	$12.5bn	Public
MISTRAL AI_	Mistral AI	Paris	2023	Novel AI	$6.4bn	Series B
DARKTRACE	Darktrace	Cambridge	2013	Cybersecurity	$5.8bn	Public
QUANTINUUM	Quantinuum	Cambridge	2021	Future of Compute	$5.3bn	Late Stage
WAYVE	Wayve	London	2017	Novel AI	$3.0bn	Series C
Helsing	Helsing	Munich	2021	Resilience	$2.0-3.0bn	Series C
DeepL	DeepL	Cologne	2009	Novel AI	$2.0bn	Series C
EXOTEC	Exotec	Croix	2015	Robotics	$2.0bn	Series D
climeworks	Climeworks	Zurich	2009	Energy	$1.9bn	Series F
NEKO	Neko Health	Stockholm	2018	Health	$1.8bn	Series B
newcleo	Newcleo	Paris	2021	Novel Energy	$1.7bn	Series A
CRISPR THERAPEUTICS	CRISPR Therapeutics	Basel	2013	Techbio	$1.6bn	Public
Oxford Nanopore Technologies	Oxford Nanopore Technologies	Oxford	2005	Techbio	$1.3bn	Public
LOFT ORBITAL	Loft Orbital	Toulouse & San Francisco	2019	Space Tech	$1.1bn	Series C
CELESTIA	Celestia	Vaduz	2019	Future of Compute	$1.0bn	Series C
OWKIN	Owkin	Paris	2016	CompBio	$1.0bn	Series B

NOVEL AI

DEEP DIVE

EXAMPLES

HOMOMORPHIC ENCRYPTION

FEDERATED LEARNING

EXPLAINABLE AI

SEMANTIC AI

GENERATIVE DESIGN ENGINEERING

TINYML

AUTONOMOUS SYSTEMS

EMPIRIC AI

MULTI-MODALITY

xLSTM

PERSONAL AI

Novel AI – *What's new?*

LLM specialization

Large Language Models are increasingly tailored for domains like biology, chemistry, and robotics, enhancing their applicability in specialized fields.

Emphasis on reasoning in AI models

A shift towards enhancing reasoning abilities in AI models, with techniques like reinforcement learning and chain-of-thought prompting leading to breakthroughs in recent models.

It's all about GPUs and capital expenditure in AI

Significant investments are shaping the AI landscape, e.g., President Trump announced a $500bn AI initiative, OpenAI's CEO, Sam Altman, is reportedly seeking a trillion-dollar fund to advance AI research, and collaborations between BlackRock and Microsoft have led to the establishment of dedicated data centre funds. This is based on the belief that more cash, i.e., more data and more training, will lead to better model performance.

Open source vs. closed source

Open-source AI models are rapidly improving, narrowing the performance gap with proprietary counterparts, fueling ongoing debates about accessibility and control.

Identifying revenue-generating use cases for AI

Despite substantial capital expenditures, revenue generation from AI technologies has lagged. This prompts comparisons to the railroad industry: building infrastructure with the expectation that profitable applications will follow.

Integrating AI with physical world understanding

Current AI models lack a comprehensive understanding of the physical world and its laws. There's a significant push to integrate AI with physical principles, such as the Navier-Stokes equations for fluid dynamics, to enhance modeling accuracy.

Increased focus on inference

The emphasis on reasoning has heightened demands on inference processes. Although inference costs are decreasing, the overall workload is expected to rise as models incorporate more advanced reasoning capabilities.

Emergence of AI agents

The development of AI agents capable of performing tasks autonomously is a potential avenue for commercialization. OpenAI's "Operator" is an example of this approach. The rise of such agents raises questions about the future role of APIs in a landscape where agents can operate independently.

The next wave of generative AI will focus on specialization

“While foundational models offer broad capabilities, fine-tuning for specific industries and tasks will drive greater accuracy, efficiency, and user trust.

This shift opens opportunities for entrepreneurs to build niche, high-value solutions, while VCs will find more defensible IP in vertical applications.

Technologists will be key in refining data pipelines and integrating models into real-world workflows while learning from subject matter experts. They will also need to orchestrate various models and tools like RAG or reasoning and memory to best serve the needs of their users.

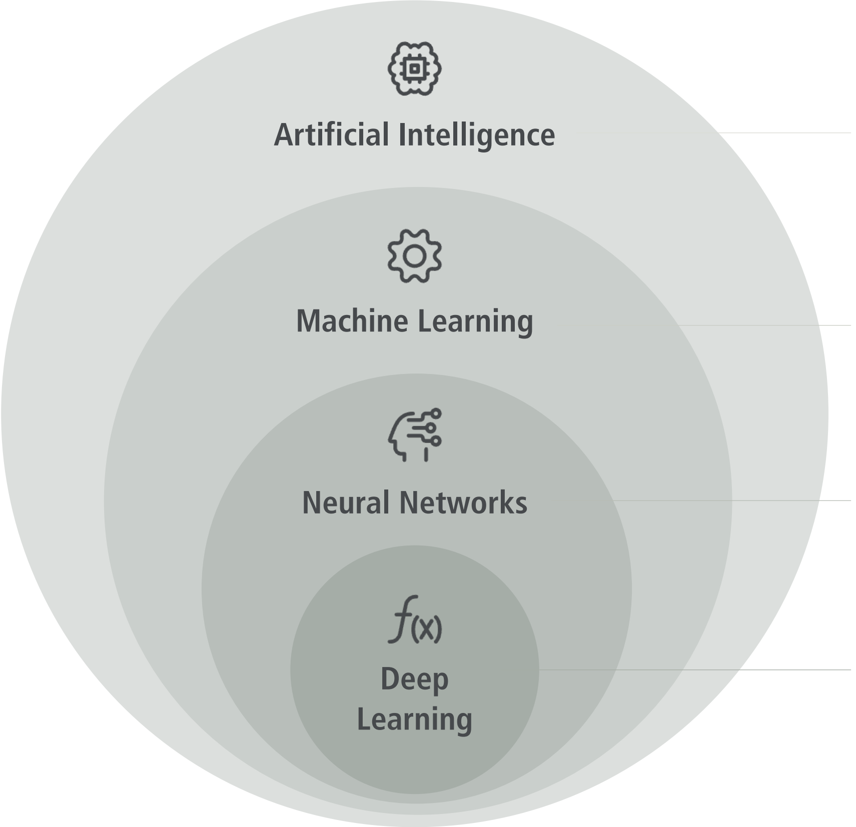
Specialization will be the catalyst for the next generation of scalable, high-impact AI products!”

MEHDI GHISSASSI
CPO AT AI71

AI71

Novel AI is a subset of AI, referring to fundamentally new maths and algorithms

What is Artificial Intelligence?



A technique which enables machines to **mimic human behaviour**

Subset of AI technique which uses statistical methods to enable machines to **improve with experience**

Subset of ML inspired by the human brain which **mimics the way biological neurons communicate** with one another

Enables the computation of **multi-layer neural networks**

What is 'Novel' AI?

'Novel' AI refers to fundamentally new maths and algorithms that are being used in products and companies for the first time.

Conversely, applied AI refers to AI that is well understood and has already been applied to an industry. It is not considered novel.

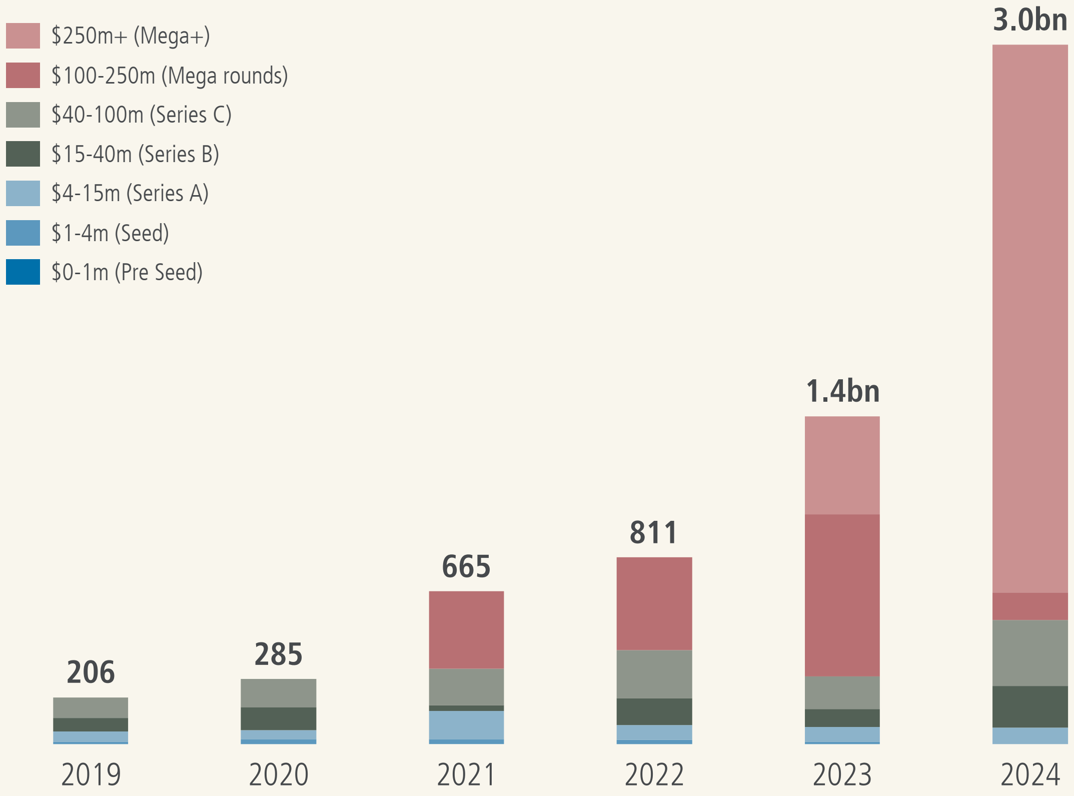
Novel AI example sub-categories

Federated Learning	Explainable AI
Homomorphic Encryption	Semantic AI
TinyML	Autonomous Systems

Novel AI funding more than doubled from last year, led by LLMs and autonomous driving

VC funding in European Novel AI startups[1]

$ m



Select European Novel AI VC-rounds in 2024

Startup	Funding round	Focus
WAYVE	$1.1bn Series C	Autonomous driving
MISTRAL AI_	€468m Series B	Foundational Models
poolside	$500m Series B	AI coding with LLMs
DeepL	$300m Late VC	Language translation
H	$200m Seed & Convertible	AI agents
black forest labs.	$31m Seed	LLMs for image and video generation

1) In this report more LLMs model makers have been included into Novel AI in respect to the latest edition. Conigital autonomous driving financing has been removed due to the discovery that the rounds never finalized. Data of 14 January 2025

Novel AI startups in Europe

(click to view live version)

Autonomous driving
Combined funding $ 1.8B

aiMotive, Wayve, Oxa, Sensible 4, EasyMile, Five AI, Gama, Kognic, Embotech, Humanising A..., Conigital, driveblocks

Explainable and aligned AI
Combined funding $ 80M

Aligned AI, CausaLens, Deeploy, QuantPi, Calvin Risk, Unlikely

Text processing, Speech Recognition & conversational AI
Combined funding $ 131M

PolyAI, thingsTHINKING, Gladia

Privacy-preserving AI and data analytics (e.g. synthetic data)
Combined funding $ 293M

Synthesized, Sherpa, Brighter AI, Statice, Mostly AI, Privitar, Decentriq, Hazy, Mindtech Global, Anyverse, YData, Sarus, Sky Engine AI, Octopize, Syntho, Oblivious, Syntheticus, Pionic, Generatrix, Usencryption, Syndata, Trūata, VEIL.AI, KIProtect, Syntonym, Aindo

Privacy Enhancing Technologies (PETs)
Combined funding $ 497M

Ravel Technolog, Zama, Linksight, Roseman Labs, Vaultree, FLock.io, Mithril Securit, Astran, Edgeless Syst..., Apheris AI, Bitfount, Owkin

New AI/ML tech stack (AI acceleration, error correction)
Combined funding $ 112M

InstaDeep, Boltzbit, Tenyks, Embedl, Qsimov

Neuromorphic AI algorithms
Combined funding $ 33M

Another Brain

General-purpose AI
Combined funding $ 4.5M

Google Deep..., GoodAI, NNAISENSE

Generative AI model makers
Combined funding $ 1.8B

Stability AI, Aleph Alpha, LightOn, Conjecture, Mistral AI, Black Forest La, nyonic

Generative design engineering & AI-aided engineering
Combined funding $ 104M

Neural Concept, Monolith AI, Frenetic, PhysicsX, BeyondMath

GenAI infrastructure
Combined funding $ 22M

Flower Labs

GenAI applications with proprietary models
Combined funding $ 1.3B

Poolside AI, Diffblue, DeepL, Synthesia, Raidium

TinyML
Combined funding $ 3.7M

Plumerai, Hoursec Energy, Literal Labs

Symbolic AI
Combined funding $ 3.4M

UMNAI

AI agents (long term memory, error correction tc)
Combined funding $ 31M

Convergence, dottxt, Juna.Ai

AI foundation models are evolving toward holistic, multi-modal biology solutions

“This year we have witnessed impressive progress in AI foundation models for different fields of science, in particular biology.

So far, these models focus on specific data modalities and use cases, such as therapeutic protein generation from large language models on protein sequences, or diagnostics systems from foundation models on histopathology images, and have demonstrated impressive gains resulting from scaling the models and training sets.

Breaking data silos and connecting these modalities into a holistic, multiscale AI model of biology, as we do at Bioptimus, is coming next and will unlock novel use cases such as multimodal biomarkers and end-to-end rational drug discovery and development.”

JEAN-PHILIPPE VERT

CO-FOUNDER BIOPTIMUS AND
CHIEF R&D OFFICER OWKIN

BIOPTIMUS OWKIN

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LARGE LANGUAGE MODELS

SEGMENT DEEP DIVE

When it comes to AI, we need innovation that we can really rely on, not science fiction

“When it comes to AI, we need innovation that we can really rely on, not science fiction. Everyone obsesses over LLMs, but the current approach is bloated, power-hungry, and hallucination-prone. That’s not practical or sustainable.

We need to be leveraging specialized systems, Artificial Specific Intelligence (ASI), instead of relying on one-size-fits-all LLM models that consistently deliver astonishingly good results combined with ridiculous options.

When we built the iPod and Nest, we brought painkillers to real pain. That’s the mindset we need in AI today – bring painkillers without bringing more pain!”

TONY FADELL

“FATHER OF THE IPOD”
PRINCIPAL AT BUILD COLLECTIVE

BUILD

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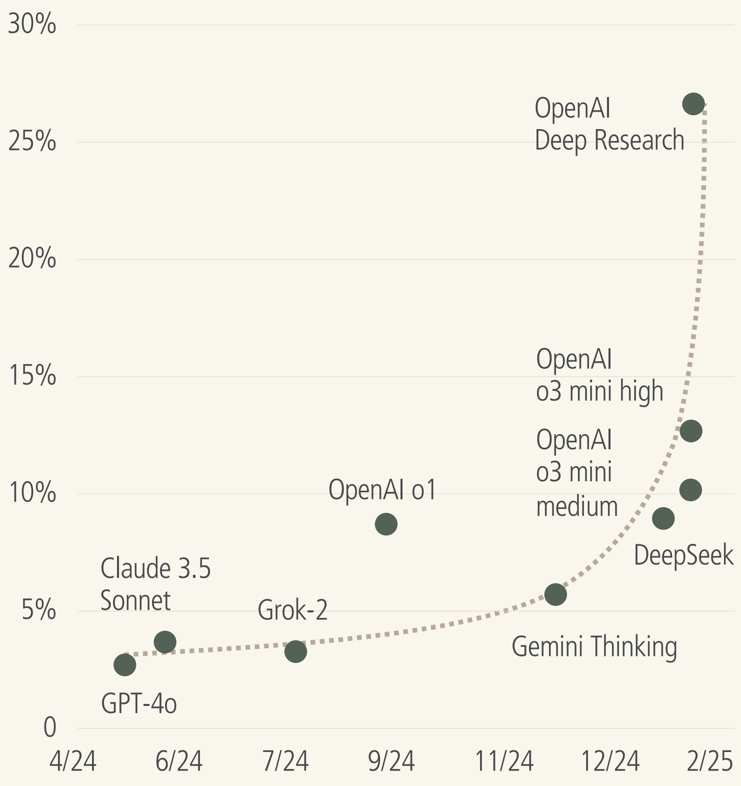
AI is a moving target

The *Humanity's Last Exam* (HLE) benchmark, released in January 2025 by Scale AI and the Center for AI Safety (CAIS), is designed to assess the limits of AI knowledge at the cutting edge of human expertise.

It was developed in response to AI models surpassing human performance on many existing benchmarks. The HLE includes 3,000 challenging text and multi-modal questions spanning over 100 subjects in math, science, and humanities, with contributions from field experts to ensure high difficulty.

AI scores on *Humanity's Last Exam*



Source: Tomas Pueyo for Uncharted Territories, with data from Dan Hendrycks

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“Geoffrey Hinton’s pioneering vision in neural networks was the seed that sprouted the AI forest we see today. With each new AI-driven breakthrough, we explore uncharted territory.

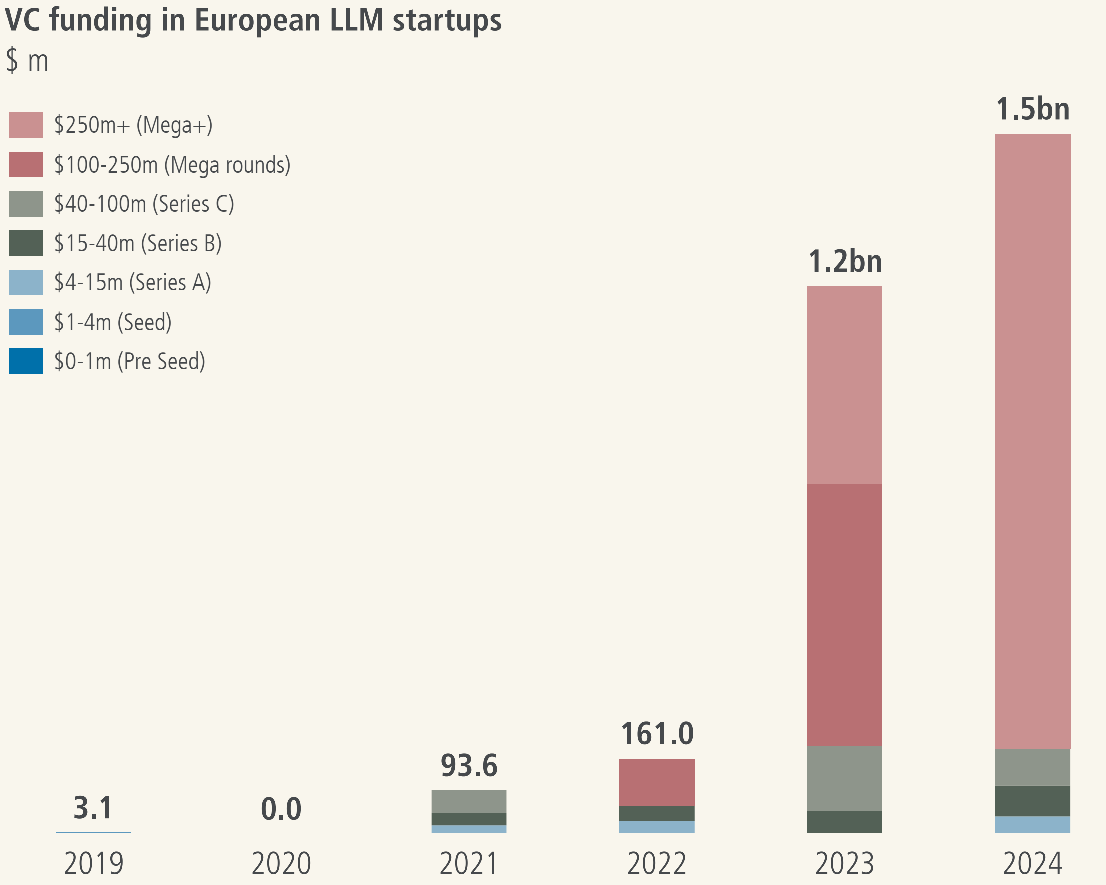
Experts project it could add up to $15.7 trillion to the global economy by 2030. With potential productivity boosts of 40% in some industries, AI stands to create unprecedented opportunities for growth. The role of investors is not just fuelling this discovery, but cultivating it responsibly for society’s benefit.”

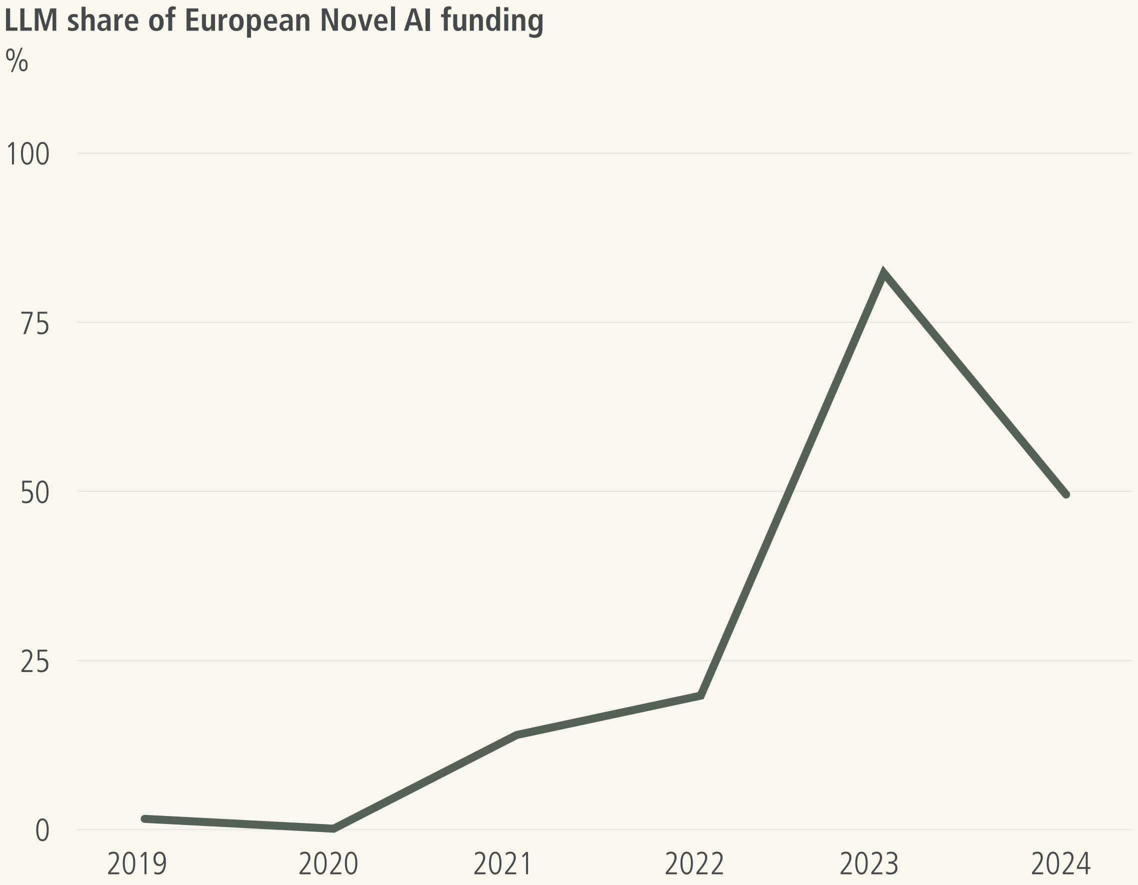
LUKAS LEITNER

DEEP TECH LEAD
LAKESTAR

LAKE STAR

$1.5bn have been invested in Deep Tech LLMs startups, up nearly 10x from two years ago. Half of Novel AI funding went to LLMs this year





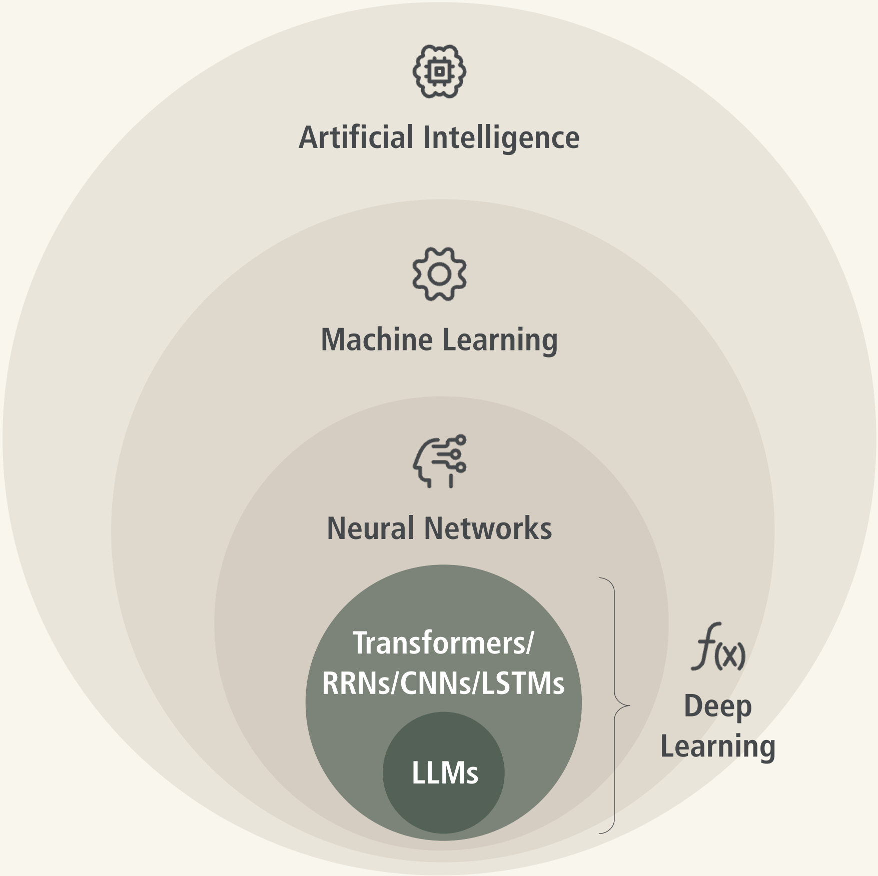
LLMs and transformers are a type of neural networks and a subset within Machine Learning

Transformers and other Deep Learning architectures

The transformer architecture, introduced in the paper "Attention Is All You Need" (2017), has become the dominant framework for LLMs due to its efficiency in handling long-range dependencies and parallelizable training. Models like GPT, BERT, and LLaMA are all transformer-based.

However, not all LLMs are based on transformers. Other neural net architectures exist such as CNNs, RNNs, and LSTMs, or hybrid approaches.

While transformers dominate today, future LLMs may incorporate new architectures or entirely different paradigms.



"The decade-long timeline for AI to reach human-level intelligence is obsolete – we'll see this reality in three years. The acceleration of research isn't just incremental advancement, it's a simultaneous, convergent breakthrough across disciplines.

Knowledge industries—software, management, finance, law—will be transformed, not replaced. This is a catalyst for human potential, a chance to redefine what's possible.

As we enter this era of unprecedented innovation, we need to prepare – not for a threat, but for an opportunity, a future where human ingenuity, amplified by AI, reshapes our world in profound and positive ways."

EISO KANT

CTO AND CO-FOUNDER
POOLSIDE

poolside

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LLMs started in the 1950s and had their breakthrough moment in 2017 with the invention of the transformer architecture

1950s

Neural network experiments and information processing systems began for natural language processing (NLP).

IBM and Georgetown University collaborated on a system for automatic Russian-to-English translation, sparking interest in machine translation.

1960s

Eliza

The creation of **Eliza**, the first chatbot, by MIT's Joseph Weizenbaum marked the beginning of NLP research. It laid the groundwork for future complex large language models (LLMs).

1997

LSTM

Introduction of **Long Short-Term Memory (LSTM)** networks, enabling deeper and more complex neural networks to process larger datasets.

2010

Stanford CoreNLP
Google Brain

Stanford launched the **CoreNLP suite**, which allowed tasks such as sentiment analysis and named entity recognition.

2011

A smaller version of **Google Brain** incorporated **word embeddings**, enhancing NLP systems' ability to understand context.

2017

Transformers
BERT

Emergence of **transformer models** like GPT (Generative Pre-trained Transformer) for generating or decoding text and **BERT** (Bidirectional Encoder Representations from Transformers) for predicting and classifying input text.

2020

OpenAI
GPT-3

The transformer model, with its encoder-decoder architecture, drove the creation of **advanced LLMs** like **GPT-3** and **ChatGPT**.

Using word embeddings for context and attention mechanisms to assess word importance, transformers revolutionized NLP by efficiently processing large data and determining context

Since then, there has been a noticeable influx of LLMs entering the market

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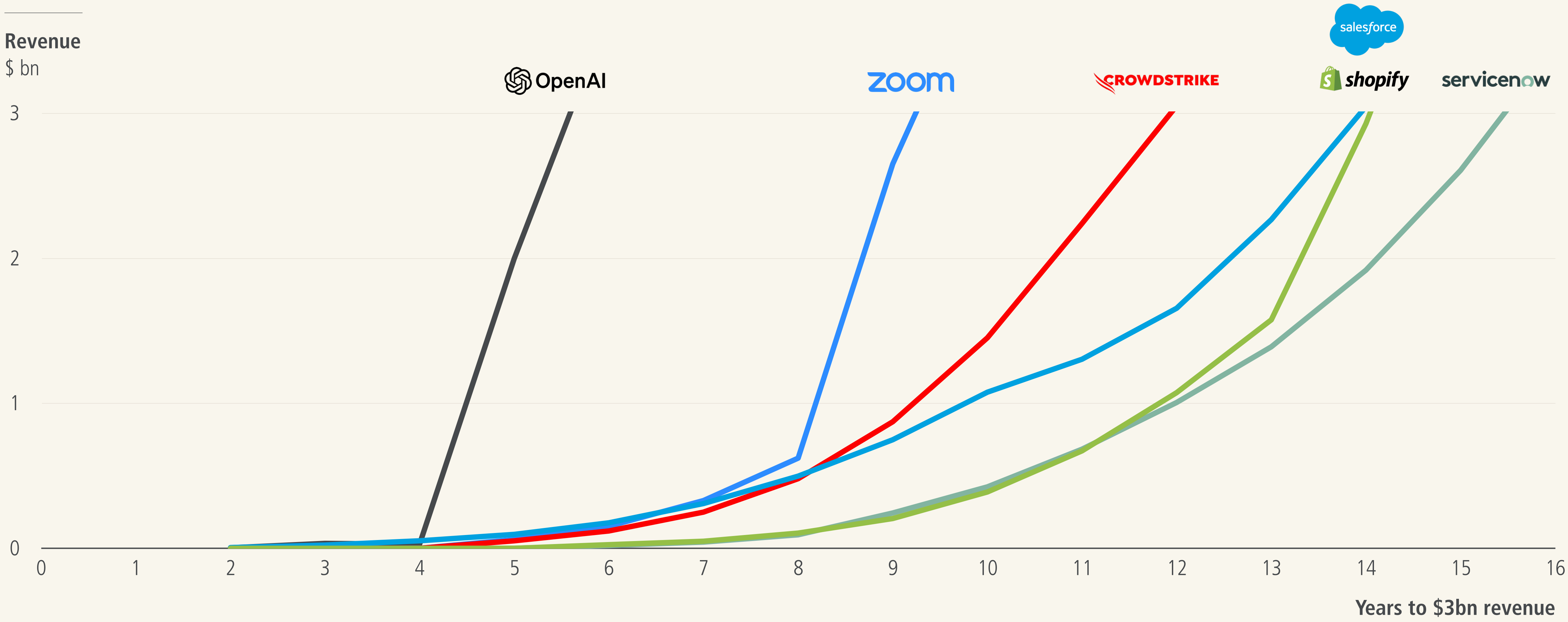
These AI companies have experienced unparalleled adoption and revenue growth



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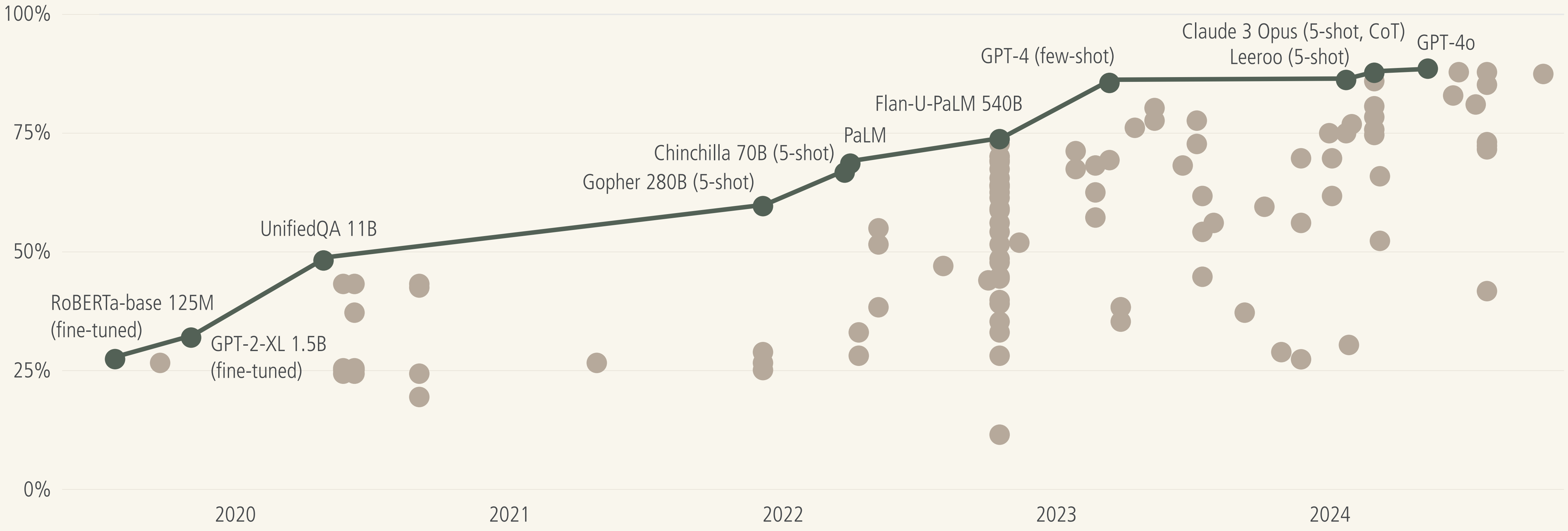
Fuelled by better model performance

Multi-task Language Understanding on MMLU
Average %



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Moreover, emergent abilities could further expand the range of capabilities LLMs possess

Scaling up language models consistently improves their performance and sample efficiency across a wide range of tasks.

A group of researchers released a paper focusing on an unpredictable phenomenon termed the *Emergent Abilities of Large Language Models*.

These abilities are considered emergent if they appear only in larger models and are absent in smaller ones, meaning they cannot be predicted by simply extrapolating from the performance of smaller models.

The existence of such emergent abilities raises the question of whether additional scaling could further expand the range of capabilities they possess.

Emergent Abilities of Large Language Models

Excerpt

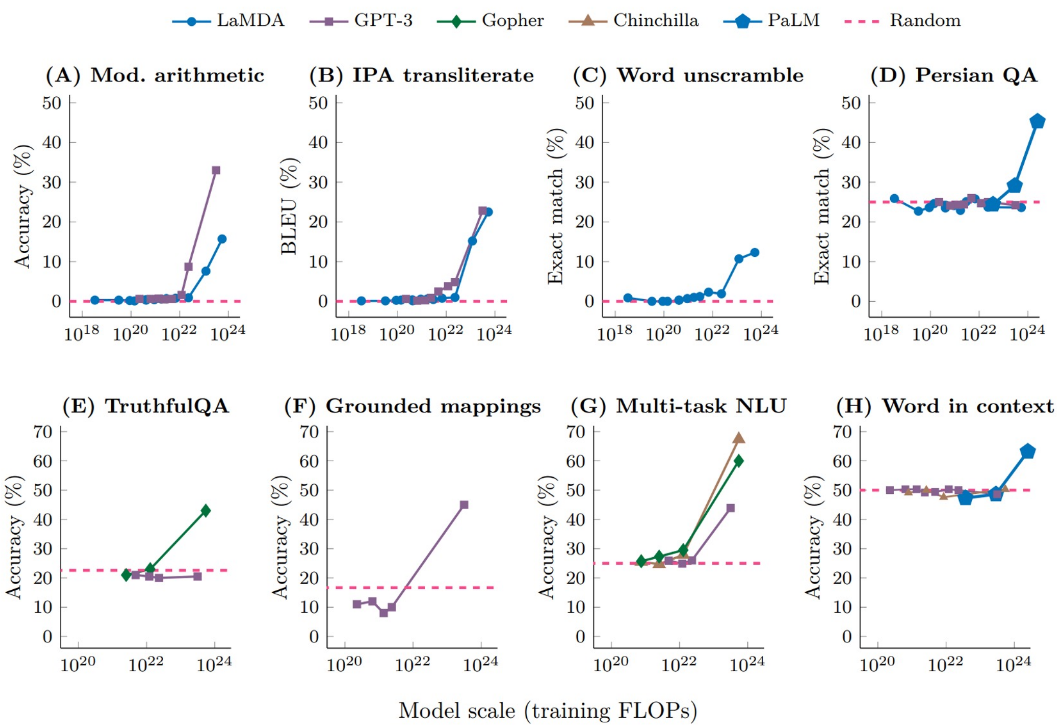

Figure 2: Eight examples of emergence in the few-shot prompting setting. Each point is a separate model. The ability to perform a task via few-shot prompting is emergent when a language model achieves random performance until a certain scale, after which performance significantly increases to well-above random. Note that models that used more training compute also typically have more parameters—hence, we show an analogous figure with number of model parameters instead of training FLOPs as the x-axis in Figure 11. A–D: BIG-Bench (2022), 2-shot. E: Lin et al. (2021) and Rae et al. (2021). F: Patel & Pavlick (2022). G: Hendrycks et al. (2021a), Rae et al. (2021), and Hoffmann et al. (2022). H: Brown et al. (2020), Hoffmann et al. (2022), and Chowdhery et al. (2022) on the WiC benchmark (Pilehvar & Camacho-Collados, 2019).

Source: "Emergent Abilities of Large Language Models" (08/2022) arXiv:2206.07682; Jason Wei, Yi Tay, Rishi Bommasani, Colin Raffel, Barret Zoph, Sebastian Borgeaud, Dani Yogatama, Maarten Bosma, Denny Zhou, Donald Metzler, Ed H. Chi, Tatsunori Hashimoto, Oriol Vinyals, Percy Liang, Jeff Dean, William Fedus

High CapEx spend on compute infrastructure raises the question of whether AI will generate sufficient revenue to justify the investment

The main question is:

Is GPU CapEx like building railroads and eventually the trains will come, as will the destinations,

or

will the AI bubble burst?

Moreover, The release of DeepSeek's R1 model led markets to fear a decrease in GPU demand due to its efficient use of less-advanced GPUs, causing a nearly 17% drop in Nvidia's share price on January 27, 2025. However, we believe that compute efficiency improvements will instead be used to train smarter AI models rather than lowering GPU demand.


Forbes

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What Does Trump's $500 Billion Stargate Mean For The World Of AI?

Bernard Marr Contributor

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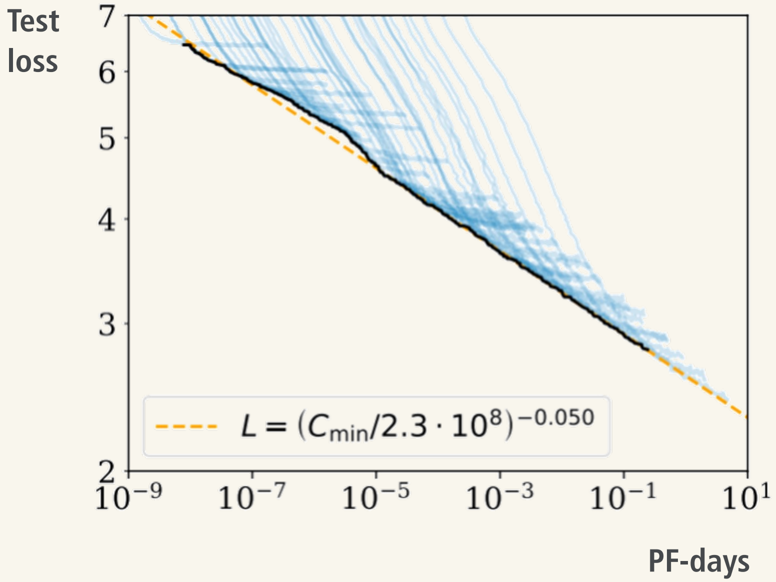
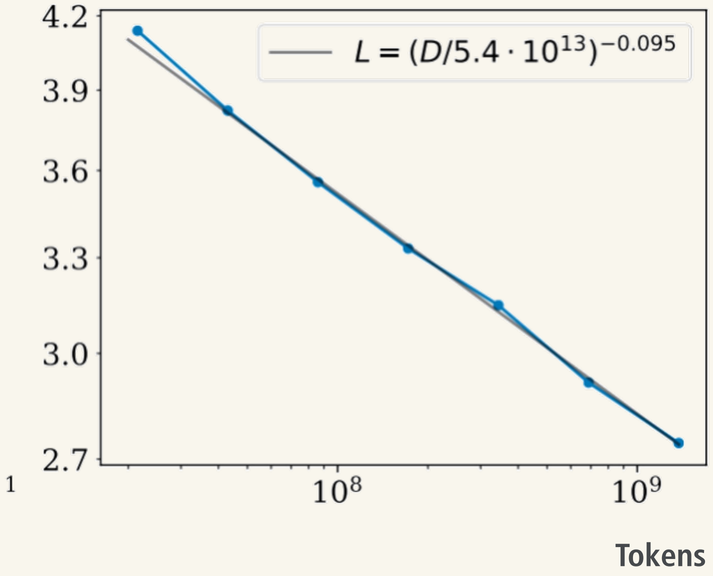
Aa

Performance is driven by LLM scaling laws – more data & training will lead to better performance

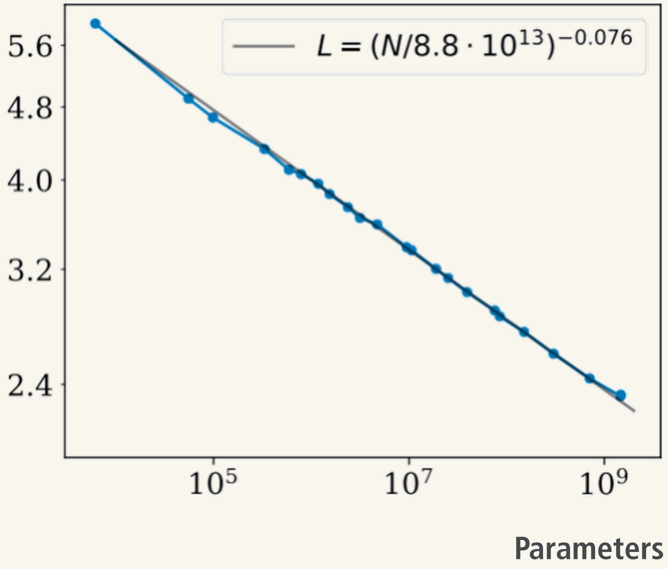
Compute
PF-days, non-embedding



Dataset size
Tokens



Parameters
Non-embedding



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Source: Jared Kaplan et al. Scaling Laws for Neural Language Models, 2020

If the scaling laws hold true, do we have enough money in Europe to keep up?

Tech Titans spending 10s of billions

2024 CapEx Spend (E)

amazon	$60-65 billion
Microsoft	$55-60 billion
Google	$50-55 billion
Meta	$35-40 billion
Apple	$10-15 billion

AI Majors spending billions

2024 Funding

OpenAI	$18.9 billion
ANTHROP\C	$12.8 billion
xAI	$12.1 billion

AI Challengers spending 100s of millions

2024 Funding

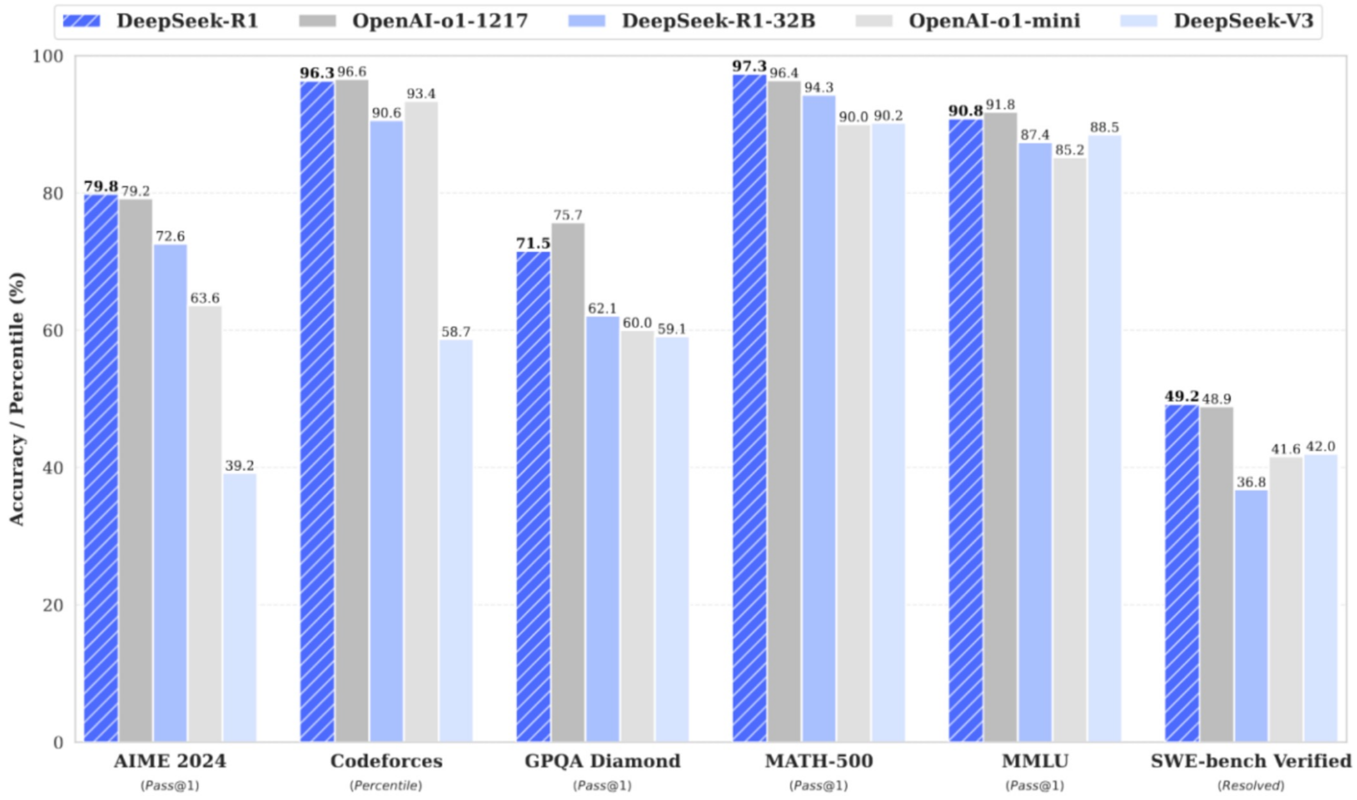
MISTRAL AI_	$1.1 billion
Safe Superintelligence Inc.	$1.0 billion
cohere	$940 million
poolside	$626 million
Magic	$437 million
kyutai	$363 million
H	$220 million
black forest labs.	$196 million
ElevenLabs	$101 million

DeepSeek challenged this notion, developing a well-performing model with much less capital – However, the jury is still out if all the claims are true

DeepSeek-R1's emergence has been met with admiration of the AI community. **Yann LeCun**, Meta's chief AI scientist, pointed to R1 as evidence that *"open-source models are surpassing proprietary ones."*

However, Open*AI* claims it found evidence that DeepSeek **used ChatGPT's answers as training data** for R1 via a technique called *distillation*. In this method, developers feed prompts to a trained model (e.g., ChatGPT) and collect its responses to **train the new model**, thereby transferring knowledge from the "teacher" to the "student" model.

BENCHMARK PERFORMANCE OF DEEPSEEK-R1 RELATIVE TO OPENAI-O1 (DEEPSEEK AI)



Source: DeepSeek

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Nevertheless, R1 demonstrated that a well-coordinated GPU cluster & clever engineering could overcome hardware limitations & cut cost – A lesson for Europe

Mixture-of-Experts Architecture

DeepSeek-R1 employs a Mixture-of-Experts (MoE) framework. The model encompasses **671bn parameters**, but only **≈37bn** are "activated" for any given input.

In other words, R1 is composed of many expert sub-models where each query uses a small subset of experts most relevant to the task.

This design reduces the computation required per token (since only a fraction of the network runs), allowing efficient training and inference even on older GPUs.

Hardware use optimizations: 8-bit floats and dual pipeline

The team relied on Nvidia's **H800 GPUs** rather than the latest high-end chips.

To compensate, they employed **FP8 mixed-precision training** (using 8-bit floats) was used for faster computation, and a **"DualPipe" pipeline parallelism** algorithm kept the many GPUs efficiently fed with data.

These optimizations improved training speed by roughly 2-3×, helping cut costs.

3FS – Fire-Flyer File System

Disaggregated architecture combines the throughput of thousands of SSDs and the network bandwidth of hundreds of storage nodes, enabling applications to access storage resource without depending on data locality (6.6 TiB/s across 180 nodes; 3-10x greater bandwidth than typical systems).

Moreover, it provides strong data consistency through chain replication and includes AI-specific optimizations like KVCache and rapid checkpointing.

This system was already mentioned in a blog back in 2019.

Source: https://www.high-flyer.cn/blog/3fs/

In Europe, we need to focus on our strengths. We need to act fast and think really big this year

“This year, and specifically the recent DeepSeek news, showed that the focus—and obsession—within Europe to compete at the LLM game was wrongheaded. As many of us have argued, just like Europe didn’t need to waste time and resources on creating a European search engine against Google in the last tech revolution, we don’t need a 'European OpenAI' now, as these models continue to become commoditized and open source.

What we need to do is focus on our strengths: applying AI at the application layer to specialized domains in industries where Europe has the talent and proprietary data sets, from manufacturing to health to finance to logistics and more. Europe stands to really benefit from this new reset in AI, but we need act fast and think really big this year.”

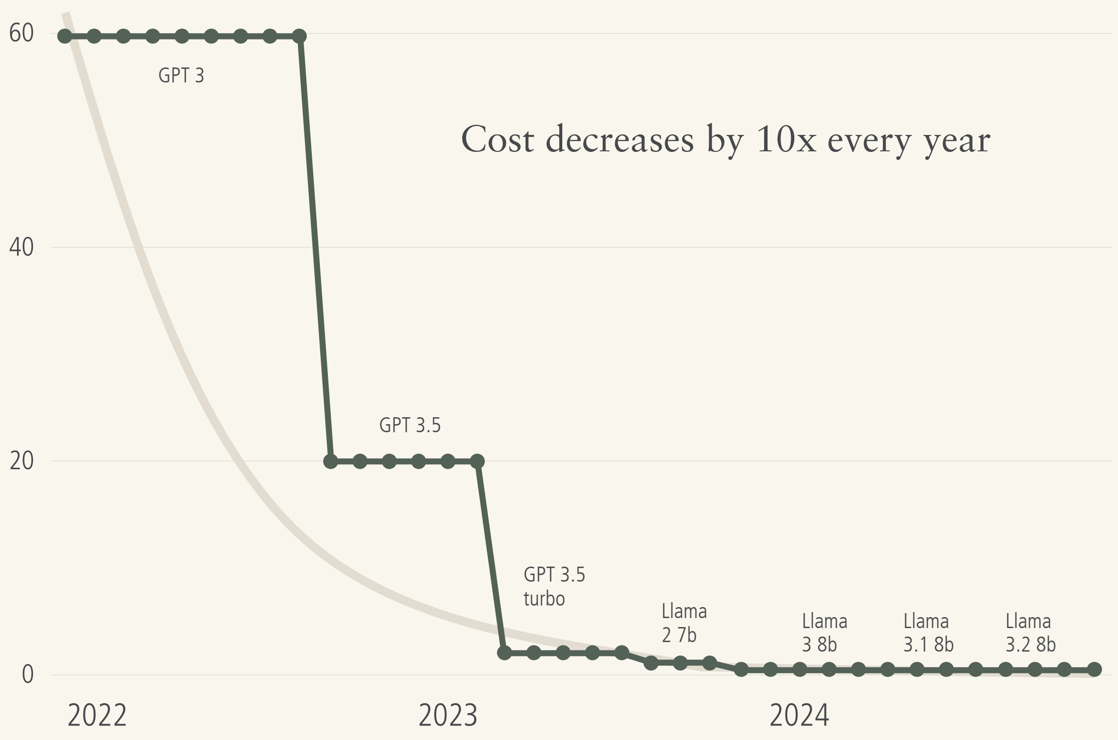
RASMUS ROTHE

FOUNDER AND GENERAL PARTNER
AT MERANTIX CAPITAL

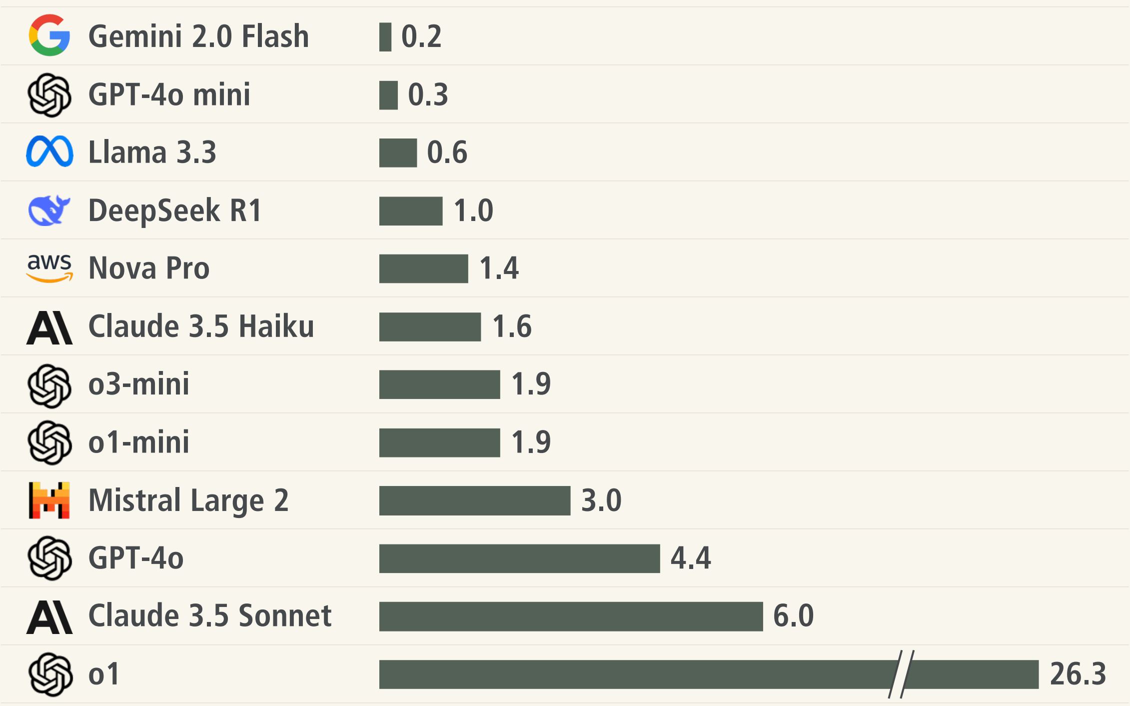
MERANTIX CAPITAL

Moreover, inference costs are decreasing. However, at the same time new reasoning capabilities increase the inference workloads

Cost development of the cheapest LLM with MMLU score ≥42
$ per 1m tokens



Inference cost
$ per 1m tokens; lower is better



Source: a16z; Artificial Analysis

As the landscape matures, models become more differentiated and tailored to specific use cases

Modern models exhibit unique characteristics that make them well-suited for different use cases. While many state-of-the-art models share a Transformer-based foundation, they diverge in **size, architecture, training data, and objectives** to meet specific application needs. This choice also drives inference workloads and cost.

Example of OpenAI's models

Model Name	Primary Use Case	Key Capabilities & Differentiators
GPT-3.5	General text generation	Fluent text generation, chatbot functionality, widely used
GPT-4	Advanced text & image understanding	High reasoning, performs well on complex tasks, multimodal
Codex	Code generation	Writes, translates, and debugs code, powers GitHub Copilot
o1	Complex reasoning & problem-solving	Enhanced logical thinking, math, and multi-step reasoning
o1-mini	Faster reasoning at lower cost	Optimized for speed, retains reasoning ability
o1 (Pro mode)	High-depth reasoning	Uses more compute per query for better accuracy
o3	Next-gen reasoning	Outperforms o1 in logic, coding, and alignment safety
o3-mini	Fast & cost-effective STEM reasoning	Strong in math and coding, supports structured outputs
o3-mini-high	High-effort reasoning	More detailed answers, better for complex problems
DALL·E 3	AI image generation	High-quality, accurate image generation, works with ChatGPT
Sora	AI video generation	Generates 1080p videos from text prompts, animates images
Whisper	Speech-to-text transcription	High accuracy, multilingual support, robust noise tolerance
Operator	AI web automation	Can browse, click, fill forms, and complete online tasks

Hence, companies are rushing to build AI agents to automate workflows and enhance productivity, i.e., generate revenues

Automating workflows and enhancing productivity using LLMs is gaining prominence, with researchers focusing on integrating LLMs with agents.

Notably, there's a surge in multi-agent reinforcement learning (MARL) research that combines LLMs and agents. Studies are exploring agent-to-agent negotiations on behalf of users, emphasizing cooperation to form contracts.

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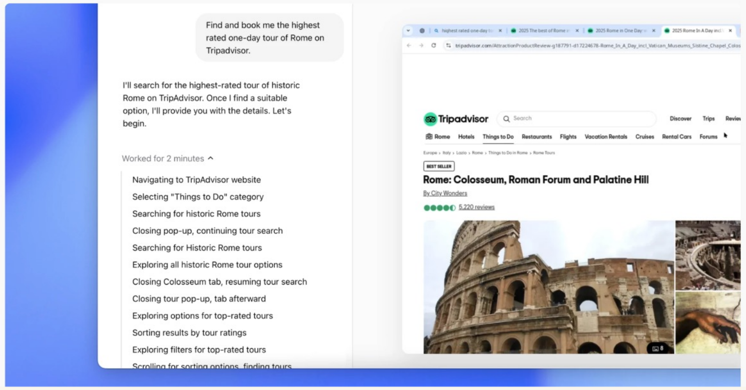
OpenAI

January 23, 2025

Introducing Operator

A research preview of an agent that can use its own browser to perform tasks for you. Available to Pro users in the U.S.

Go to Operator ↗



Google

Introducing Gemini 2.0: our new AI model for the agentic era

Dec 11, 2024 · 10 min read

LlamaIndex

LlamaIndex • 2024-06-26

Introducing llama-agents: A Powerful Framework for Building Production Multi-Agent AI Systems

Agents

We're excited to announce the alpha release of `llama-agents`, a new open-source framework designed to simplify the process of building, iterating, and deploying multi-agent AI systems and turn your agents into production microservices. Whether you're working on complex question-answering systems, collaborative AI assistants, or distributed AI workflows, llama-agents provides the tools and structure you need to bring your ideas to life.

ANTHROP\C

Building effective agents

Dec 19, 2024

Over the past year, we've worked with dozens of teams building large language model (LLM) agents across industries. Consistently, the most successful implementations weren't using complex frameworks or specialized libraries. Instead, they were building with simple, composable patterns.

In this post, we share what we've learned from working with our customers and building agents ourselves, and give practical advice for developers on building effective agents.

Apple researchers hypothesize that LLMs are not (yet) actually capable of reasoning. Making LLMs understand mathematics and physics is the next frontier in AI

"Our findings reveal that LLMs exhibit noticeable variance when responding to different instantiations of the same question. Specifically, the performance of all models declines when only the numerical values in the question are altered in the GSM-Symbolic benchmark.

We hypothesize that this decline is due to the fact that current LLMs are not capable of genuine logical reasoning; instead, they attempt to replicate the reasoning steps observed in their training data."

GSM-Symbolic: Understanding the Limitations of Mathematical Reasoning in Large Language Models

Excerpt

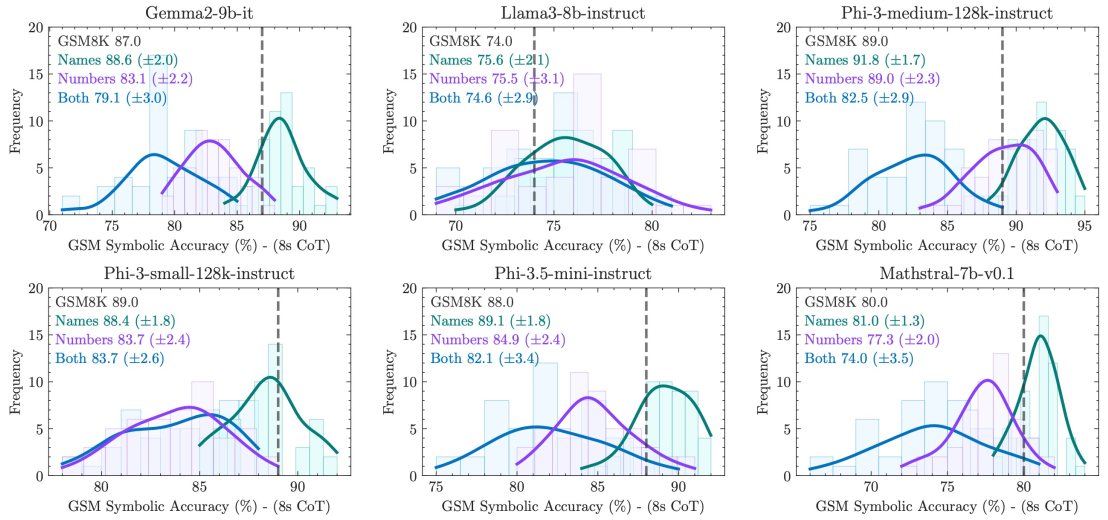


Figure 4: How sensitive are LLMs when we change only names, only proper numbers, or both names and numbers? Overall, models have noticeable performance variation even if we only change names, but even more when we change numbers or combine these changes.

Source: "GSM-Symbolic: Understanding the Limitations of Mathematical Reasoning in Large Language Models" (10/2024) arXiv:2410.05229; Iman Mirzadeh, Keivan Alizadeh, Hooman Shahrokhi, Oncel Tuzel, Samy Bengio, Mehrdad Farajtabar

LLMs of today are knowledge sharing on steroids

“ Humans have advanced a lot because of knowledge sharing—LLMs of today are knowledge sharing on steroids. Humans, however, are also great at dealing with uncertainties and taking decisions in spite of such uncertainties—LLMs of today don't stand a chance here. This is the progress in AI I want to see and, even more importantly, one to be part of.

MICHAEL VALKO

FORMER PRINCIPAL LLAMA (META) ENGINEER AND
CHIEF MODELS OFFICER AT STEALTH STARTUP

Advancements in Reinforcement Learning could further accelerate the performances of AI

Typical LLM training steps

1 Pre-Training — The model learns to predict the next token from a vast corpus of text data – proficient at language generation but unable to follow human instructions.

2 Supervised Fine-Tuning — The model is provided with structured "instruction-response" pairs, explicitly learning how to produce appropriate responses to human instructions.

3 Reinforcement Learning — In this final stage, the model's performance is refined using extensive, high-quality feedback – either human (RLHF) or AI-generated (RLAIF).

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Case Study DeepSeek

DeepSeek first trained R1-Zero, a preliminary model *purely via RL* without any supervised fine-tuning.

By rewarding successful problem-solving steps, R1-Zero *naturally emerged with numerous powerful reasoning behaviors"* demonstrating that an LLM can learn complex reasoning through trial-and-error alone.

In their paper, the authors highlight an "aha-moment", where the model rethinks in a human fashion, showing human-like behaviour of self-correction & reevaluation.

Question: If $a > 1$, then the sum of the real solutions of $\sqrt{a - \sqrt{a + x}} = x$ is equal to

Response: <think>

To solve the equation $\sqrt{a - \sqrt{a + x}} = x$, let's start by squaring both $\cdots$

$\left(\sqrt{a - \sqrt{a+x}}\right)^2 = x^2 \implies a - \sqrt{a+x} = x^2.$

Rearrange to isolate the inner square root term:

$(a - x^2)^2 = a + x \implies a^2 - 2ax^2 + (x^2)^2 = a + x \implies x^4 - 2ax^2 - x + (a^2 - a) = 0$

...

Wait, wait. Wait. That's an aha moment I can flag here.

Let's reevaluate this step-by-step to identify if the correct sum can be $\cdots$

We started with the equation:

$\sqrt{a - \sqrt{a+x}} = x$

First, let's square both sides:

$a - \sqrt{a+x} = x^2 \implies \sqrt{a+x} = a - x^2$

Next, I could square both sides again, treating the equation: $\cdots$

...

Table 3 | An interesting "aha moment" of an intermediate version of DeepSeek-R1-Zero. The model learns to rethink using an anthropomorphic tone. This is also an aha moment for us, allowing us to witness the power and beauty of reinforcement learning.

Source: DeepSeek-R1: Incentivizing Reasoning Capability in LLMs via Reinforcement Learning

The path to AGI – current bottlenecks and potential solutions

Current leading AI models contain roughly 1T+ parameters, whereas the human brain has about 100T synapses. By this analogy, AI models are approximately within 100x from the human brain. Which bottlenecks do we need to overcome?

1. The Data Wall

AI model training has scaled dramatically from 40bn tokens (five years ago) to 15T tokens today.

Analysts predict human-generated internet data (~300T tokens) might be fully utilized between 2026 and 2032.

Potential solutions

Synthetic data, self-play, proprietary data acquisition, & more efficient algorithmic approaches

Humans effectively learn language from roughly 10^7 meaningful words, whereas current AI models require 10^12 10^13 tokens to reach similar performances, making AI 10^4 to 10^6 times less sample-efficient— improvements in reasoning may reduce this gap

2. The Interconnect Wall

Scaling by adding GPUs leads to reduced efficiency due to limited bandwidth for data movement between GPUs

The interconnect wall, is currently around 7×10^28 FLOPs (for 2022 chips).

Recent large-scale training efforts have reached 10^25 FLOPs – already within 100x of this limit.

Optical I/Os, running more GPUs in parallel, dividing up training workloads more effectively, dividing models into more diverse mixtures of smaller experts

3. The Latency Wall

When models are trained, gradient steps must be performed sequentially. As model sizes grow, the number of steps/operations required within six months increases, reducing the time available per operation

At c.10^31 FLOPs, at 1 million times beyond current capabilities, each operation would need to be performed faster than data can physically move.

Increase training duration, increasing batch sizes, dividing models into more sub-models

Improving data efficiency would unlock new AI capabilities and applications

“I hope to see breakthroughs on data efficiency: Foundation models require vast amounts of data to learn, and developing new models or learning methods that enable more efficient adaptation is crucial. For example, a human can grasp a topic from a single textbook. How can we enable a language model to do the same? I also hope to witness significant progress on how AI learns from challenging data sources, such as the 3D physical world, where current approaches struggle.

Collaboration between academia, industry, startups, and investors is essential for driving and commercializing AI innovation. Academia contributes foundational research. Industries beyond AI-focused companies are critical data providers and curators and generate value from AI solutions. Startups push novel breakthroughs, and investors provide the necessary funding for those breakthroughs and help align technological progress with market needs. Universities play a critical role for training AI talent and provide an environment for high-risk high-reward research that might not be prioritized by industry.”

REINHARD HECKEL

PROFESSOR FOR MACHINE LEARNING AT
THE TECHNICAL UNIVERSITY OF MUNICH

FUTURE OF COMPUTE

DEEP DIVE

EXAMPLES

AI ACCELERATORS

SUPERCONDUCTORS

PHOTONIC COMPUTING

DISTRIBUTED & DECENTRALISED COMPUTING

RISC V

NEUROMORPHIC COMPUTING

AMBIENT COMPUTING

WEARABLE COMPUTING

IN-MEMORY COMPUTING

BRAIN-COMPUTER INTERFACES

SILICON PHOTONICS

AR / VR / MR

The tools we use to think will continue to evolve

Computing was elegantly summarised by Steve Jobs as a bicycle for the mind.

They are the tools we use, for work or pleasure, to amplify the impact our thoughts can have in the world.

Ultimately, they conserve our most precious resource, our time, and let us do more during our days, our years, and our lifetimes.

Given this deep fundamental value to humanity, 4-out-of-5 of the world's largest companies by market cap have a focus on building the next generation of computing platforms.

Future of Compute – *What's new?*

Last year we broke down the computing stack into three core paradigms: mobile, desktop, and cloud.

In 2024 we saw advancements on the hardware side for wearables and cloud and in the operating system for desktop/ambient computing.

While application development will continue across all major paradigms, the OS providers are largely spoken for and the opportunities for major innovation likes in the hardware layers.

The lowest layers of the hardware stack have the greatest demand for innovation, ultimately hampering or enabling the scalability of the software layers.

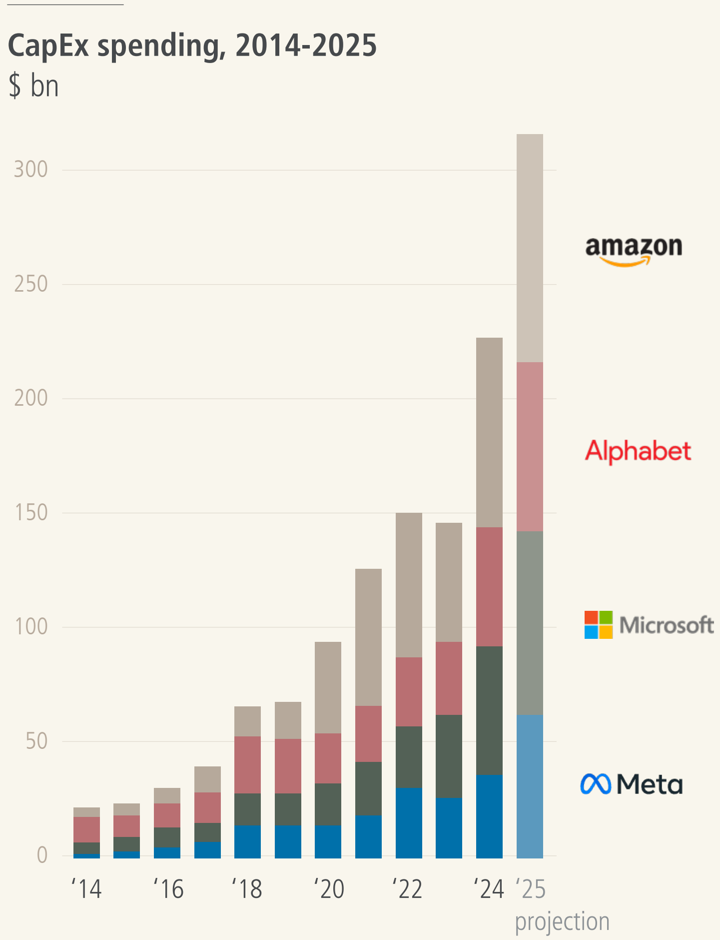
		Frontend (user facing)		**Backend** (not user facing)	
PARADIGM	**Current**	**Mobile**	**Desktop**	**Cloud**	
	Future	Wearable	Ambient	Centralised Cloud	Decentralised & Distributed Cloud
SOFTWARE	**Applications**	Various			
	Operating Systems	Android, WatchOS, VisionOS, XROS	CoPilot, Alexa, Siri, Google Assist.	Proprietary	Ethereum, Filecoin
	Protocols & Standards	Internet (TCP/IP), Blockchain			
HARDWARE	**Form Factor**	AR/VR/XR, Headphones, BCI, Smart Watches, Smart Contacts	Smart Speakers, TVs, Appliances, Homes, Buildings (integrated)	Data Centres	Existing Edge Devices (see other paradigms)
	Sensors & I/O	Radar, Retinal Scanning, Optical Tracking, Health Sensors			
	Networking	6G Cellular, Satellite Networks, Optical, Peer-to-Peer Direct, Quantum Networks			
	Processing	Semiconductors, Photonics, Neuromorphic, Analog, Quantum			

Cloud infrastructure starts to see significant innovations accelerated by epic levels of investment

Alphabet, Amazon, Meta and Microsoft spent an estimated average of 17% of revenues on capital expenditures in 2024 (up from 12% in 2021) to ramp up AI infrastructure. That's a larger share than big oil firms spent during the last investment supercycle in the 2010s. In absolute terms, it’s on the order of a quarter of a trillion dollars between the four of them.

In 2024, TSMC spent $29.8 billion on CapEx, 33% of its revenue. The company has projected CapEx rising to between $38 billion and $42 billion in 2025.

According to Mark Zuckerberg, the rationale for tech companies *“investing very heavily in CapEx”* is that it becomes a *“strategic advantage over time.”*



Source: public company information

“When we think about how AI will become increasingly useful, it is clear that the incremental software improvements to how data centres are run is not the answer.

The 10x, 100x, and 1000x improvements in speed, performance, power efficiency, and cost will be unlocked via breakthroughs in the hardware layers of the cloud computing stack.

The increased use of photons instead of electrons, moving memory closer to compute, novel liquid cooling techniques, and the like, will transform how we’re able to power these incredibly demanding workloads and ensure everyone has access to the promise that the application layer will bring.

Ultimately, we will start to see a departure from the traditional Von Neumann architectures used by all CPUs and GPUs today as companies start to experiment with compute in memory and other novel architectures that eliminate traditional bottlenecks.

The next 10 years will continue to see enormous investment in computing advancements to power the new algorithms being developed at the edge.”

STEVEN JACOBS

DEEP TECH INVESTOR

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Desktop & Ambient computers start to benefit from personal assistant chatbot front ends

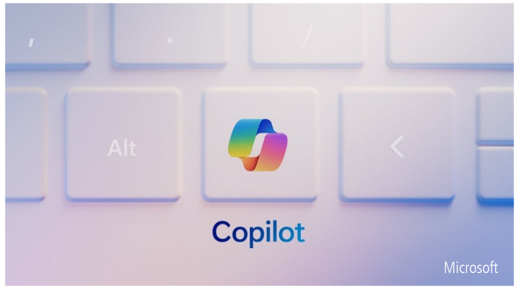
As anyone who has used a HomePod knows, the limiting factor to any ambient compute experience is the voice-based chat bot, in this case Siri.

2024 marked a significant upgrade to what voice based chatbots can do as our personal assistants. With massive models trained on significantly more data, the natural language capabilities and breath of real-world knowledge accessible to our digital personal assistant has grown substantially, unleashing the power of voice.

As the new, more powerful front-end assistants become integrated into our daily workflows, demand will increase for privacy preserving edge computing, encrypted data transmission and processing, and low power contextual monitoring to provide the best performance and security.

The innovations that will power these advancements will span novel algorithm development, sensor integration, and hardware advancement on the edge.

Microsoft, Apple, and Google introduced new interaction paradigms into their desktops, laptops, and ambient compute devices.



Microsoft announced Copilot buttons designed natively into their laptops.

Apple integrated ChatGPT into Siri as a source of world knowledge.

Google rolled Gemini out to all Gmail and paid Google Workspace users natively integrated with their web apps.

Wearables continue to make steady progress

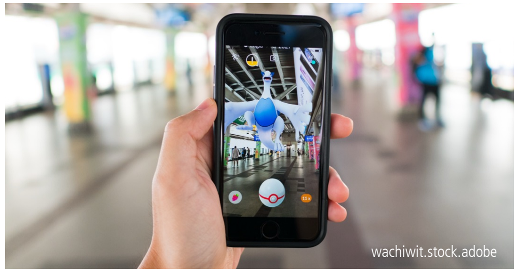
With the significant advances in AI, the ability to have a personal assistant always within view/earshot has started to become more real and useful.

Now that there are 'killer apps' being developed using those novel voice based operating systems, the pressure on teams to innovate on the hardware is greater than ever.

We expect to see impressive announcements on novel battery chemistries, light engines, optics and waveguides, and edge computing to bring these new experiences to life.

Apple

AR/VR continued to advance with Apple making its entry into the market with the Vision Pro headset, joining the Meta Quest 3 and Sony Playstation VR2 as the best-selling headsets. Despite massive investments in the category AR/VR products have not yet delivered on their promise.



wachiwit.stock.adobe

While demand for AR/VR headsets remains in the early stages of adoption, **breakout apps** like Pokemon Go retain user bases around 100m with annual revenues around $580m.

Smartwatches and smart headphones are now a staple across all big consumer electronics manufacturers. It is estimated that ~22% of all adults worldwide wear a smart wearable. Apple has the largest share of the smartwatch market at 21%.

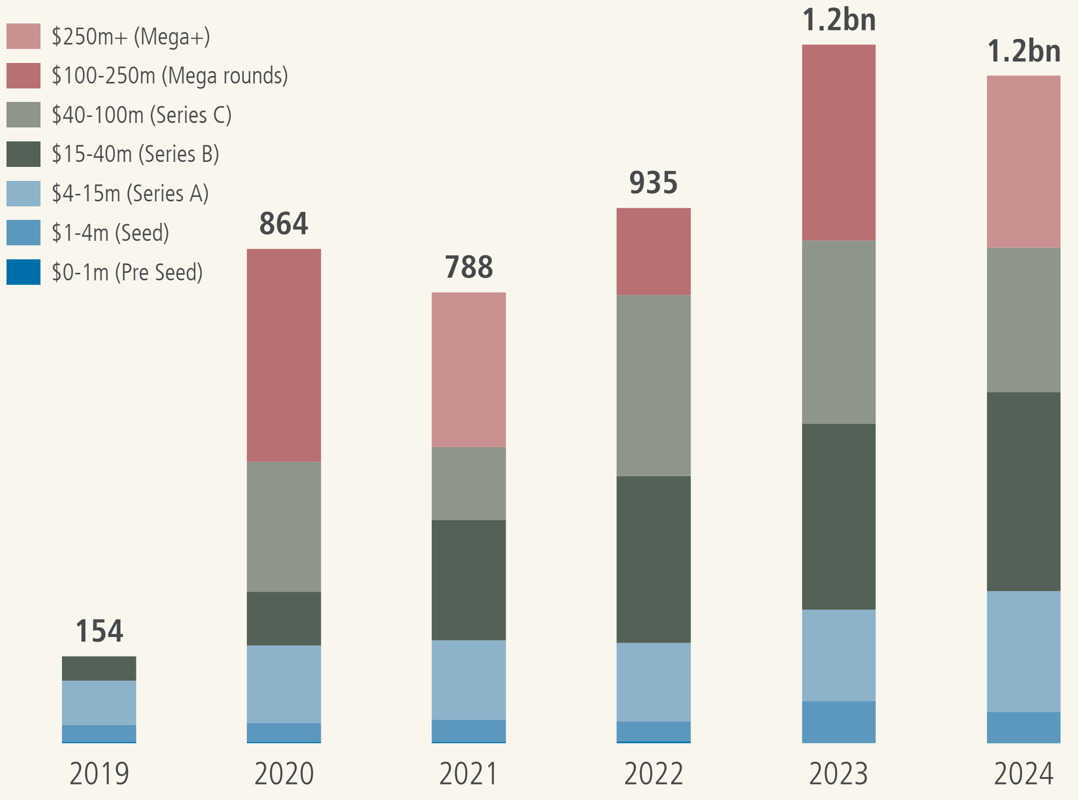
Meta x Rayban

Key signals for where this industry goes next lie in the leaked rumours for new products from Meta and Google focused on the AR space with **smartglasses**.

Future of Compute funding neared last year's record at $1.2bn, driven by quantum, AI chips, brain-computer interfaces, and photonics

VC funding in European Future of Compute startups

$ m



Select European Future of Compute VC-rounds in 2024

Startup	Funding round	Focus
QUANTINUUM	$300m Late VC	Full-stack quantum computing
river lane	£58.7m Series C	Quantum computing software
AXELERA ARTIFICIAL INTELLIGENCE	$68m Series B	AI interference hardware for edge applications
planqc	€50m Series A	Quantum computers
INBRAIN NEUROELECTRONICS	€46.3m Series A	Brain computer interfaces
EFFECT PHOTONICS	€35m Series D	Integrated photonics

Future of Compute startups in Europe

(click to view live version)

Advanced AI and high-performance computing chips
Combined funding $ 990M

- Graphcore
- GrAI Matter Lab
- Kalray
- qurv
- Synthara Techno
- Axelera AI
- VSORA
- GreenWaves Tech
- SiPearl
- Corintis
- Semron
- Arago AI
- Flow-computing
- Vaire Computing
- RaiderChip

Quantum computers & processors
Combined funding $ 1.7B

- IQM
- Oxford Quantum
- Quantum Motion
- Qilimanjaro Qua
- Alice & Bob
- Kipu Quantum
- ORCA Computing
- Pasqal
- NextGenQ
- C12
- Universal Quant
- Quantware
- Qdevil
- QuiX Quantum
- Sparrow Quantum
- Alpine Quantum
- eleQtron
- Equal1
- Delft Circuits
- AegiQ
- Oxford Ionics
- Welinq
- planqc
- Quandela
- Arque
- Quobly
- Quantinuum
- Orange Quantum
- Qblox
- QC Design
- SemiQon
- XeedQ
- Kelvin Nanotech
- LakeDiamond SA
- Peak Quantum
- TundraSystems G
- Quantopticon
- Groove Quantum
- Arctic Instrume
- Silent Waves
- ZuriQ

Quantum computing software
Combined funding $ 416M

- Cambridge Quant
- Multiverse Comp
- Beit
- Riverlane
- Nordic Quantum
- Phasecraft
- Ketita labs
- QuantrolOx
- Quantastica
- JoS Quantum
- Qu & Co
- Quanscient
- ParityQC
- Quantagonia
- QuSoft
- QMWare
- Equal1
- Fermioniq
- Kvantify
- ColibrITD
- Quanvia
- Quantum Flytrap
- QMill
- PlanQK
- Quantum Mads

Photonic chips, integrated circuits & photonics IP
Combined funding $ 613M

- LiGenTec
- ActLight
- Optoscribe
- Scintil Photoni
- Ipronics
- Sicoya
- Photonpath
- SMART Photonics
- EFFECT Photonic
- Salience Labs
- Lumai
- Enlightra
- Akhetonics
- Black Semicondu
- Optalysys
- CamGraPhIC
- Polariton Techn
- Ephos
- Oriole Networks
- NcodiN
- MantiSpectra
- PHOTON IP
- MicroAlign
- Wave Photonics
- Axithra
- Lightium
- Finchetto
- Lumiphase
- Alcyon Photonic
- Astrape Network
- Rapid Photonics
- Light Trace Pho
- FLOW Photonics
- Amazec Photonic
- Phix Systems
- LioniX Internat

Quantum cascade lasers, laser tech for sensing & LiDAR
Combined funding $ 32M

- Pilot Photonics
- Integrated Opti
- Lytid
- Eblana Photonic
- Chromacity
- QuantaRed Techn
- Quantune Techno

Quantum cryptography
Combined funding $ 247M

- Arqit
- KETS Quantum Se
- Crypta Labs
- Crypto Quantiqu
- CryptoNext Secu
- Nu Quantum
- Infiniquant
- Terra Quantum
- ID Quantique
- Keequant
- ThinkQuantum
- LuxQuanta
- QuSide
- Quantum Base
- Quantum Dice
- iQrypto
- VeriQloud
- SECQAI
- Random Power
- EvolutionQ

Photon detection & counting
Combined funding $ 14M

- Quantum Detecto
- Photon Force
- Single Quantum
- Micro Photon De
- Pixel Photonics
- ElFys

Quantum communication (Quantum key distribution, QKD)
Combined funding $ 27M

- QphoX
- Craft Prospect
- Synergy Quantum
- Quantum Optics
- Q*Bird
- Qubitrium
- nodeQ

Cryogen-free refrigeration systems for research
Combined funding $ 2.6M

- Kiutra
- Bluefors
- Leiden Cryogeni

Lithography and other sem. manufacturing
Combined funding $ 37M

- Qoniac
- AlixLabs
- LIDROTEC
- Morphotonics
- Lace Lithograph
- SCIL Nanoimprin
- Chiral Nano

Brain-computer interfaces/neurostimulation
Combined funding $ 305M

- Aleva Neurother
- ONWARD Medical
- IDUN Technologi
- Sublimed
- CorTec
- Restorative Neu
- Comind.io
- NextMind
- Inbrain Neuroel
- CereGate
- BIOS
- Brainpatch
- Neuroelectrics
- MindRove
- Ourobionics
- Bitbrain
- MBrainTrain
- NeuroCONCISE
- G tec
- Plato
- MintNeuro
- Cogitat
- NeuroVLC

Next gen laser & photonics
Combined funding $ 82M

- M Squared Laser
- VEXLUM
- Vector Photonic
- Fusion Bionic G
- Skylark Lasers
- Spark Lasers
- Living Optics
- SuperLight Phot

Post-quantum cryptography (PQC)
Combined funding $ 73M

- CyberHive
- Post-Quantum
- PQShield
- Resquant
- QuantiCor Secur
- QuantumNova

Decentralized computing
Combined funding $ 336M

- Gensyn
- Hadean
- Signaloid
- Coinweb
- MultiversX
- Unweave
- Holochain
- Velas
- W3BCLOUD
- DeepSquare
- Zenith Chain
- NuNet
- Hive
- Namla
- FlexAI

Neuromorphic chips
Combined funding $ 156M

- Innatera Nanosy
- Prophesee
- SynSense
- Grayscale AI
- Polyn AI
- iniVation
- Gemesys

AI-driven electronic design automation (EDA)
Combined funding $ 20M

- Circuit Mind
- Machine Discove
- ChipFlow
- AMSIMCEL

RISC V
Combined funding $ 43M

- Codasip
- Semidynamics Te
- Keysom
- VyperCore
- Ubitium

In-memory computing
Combined funding $ 44M

- SURECORE
- Neureka computi
- Upmem
- Fractile

Memory and storage tech
Combined funding $ 46M

- QuInAs Tech
- Cerabyte
- Ferroelectric M
- Intrinsic Semic

Sensors for AI-based application
Combined funding $ 113M

- Toposens
- Terabee
- Novelda
- Xavveo

Quantum sensing
Combined funding $ 130M

- Qnami
- Muquans
- QustomDot
- QuantumDiamonds
- Q.ant
- Quantum Solutio
- Adamant Quanta
- NIQS Technology
- QLM Technology
- QDI-Systems
- NVision Imaging
- MIRO Analytical
- QuantaMap
- InSpek
- Aquark Technolo

AR/VR Hardware & Holography
Combined funding $ 785M

- WaveOptics
- Varjo
- Dispelix
- OQmented
- LightSpace Tech
- SeeReal Technol
- Miraex
- VividQ
- CREAL
- Ultraleap
- Aledia
- VoxelSensors
- AllFocal Optics
- XRF
- Distance Techno
- Vrgineers
- Gixel
- MICLEDI Microdi
- TriLite Technol
- Swave Photonics

Biochips & biomemory
Combined funding $ 21M

- Nanogami
- Biomemory

Semiconductor materials
Combined funding $ 8.7M

- DIAMFAB

Others
Combined funding $ 20M

- ZeroPoint Tech
- NordAmps
- FononTech
- apheros

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“Each generation of tech companies builds on the previous one. All the present excitement of the phenomenal progress with AI is only possible because of the amazing progress in processing power provided by CPUs, like ARM and GPUs like Nvidia.”

HERMANN HAUSER

CO-FOUNDER OF AMADEUS CAPITAL AND ACORN COMPUTERS

Amadeus Capital Partners

“The semiconductor industry is no longer defined by traditional transistor scaling alone—it is now an intricate ecosystem of advanced lithography, heterogeneous integration, and precise metrology. The future of performance scaling relies on a holistic approach.

In this new paradigm, Moore’s Law is evolving into "System Energy-Efficient Performance" scaling, where 3D architectures, chiplet-based designs, and AI-driven optimizations ensure continued semiconductor progress. As the industry pushes the boundaries of compute power, thermal management, and manufacturing precision, the interplay of lithography, packaging and metrology will define the next decade of semiconductor innovation.

In this, Europe is poised to play a crucial role, particularly in advanced equipment such as lithography, hybrid bonding equipment, metrology and inspection equipment, and advanced materials.”

HAMED SADEGHIAN

FOUNDER AND CEO OF NEARFIELD

NEARFIELD INSTRUMENTS

We need a coalition of the willing in Europe

AN INTERVIEW WITH PETER WENNINK

FORMER CEO OF ASML

ASML

What is the current global status of the semiconductor industry?

Semiconductors are often referred to as the "new oil," and the industry operates in a highly political environment. The United States excels in chip design and is now attempting to rebuild its manufacturing capabilities, driven by political pressure. Asia dominates semiconductor manufacturing with unmatched precision, especially in high-end nodes, which are considered an art form. Europe remains strong in equipment, such as laser technologies.

How can Europe strengthen its position in the global semiconductor ecosystem?

Collaboration with Asian manufacturers is essential, particularly by incentivizing them to establish fabrication plants (fabs) in Europe. This requires a unified approach, with major corporates such as Siemens, Bosch, and the automotive sector acting as collective customers and strong advocates for local manufacturing.

What strengths should Europe leverage to enhance its semiconductor industry?

Europe's key advantages include top-tier academic institutions, a highly skilled workforce, strong manufacturing capabilities, and, in some areas, a competitive cost base. Moreover, its commitment to social responsibility enhances its appeal as both a desirable place to live and a thriving hub for innovation.

What regulatory changes are required in Europe to enhance innovation and competitiveness?

Europe must enhance the "golden triangle" of government, academia, and private.

1. Stakeholders must recognize the urgency of fostering innovation.
2. Regulatory frameworks should focus on enabling action, collaboration, and incentivize investments.
3. Europe must adopt a more risk-tolerant mindset.

In the U.S., there is greater appreciation for risk-taking, supported by government-backed risk-sharing mechanisms.

Additionally, most available capital in the U.S. is in capital markets, while Europe relies heavily on banks constrained by stringent regulations. The major challenge is bringing these elements together. We need a coalition of the willing in Europe.

Is the *European Chips Act* the right step to drive innovation?

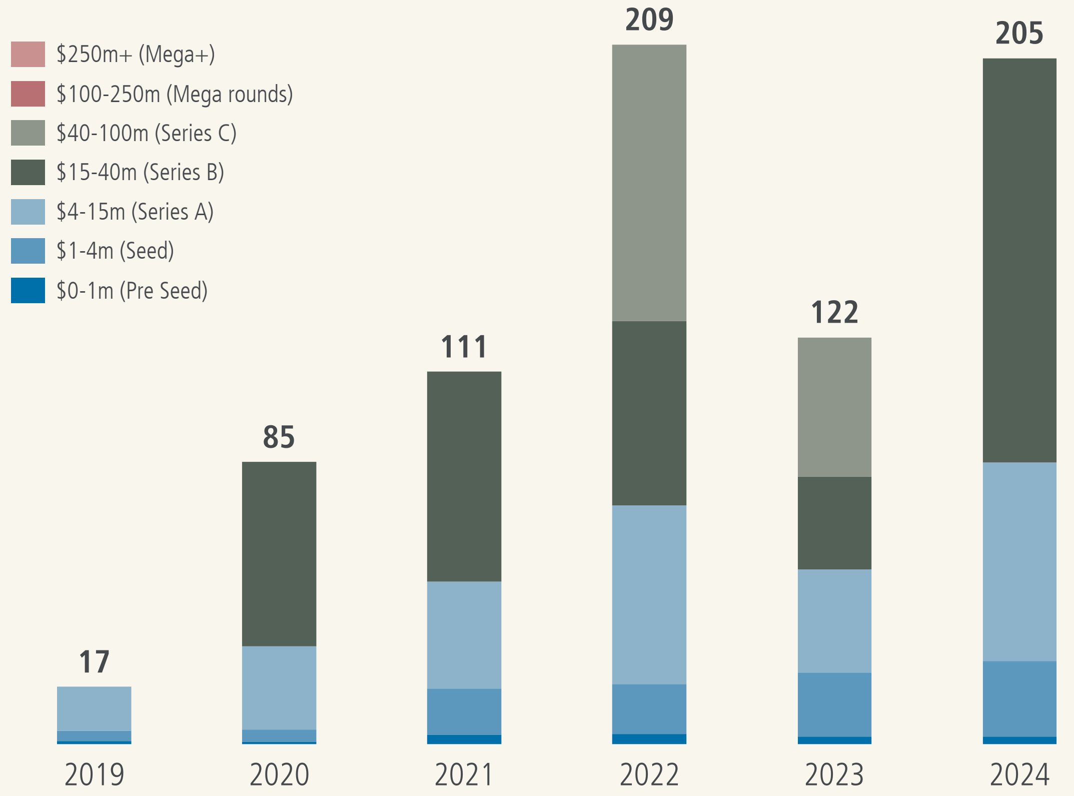
The European Chips Act is a commendable initiative addressing key concerns; however, it falls short in facilitating a focused access to capital and fostering targeted innovation. Establishing an innovation fund specifically for the AI stack and creating dedicated innovation centres across Europe are essential steps to drive meaningful progress.

PHOTONICS

SEGMENT DEEP DIVE

Photonics VC funding is on the rise, with strong activity at the early and early growth stage

VC funding in European Photonics startups[1]
$ m



Select European Photonics VC-rounds in 2024

Startup	Funding round	Focus
Effect Photonics	€35m Series D	Integrated photonics
NIL Technology	€29m Series D[2]	Optical sensors
black semiconductor	€25.7m Series A[3]	Data centre networking and interconnect
Oriole Networks	$22m Series A	Data centre networking and interconnect
Xavveo	$8.6m Seed	Photonics sensors for autonomous driving
ephos	$8m Seed	Data centre computing
LIGHTIUM	$7m Seed	Photonic Foundry

1) Photonics here does not include quantum computers based on photonics like Pasqal, or LED technology.
2) NIL Technology has afterwards been acquired for €250m by Radiant Opto-Electronics; 3) Black Semiconductor has also raised €229m in public financing. Data of 14 January 2025

Photonic startups improving data transfer and interconnection for AI & telecom data centres have seen a ramp up in attention in the last 2 years

(click to view live version)

Data center - computing
Combined funding $ 52M
- Akhetonics
- Ephos
- Lumai
- Finchetto
- Optalysys

Data center - networking and interconnect
Combined funding $ 151M
- Black Semicondu
- Oriole Networks
- NcodiN
- CamGraPhIC
- Ipronics
- Enlightra
- Salience Labs
- Astrape Network
- Lumiphase
- Sicoya
- PHOTON IP

Sensing
Combined funding $ 160M
- MantiSpectra
- Living Optics
- FLOW Photonics
- Amazec Photonic
- Senergetics
- Siloton
- Surfix Diagnost
- Xavveo
- Axithra
- Phaseform
- iLoF
- Delta Diagnosti
- NIL Technology
- Emberion
- Steerlight
- Fastree3D

Photon detection and counting
Combined funding $ 12M
- Pixel Photonics
- ElFys
- Photon Force
- Micro Photon De

Next-gen lasers for various applications
Combined funding $ 185M
- SuperLight Phot
- VEXLUM
- Vector Photonic
- Fusion Bionic G
- Quantune Techno
- M Squared Laser
- Pilot Photonics
- Integrated Opti
- Chromacity
- Skylark Lasers
- Lytid
- Cailabs
- Lithium Lasers
- Scantinel Photo
- Fluence.technol
- Photonicsens
- FYLA
- Hypermemo
- Innolume

Integrated photonic circuits for sensing and communication
Combined funding $ 7.6M
- Photonpath
- Rapid Photonics
- Optoscribe

Photonics foundries
Combined funding $ 368M
- SMART Photonics
- Phix Systems
- Lightium
- EFFECT Photonic
- Scintil Photoni
- LioniX Internat
- LiGenTec

Photonics design tools
Combined funding $ 9.2M
- Wave Photonics

Photonics integrated design services
Combined funding $ 2.1M
- Alcyon Photonic

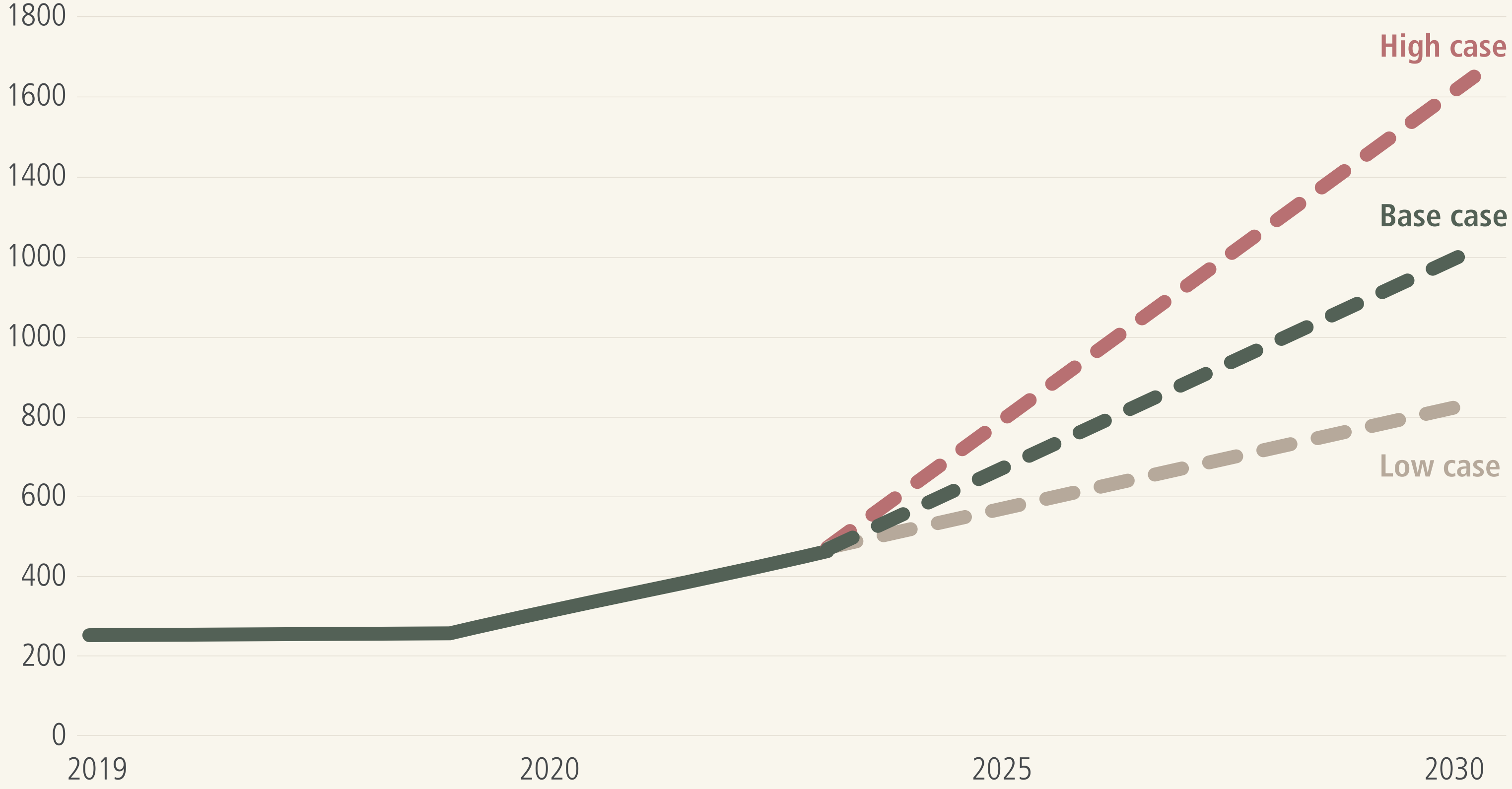
AR/VR hardware
Combined funding $ 50M
- TriLite Technol
- Swave Photonics
- AllFocal Optics

Space-ground communication
Combined funding $ 4.9M
- Astrolight
- Archangel Light

Others
Combined funding $ 9.9M
- PICadvanced
- Light Trace Pho
- MicroAlign
- Polariton Techn
- Subphoton

Data centres will consume more and more energy

Global electricity demand from data centres, AI, and cryptocurrencies, 2019-2026
in TWh



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> "The growth of AI is driving hyperscalers to closely integrate co-packaged optics and photonic chiplets with XPUs and high bandwidth memory to deliver performance and scaling while meeting energy and cost constraints.
>
> The pace of adoption will depend on the level of support and integration of photonics by the CMOS integrated circuit supply chain for fab, assembly, packaging, and test."

FRANCIS HO
PARTNER AT
WALDEN CATALYST

(w)C
Walden Catalyst

Development of AI drives the need for photonics interconnect in data centres

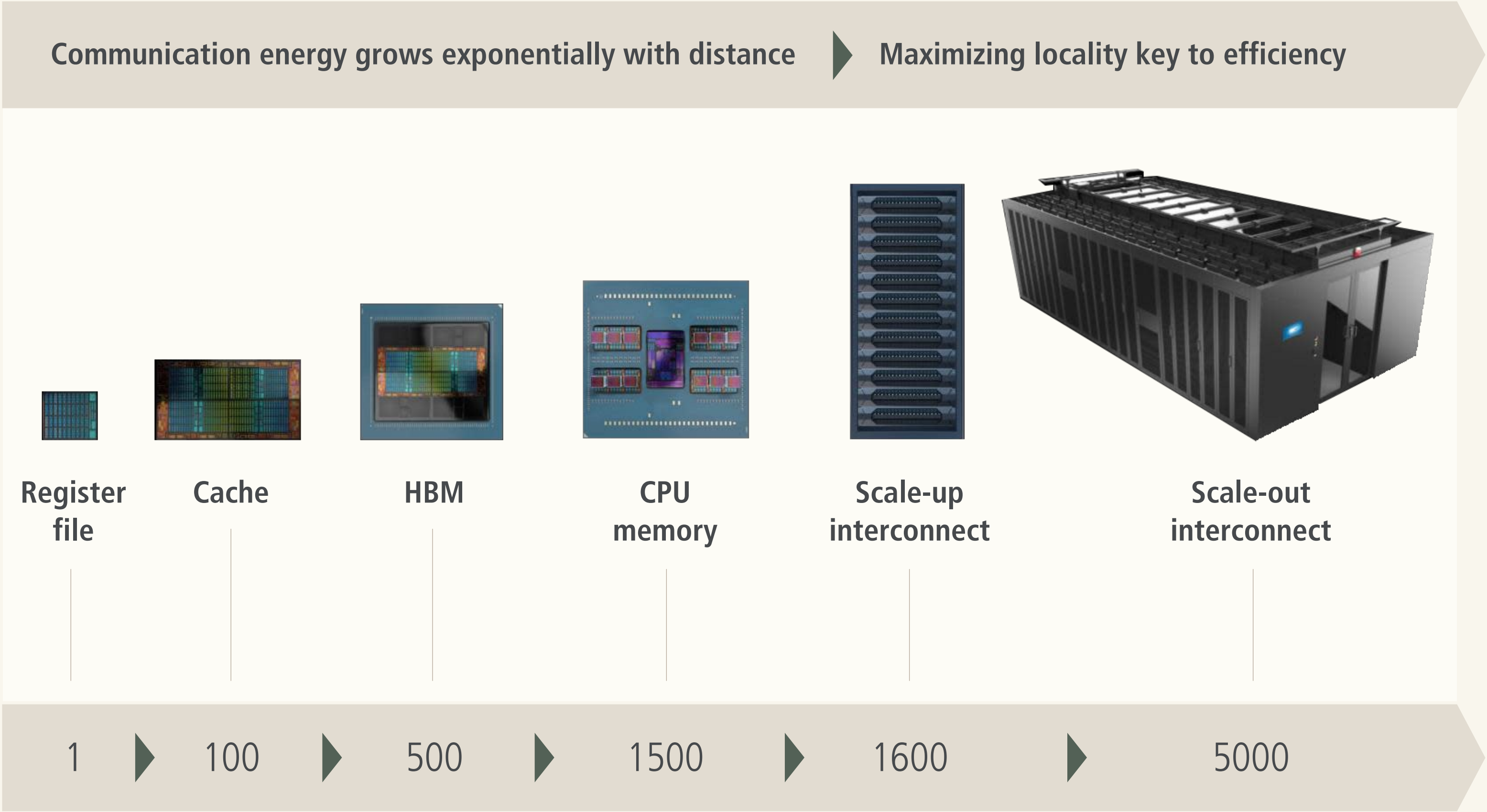
AI adoption is driving semiconductor growth, with the market projected to expand from $600bn in 2024 to $1tn by 2030. While AI offers economic and societal benefits, its scaling presents challenges, particularly soaring energy demands—data centres consumed ~2% of global electricity in 2022, expected to double by 2026.

Most AI energy use stems from data movement. Moving data to HBM costs up to **500x** more energy than within a chip, and to other server racks, up to **5000x** more. To sustain AI growth, we must reduce data movement distances and improve efficiency.

Unlike electrical interconnects, where energy use rises sharply with distance, **photonic interconnects** enable high-bandwidth transfer with minimal energy increase, making them essential for scalable AI infrastructure.

Reducing data movement energy

Normalized energy/bit



Data centres as the next deployment frontier for photonics

Today's AI and computing systems rely solely on electrical interconnects within data centre racks (e.g., between processor and memory), while photonic interconnects serve longer distances.

Reducing the threshold for photonics to millimeters could significantly improve energy efficiency, requiring closer integration of CMOS electronics and photonics.

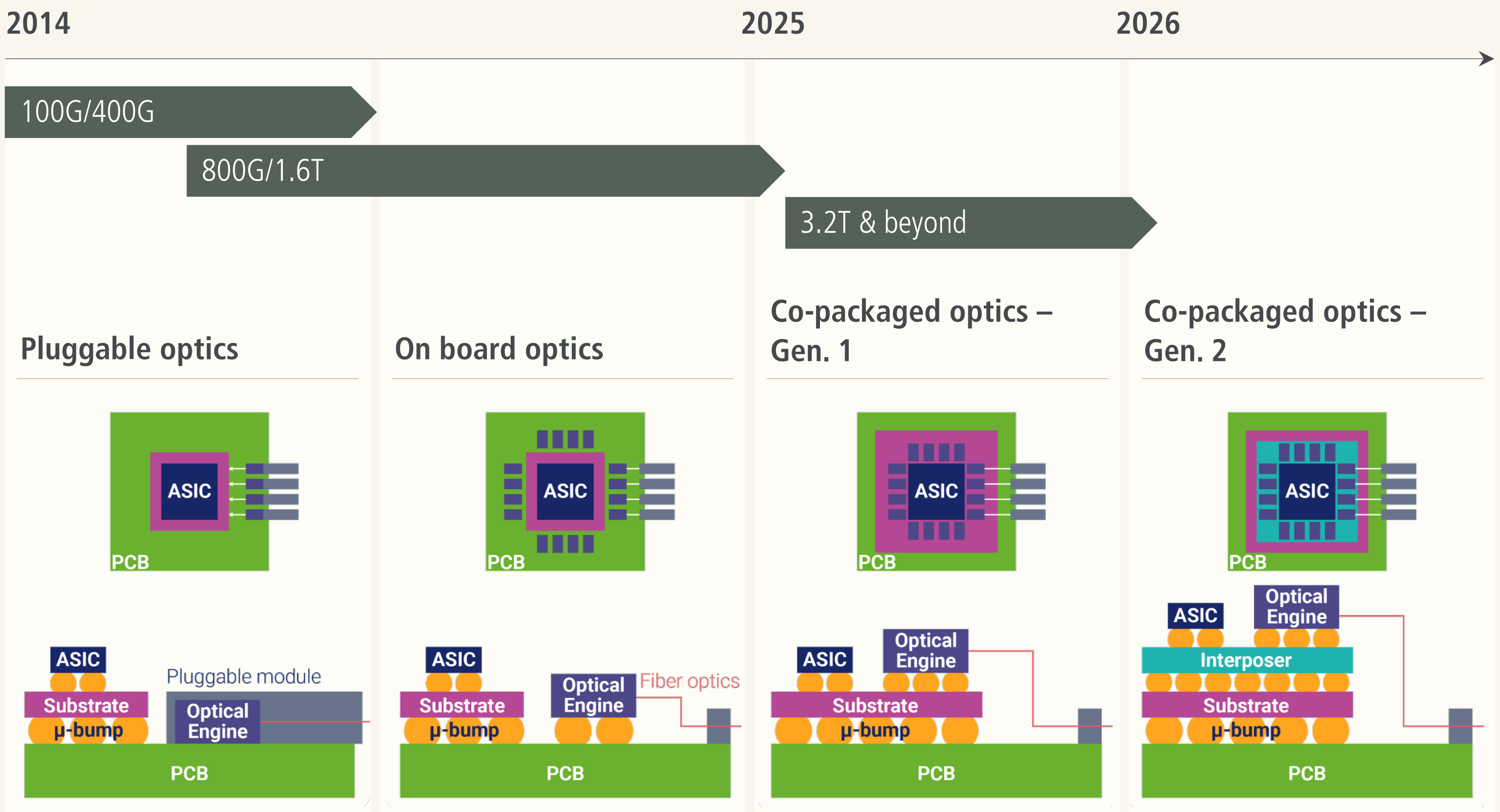
Key benefits of photonics include higher bandwidth and lower latency. AI data centres will adopt photonic interconnects in several areas:

Co-packaged optics (CPO) & optical chiplets
Integrated into GPUs and memory to link GPUs with HBM and other GPUs.

Embedded optical transceivers
Streamlining connectivity between GPU/CPU/memory/storage/networking across racks.

Optical circuit switches (OCS)
Connecting GPUs in AI superpods and linking superpods within large data centres.

Key trend of optical transceiver packaging in high-end data centre
More advanced package (higher complexity), shorter electrical path, high bandwidth, lower power consumption



Sources: idtechex; eetimes.eu

We are just at the beginning of this next revolution that will be enabled by silicon photonics

“There is a saying that “silicon always wins”! With bandwidth demands in the data centre pushing from 800Gb/s to 1.6Tb/s to 3.2Tb/s and with the explosion of AI workloads and very large compute models, the expected need for optical communication links will be 10x over the current data centre demands. This puts even more need for volume scalable, low-cost ($/Gbit) and low-power (pj/bit) optical solutions.

As Moore’s law did for the electronics industry, integrated silicon photonics will enable the datacom and AI revolution. But it will not simply be silicon photonics but rather solutions that enable heterogeneously integrated lasers, amplifiers, modulators, and detectors all at the wafer level, resulting in a single hybrid photonic integrated chip (PIC) that will usher in this new era of data and compute.

The world is going optical, and we are just at the beginning of this next revolution that will be enabled by silicon photonics. Exciting times.”

DR MARIO PANICCIA

CEO ANELLO PHOTONICS

ANELLO

The Creator Of The SiPhOG™

Key innovations to enable adoption of photonic interconnects

Advanced packaging

2.5D and 3D Integration

Stacks photonic and electronic components vertically or on a shared substrate

Enhances the density and energy efficiency of chip designs

Hybrid Copper Bonding

Combines electrical and photonic interconnects at the chip level, improving overall system performance

Photonic Interposers

Enable precise alignment and connection of photonic and electronic components, ensuring minimal signal loss and high bandwidth

Advanced materials

Thin-Film Lithium Niobate (TFLN) Modulators

Enables highly efficient optical modulation, which is crucial for converting electrical signals into optical ones

TFLN brings high bandwidth, low power consumption, and compact size

Quantum Dot Lasers

Provide a highly efficient and reliable light source for optical data transmission

Allow precise control over wavelength, improving data transfer rates and minimizing losses

MicroLED Photonics

Used for generating and modulating light efficiently at high speeds

Promising for short-range optical communication

Photonics integration with CMOS

Hybrid Integration

Combines photonic components with traditional electronic CMOS circuits.

Essential for integrating photonics into GPU, CPU, and memory systems for seamless operation.

Co-Packaged Optics (CPO)

Integrates optical transceivers directly into processor and memory packages.

This innovation minimizes the distance between components, reducing latency and energy costs.

Die-to-Die (D2D) Interconnects

Advanced packaging techniques enable direct optical communication between dies on the same or neighboring chips.

Europe’s biggest challenge is the lack of end-users, system integrators and OEMs

“Photonics technologies are at the centre of our modern digitalization and our digital lives. Without photonics and fibre optics network, the internet and interconnectivity as we know it today would not have been possible.

Unlike electronics ecosystem, the gap to the USA is much much smaller, and, in many cases, Europe is even leading the market with a strong ecosystem and with startups in almost the entire supply chain. However, the biggest challenge of European is the lack of end-users, system integrators and OEM.

The rapid growth of big data, ML, and AI has made data centres a critical focus, driving the need for faster data links to keep up with exponentially increasing global data consumption.

We developed a pioneering material platform, thin-film lithium niobate (TFLN), enabling ~2x faster data transmission and ~4x lower energy consumption than competing technologies. This innovation supports digital growth, meets increasing data traffic demands, and reduces data centres' carbon footprint.”

AMIR GHADAMI

FOUNDER AND CEO OF LIGHTIUM

LIGHTIUM

US photonics startups still get an order of magnitude more VC funding than European peers

US photonic startups benefit from a denser ecosystem: access to talent (Marvell, Broadcom, Nvidia, etc.), proximity of end customers (AWS, GCP, Azure), and availability of sophisticated scale-up funding.

Examples of US Photonic startups

Company	Description and status	Status	Funding raised
	Interposer with photonic inter-connect (related to CPO+OCS)	Series D	$821m
AyarLabs	Co-Packaged Optics (CPO)	Series D	$374m
celestial AI	CPO	Series C	$339m
XSCAPE PHOTONICS	Microresonator nonlinear optical source for transceiver and CPO	Series A	$57m
HL HYPERLIGHT	Thin film lithium niobate modulator for transceiver	Series B	$55m
AVICENA	Active optical cable and CPO (microLED)	Series A	$47m
Q QUINTESSENT	Quantum dot laser for transceiver and CPO	Seed	$18m

Examples of European Photonic startups

Company	Description and status	Status	Funding raised
black semiconductor	CPO	Series A	$282m
Salience Labs	Optical Circuit Switches	Seed	$52m
Oriole Networks	Photonic switch for data centre	Series A	$35m
iPronics	Optical Circuit Switches	Series B	$28m
SCINTIL PHOTONICS	Photonic chip for transceiver & CPO	Series A	$25m
LIGHTIUM	Thin film lithium niobate foundry	Seed	$7m
NcodiN	Optical interposer	Seed	$4m

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Photonics in Computational Biology

Biophotonics

In addition to the transformational role photonics will play in the Future of Compute, we're also excited about the transformative potential of biophotonics and machine learning in enhancing human health and food safety.

The ability to shine light on food samples and analyze the interaction between microorganisms and light represents a significant innovation in pathogen detection, especially when coupled with Machine Learning models trained to identify specific spectral signatures of harmful bacteria.

Optical neuromonitoring

Optical neuromonitoring technologies are also a game-changer in the medical device landscape. Cutting-edge optical devices are now capable of delivering non-invasive measurements of critical physiological parameters. These innovations not only reduce the risks associated with invasive procedures but also enhance the quality of patient monitoring and improve outcomes.

Optogenetics

Advancements in optogenetics have produced an innovative technique that uses engineered light-sensitive proteins (opsins) to precisely control neural circuits, providing novel treatment strategies for brain and nervous system disorders which can lead to radically improved therapeutic capabilities in neurology.

Laser technology

There is huge promise in precision of laser technology that allows for minimally invasive surgeries, as well as innovations in wearable technology, like optical sensors incorporated into smartwatches or health monitors, enabling continuous monitoring of vital signs, oxygen levels, and other health metrics in real-time.

"We're excited about Deep Tech companies, which are enabled by scientific or engineering breakthroughs, including in photonics, that solve real-world problems, including in health and life sciences – and we believe these technologies will drive the next wave of economic growth."

JULIA HAWKINS

PARTNER AT LOCAL GLOBE

LocalGlobe

NOVEL ENERGY

DEEP DIVE

EXAMPLES

SPACE-BASED SOLAR

NUCLEAR FUSION

NUCLEAR FISSION

NEXT GEN SOLAR

GEOTHERMAL

SUPER/ULTRACAPACITORS

FLYWHEELS

NEW CELL CHEMISTRIES

(GREEN) HYDROGEN

LONG-DURATION STORAGE

HYDROGEN/ELECTRIC AVIATION

WASTE HEAT RECOVERY

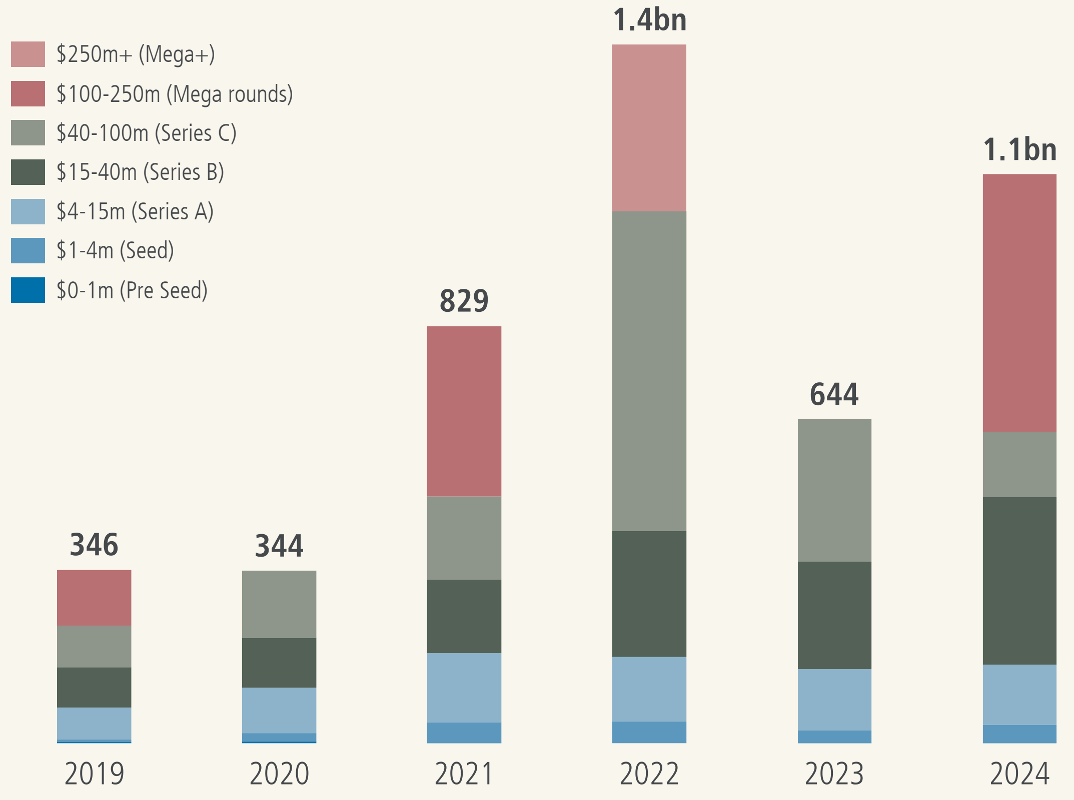
Novel Energy – *What's new?*

Geothermal	Harnessing Earth's heat with advanced drilling and enhanced geothermal systems (EGS) for scalable, clean energy.	In January 2025, Fervo Energy announced a 70% increase in EGS output in Utah, targeting commercial scale by 2026.
Nuclear Fission	Improved nuclear power with next-gen reactors focusing on safety, efficiency, and waste reduction.	In December 2024, TerraPower began building a sodium-cooled reactor in Wyoming, set for completion by 2030.
Small Modular Reactors (SMRs)	Compact reactors (50-300 MW) for flexible, safe power generation with lower upfront costs.	In November 2024, NuScale Power secured a $1.5bn deal for SMRs in Ohio, targeting deployment by 2029.
Nuclear Fusion	Fusing nuclei for near-limitless clean energy, still in experimental stages with significant potential.	In February 2025, Commonwealth Fusion Systems achieved a 20-second sustained fusion reaction in SPARC, aiming for grid use by 2035.
Battery Technologies (Silicon Anode)	Silicon anodes in lithium-ion batteries boost capacity and charging speed for EVs and storage.	In January 2025, Sila Nanotechnologies shipped silicon-anode batteries, with EV integration planned by 2027. Moreover, Si-anode is starting to get integrated into smartphones (mostly Chinese smartphones being sold in Asia and Europe).
EV Battery Sales Slowdown	A market trend where EV battery demand growth is decelerating due to saturation, cost, and infrastructure delays.	In late 2024, reports showed a 10% drop in EV battery sales growth, with Tesla and BYD citing softer demand. Northvolt declared bankruptcy given production delays and canceled orders - getting battery manufacturing stable is incredibly hard and Europe is clearly behind Asian counterparts.
Data Centre Power Consumption	Rising energy demand from data centres, driving adoption of sustainable, high-output energy solutions.	In January 2025, Google and Amazon announced plans to power data centres with next-gen energy, including SMRs and geothermal, by 2030.

Novel Energy funding picked up again this year reaching $1.1bn – Nuclear energy, fusion and SMRs, accounted for three of the top deals

VC funding in European Novel Energy startups

$ m



Select Novel Energy Tech VC-rounds in 2024

Startup	Funding round	Focus
sunfire	€215m Series E	Hydrogen electrolysers
newcleo	€135m Series A	Small nuclear reactors (SMRs)
Tokamak Energy	$125m Growth Equity	Nuclear fusion
Marvel Fusion	€62.8m Series B	Nuclear fusion
CYLIB	€55m Series A	Battery recycling
ECHION TECHNOLOGIES	£39m Series B	Niobium anodes for Li-ion batteries

Novel Energy startups in Europe

(click to view live version)

Nuclear fusion
Combined funding $ 622M

Focused Energy, Tokamak Energy, First Light Fus, Marvel Fusion, Pulsar Fusion, Renaissance Fus, Crossfield Fusi, Deutelio, Novatron Fusion, Proxima Fusion, Gauss Fusion, Fusion Reactors, Next Step Fusio, Astral Systems, Otrera, Suprema, Firefly Fusion, Blue Capsule Te

Nuclear fission
Combined funding $ 924M

Newcleo, Moltex Energy, CORE-POWER, Seaborg Technol, Horizon Nuclear, Blykalla, Thorizon, Transmutex, Stellaria, Naarea, Jimmy, Steady Energy, Kärnfull Next

Next-gen lithium batteries
Combined funding $ 417M

LionVolt, Addionics, LithiumWerks, E-magy, LeydenJar Techn, Echion Technolo, Cenate, Anaphite, BASQUEVOLT, The Batteries, CustomCells, Gouach, OXLiD, Ilika, Floatech, SOLiTHOR, ENWIRES, Molyon, Ampoxe, BTRY, NorcSi GmbH

Other battery chemistries & supercapacitors (mobile applications)
Combined funding $ 689M

Skeleton Techno, NAWAH, Geyser Batterie, theion, Oxis Energy, Beyonder, Faradion, Nanom, Nyobolt, BroadBit Batter, Tiamat Energy, ITEN, LiNa Energy, Altris, NDB, Rivus, C2C NewCap, Swistor, 8inks, Easyl, Ligna Energy, Volta Structura

Innovative large scale energy storage (flow batteries, salt storage, kinetic etc)
Combined funding $ 520M

Energy Vault, VoltStorage, Elestor, SaltX Technolog, Kemiwatt, Volterion, Nilar, Energy Dome, Sinergy Flow, Enerpoly, Cellfion, Zelestium Techn, Bettery, Unbound Potenti, HalioGen Power, Ore Energy, Silbat, Flow-nano, Redox One, VANEVO, AquaBattery

Hydrogen & ammonia
Combined funding $ 2.1B

Enapter, StoreH, H2site, Supercritical, IC Technologies, Fuel Cell Power, Sunfire, Areva H2Gen, HSL Technologie, HyMove, Hymeth, PowerCell Swede, Hiiroc, HyET Hydrogen, Lhyfe, Mahytec, Cyrus PC, Bramble Energy, Green Hydrogen, H2GO Power, Hydrofy, H2Fuel-Systems, HydrogenPro, Hydrogenious LO, Elcogen, EH Group, HPNow, Rouge H2, GRZ Technologie, H2B2, Inergio, Battolyser Syst, Spark Cleantech, Intelligent Ene, McPhy Energy, NHOA, Convion, Helion Hydrogen, Symbio, zepp.solutions, Ceres, SCW Systems, Hystar, DENS, Cella Energy, NPROXX, ZEG Power, Nium, ITM Power, Oort Energy, Ki Hydrogen, NovaMea

Novel wind energy (Bladeless, innovative materials)
Combined funding $ 127M

X1 Wind, Vortex Bladeles, SeaTwirl, Hydro Wind Ener, TwingTec, Skypull, Norsepower, Kitemill

Novel solar tech (curve, transparent, materials, solar cars)
Combined funding $ 292M

Mesoline, Exeger, Oxford Photovol, Saule Technolog, Heliup, GraphEnergyTech, Perovskia, Power Roll, Evolar

Battery recycling
Combined funding $ 136M

cylib, Altilium Metals, Gigamine, The Battery Rec, tozero, Solveteq, Librec, Mecaware

Battery Management Systems (BMS) & battery analytics
Combined funding $ 23M

Breathe Battery, PowerUp

Wave & tidal energy
Combined funding $ 123M

CorPower Ocean, Minesto, Mocean Energy, SeaQurrent

Thermal energy storage
Combined funding $ 77M

Sunamp, Kraftblock, Exergy3

Battery swapping

TANKTWO

Waste heat recovery & energy harvesting
Combined funding $ 5.7M

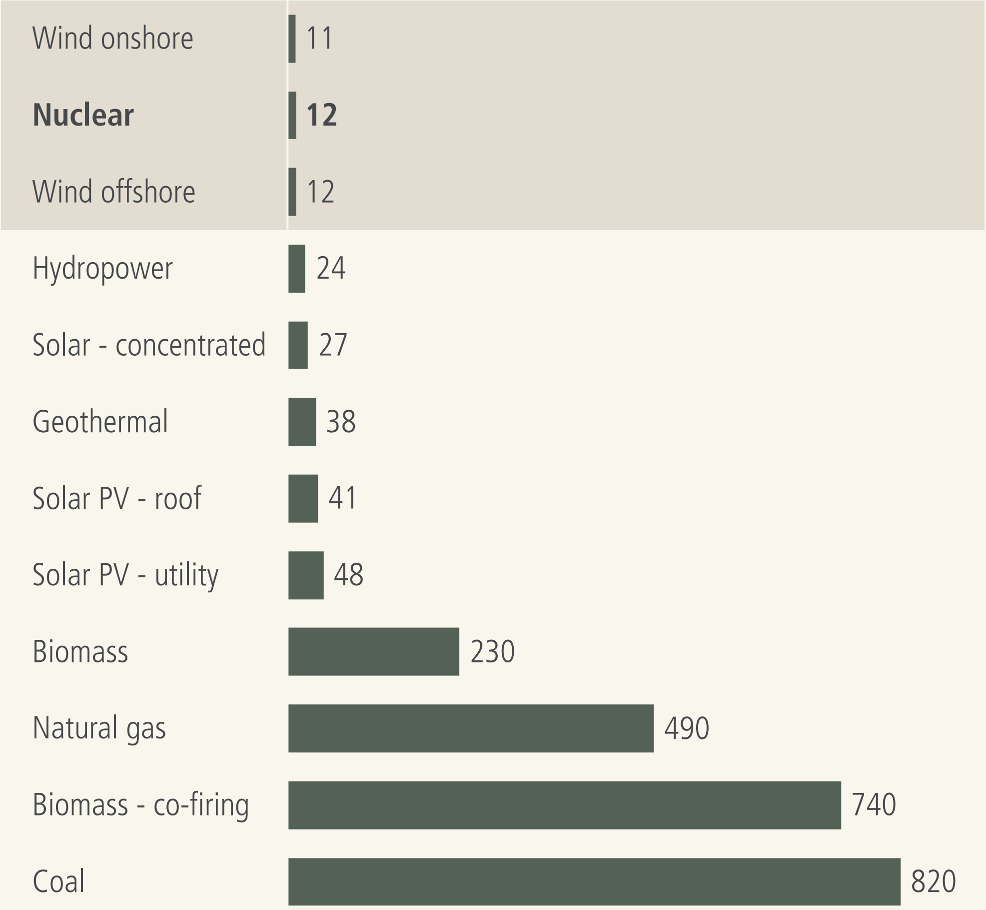
Efenco

NUCLEAR FISSION

SEGMENT DEEP DIVE

Since the 1940s Nuclear Energy promised us a clean and bright future

Lifecycle emissions of electricity options
gCO_2 equivalent per kWh



Source: World Nuclear Association

Energy independence is vital for national sovereignty, with each energy source having trade-offs

Renewables

Solar and wind fluctuate with weather; battery storage degrades over time and have capacity constraints.

Fossil Fuels

Less energy-dense and reliant on complex logistics to keep the power plant fuelled and operating.

Nuclear

Nuclear provides consistent baseload energy, storing lifetime fuel on-site in minimal space, with fuel costs at 10% of energy costs vs. 60–70% for gas, ensuring price stability and reliable baseload power.

Nuclear is not just the best solution to these challenges, it's the only rational solution

"On a first principles basis, nuclear power has orders-of-magnitude advantages over every other energy source. Nuclear fuel's power density is three million times that of fossil fuels and is as abundant in the Earth's crust as tin. Nuclear also requires a thousand-fold less in materials than renewables and delivers power 24/7 irrespective of environmental factors.

The reason for nuclear's resurgence is simple. In previous eras, the world was stable enough that society could be impractical about energy. But land wars, geopolitical tensions, supply chain disruptions, and climate change have upended that logic.

Nuclear is not just the best solution to these challenges, it's the only rational solution. The folly of nuclear incumbents is to imagine that a unicorn reactor is what will make nuclear popular. Last Energy thinks differently. We take existing technology to the factory, focus on mass-manufacturability to reduce costs, and bury our reactor underground in a thousand-ton steel shell to resolve every other concern."

BRET KUGELMASS

FOUNDER AND CEO OF LAST ENERGY

LAST ENERGY

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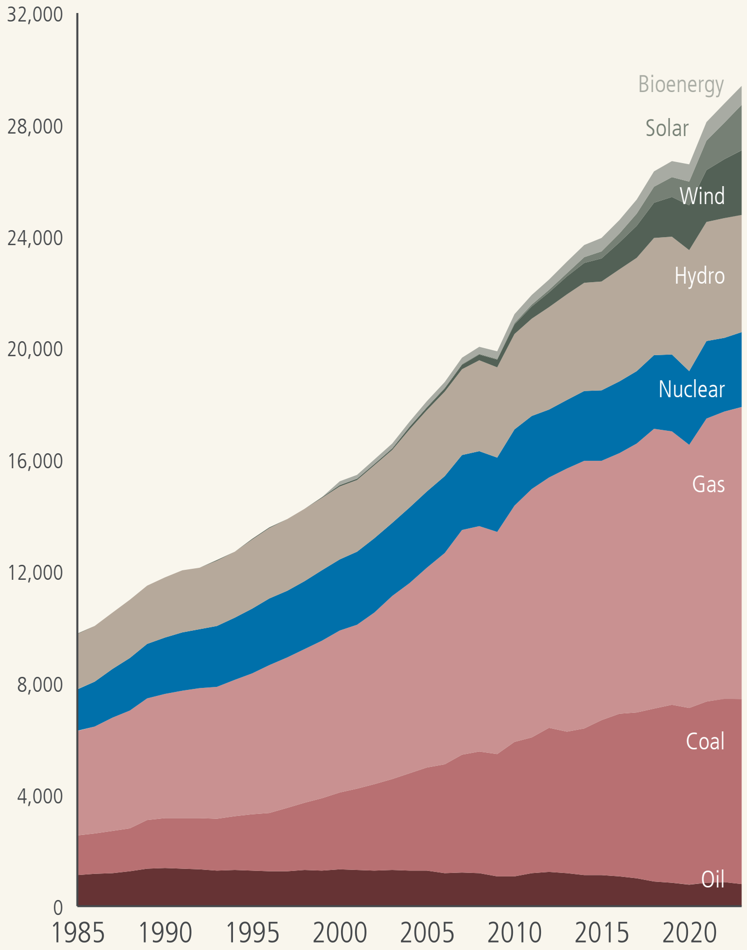
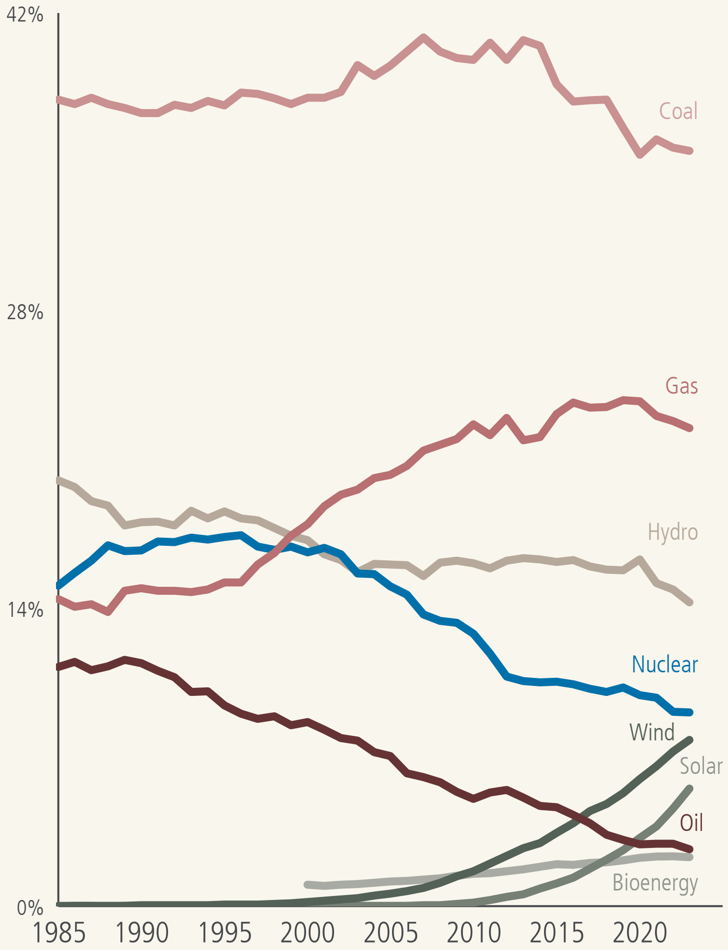
But Nuclear Fission's share of electricity production is down nearly 50% since it's peak in 1996 with Wind and Solar quickly catching up

World electricity production by source, world
Terawatt hours



Share of electricity production by source, world
%



Source: Ember (2024); Energy Institute - Statistical Review of World Energy (2024)

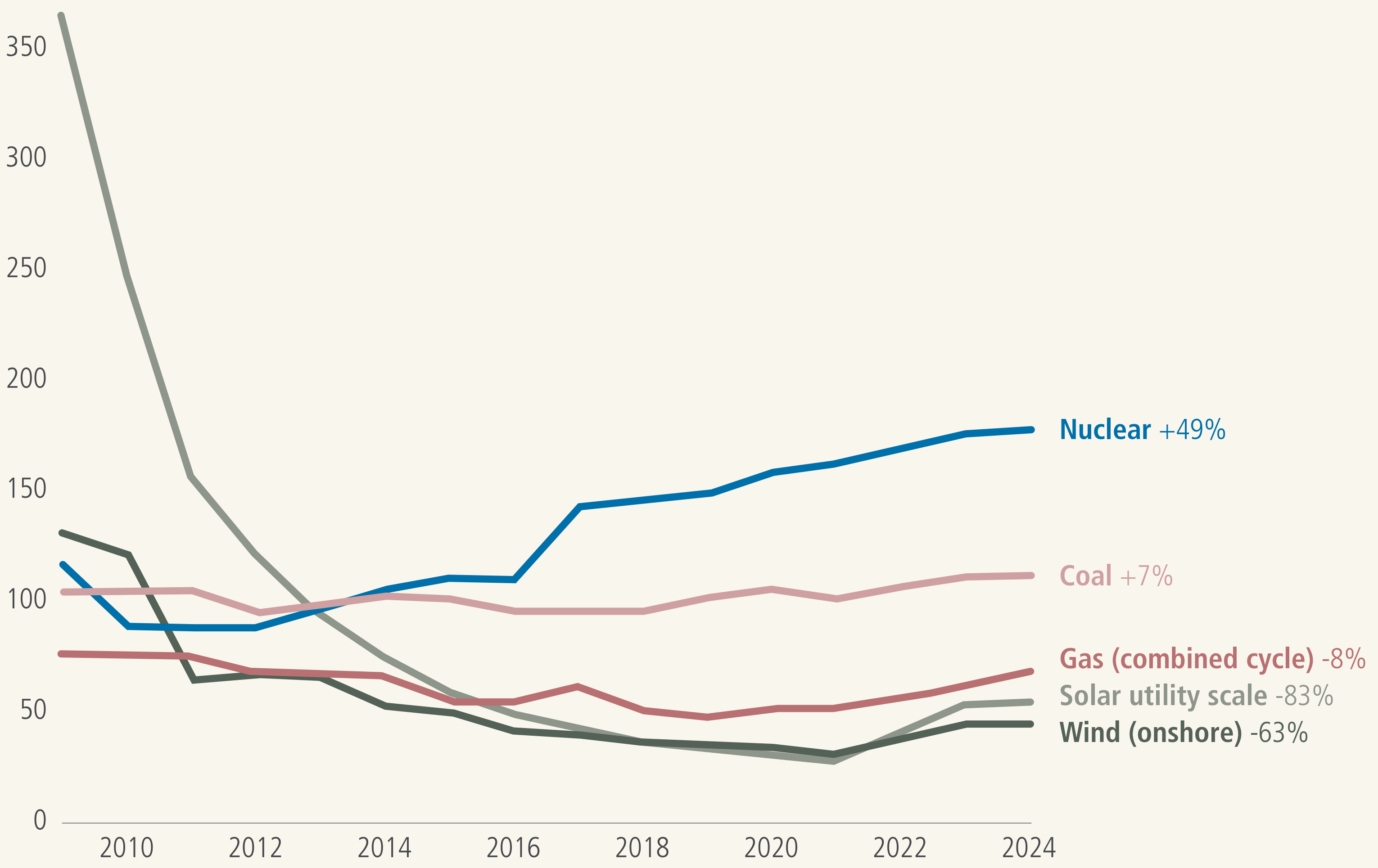
The core problems with Nuclear Fission are cost, time, and regulation

The *Levelized Cost of Energy* (LCOE) refers to the average cost of producing electricity from a power plant over its entire lifespan, taking into account all costs like initial capital expenditure, operation and maintenance, fuel costs, and considering factors like capacity factor and project lifetime, essentially providing a standardized way to compare the cost of different electricity generation technologies across their lifespans.

LCOE for Nuclear has increased by 49% while other energy sources have remained flat or significantly lowered their LCOE. This makes Nuclear Fission as we traditionally think about it less viable today than at any point in history.

Select historical mean costs by technology

LCOE values in $/MWh[1]



1) This graph reflects the average unsubsidized LCOE values for a given version of LCOE study. It primarily relates to the North American energy landscape but reflects broader/Global cost developments

Source: Lazard Estimates, 2024

So, do we give up on Nuclear Fission, or do we rethink it from first principles?

What is Nuclear Fission?

SPLIT ATOM → HEAT WATER → TURN STEAM TURBINE → GENERATE ELECTRICITY

This is the tricky bit, and the part that has people concerned for their safety *(Split atom)*

This is what coal, gas, and oil do as well, so we understand this part pretty well *(Heat water, turn steam turbine, generate electricity)*

Nuclear Fission development

1895 to 1945

The science of nuclear fission, atomic change, and atomic radiation is developed.

In the years just before and during World War II, nuclear research focused mainly on the development of defence weapons.

1934 to 1942

Enrico Fermi splits atoms with neutrons in Rome.

Otto Hahn and Fritz Strassman confirm Einstein's work by converting mass into energy in Germany.

Fermi achieves first nuclear chain reaction at University of Chicago.

1946 to 1957

The US Congress creates the Atomic Energy Commission.

First electricity from atomic energy in US.

Soviet Union connects first nuclear power station to grid.

UK opens the first full scale power station.

The US opens first commercial nuclear power plant.

1970s

Nuclear Regulatory Commission and Department of Energy formed in US create stricter regulations.

Three Mile Island accident in US (no injuries or radiation).

1980s

Globally, one new nuclear reactor is started every 17 days on average.

Nuclear fission overtakes hydro-power to become 2nd largest electricity source globally.

Chernobyl accident forces tens of thousands people to evacuate.

What happened here that caused a 30-year pause in the adoption of Nuclear Fission?

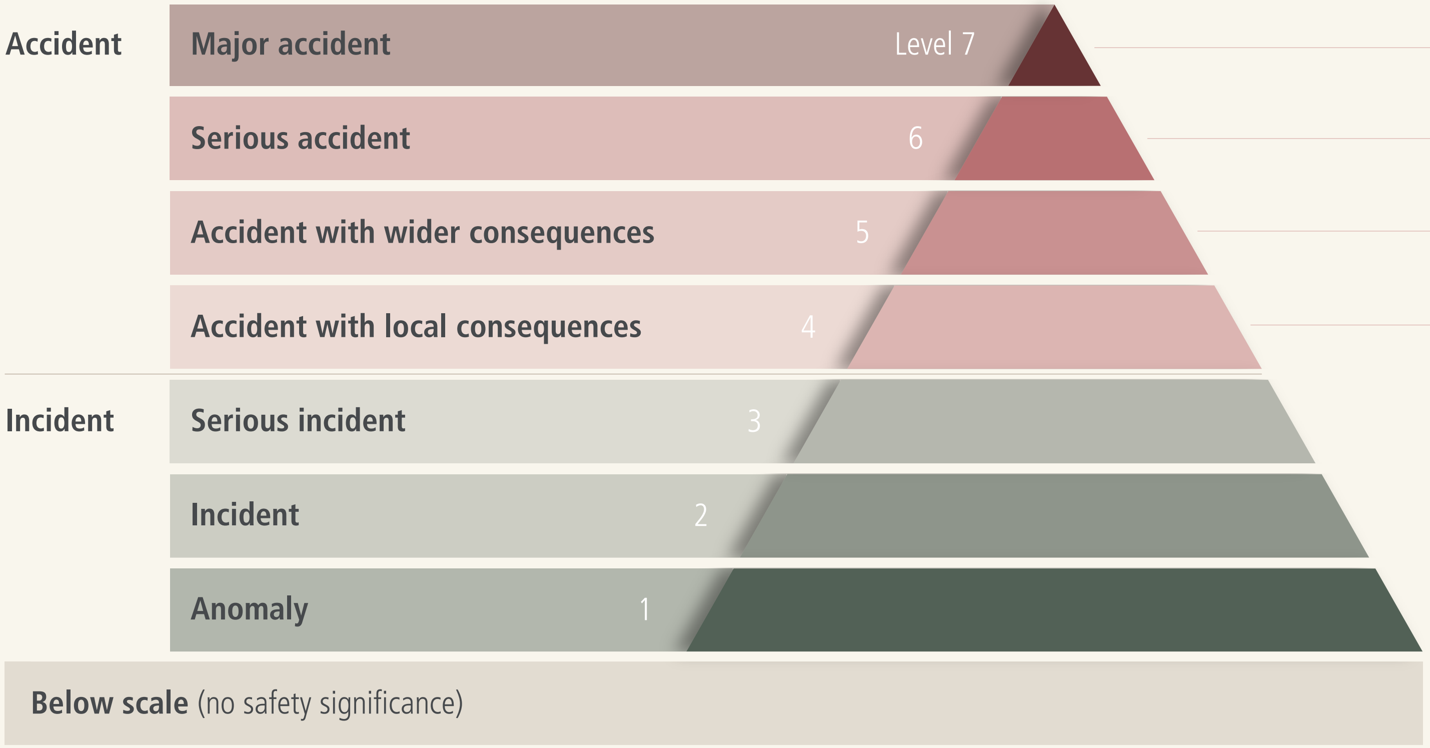
Regulation increased, thus increasing costs. Media stoked fear after accidents, and oil became cheap and abundant.

2010s

The U.S. NRC approves the construction of two reactors at the Vogtle Electric Generating Plant, the first approval in 30 years.

The fears are irrational. In the history of Nuclear Fission, only two major accidents have happened

International Nuclear and Radiological Event Scale (INES)



Accidents in the history of Nuclear Fission

Fukushima disaster, Japan 2011
Chernobyl disaster, former USSR 1986

Kyshtym disaster, Russia 1957

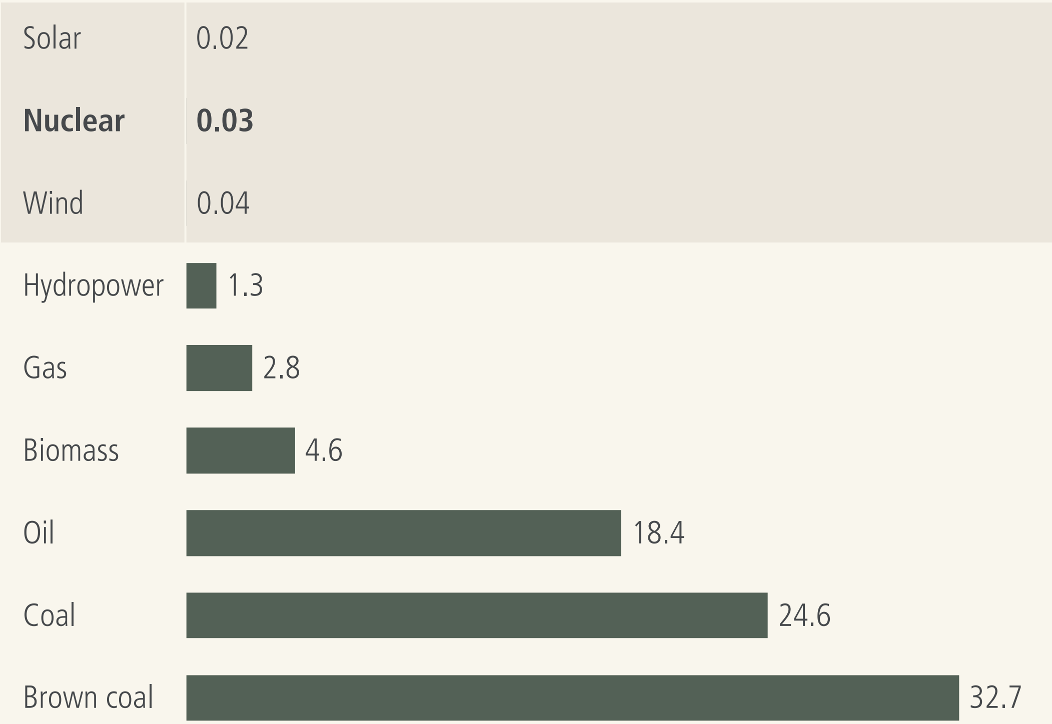
Three Mile Island accident, US 1979
First Chalk River accident, Canada 1952
Windscale fire at Sellafield, UK 1957
Goiânia accident, Brazil 1987

Sellafield (5 accidents), UK 1955 to 1979
SL-1 Experimental, US 1969
Saint-Laurent Nuclear, France 1969
Lucens, Switzerland 1969
Jaslovské Bohunice, Czechoslovakia 1977
Andreev Bay, Soviet Union 1982
Buenos Aires, Argentina 1983
Tokaimura, Japan 1999
Mayapuri, India 2010

Historical death rates per unit of electricity produced is comparable to renewable energy sources and orders of magnitude less than fossil fuels

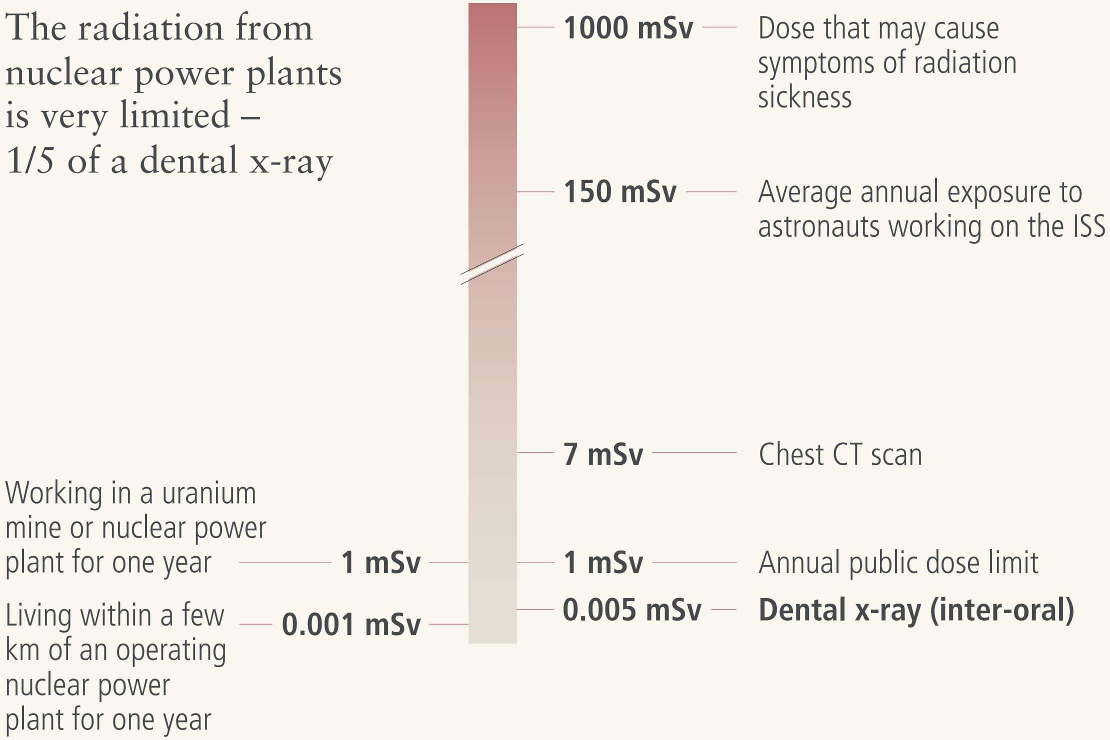
Death rates per unit of electricity production

Deaths from accidents and air pollution per terawatt-hour of electricity



Radiation dose examples

Not to scale



There are four levels of Nuclear waste

4 levels of Nuclear waste
As defined by the European Nuclear Society

Waste Type	Description	Example	Radiation duration
Very low level waste VLLW	Minimal containment needed; can be disposed of in landfills	Lightly contaminated building rubble from decommissioned nuclear sites	A few years to decades
Low level waste LLW	Requires containment for up to a few hundred years; disposed of in engineered near-surface facilities	Used protective clothing and lab equipment from hospitals or nuclear plants	Half-lives up to 30 - 100 years
Intermediate level waste ILW	Contains long-lived radionuclides; needs deeper disposal (tens to hundreds of meters)	Reactor components like irradiated fuel cladding	Half-lives of thousands to tens of thousands of years
High level waste HLW	Highly radioactive and heat-generating; requires deep geological disposal (hundreds of meters)	Spent nuclear fuel from reactors	Half-lives of thousands to millions of years

Source: European Nuclear Society

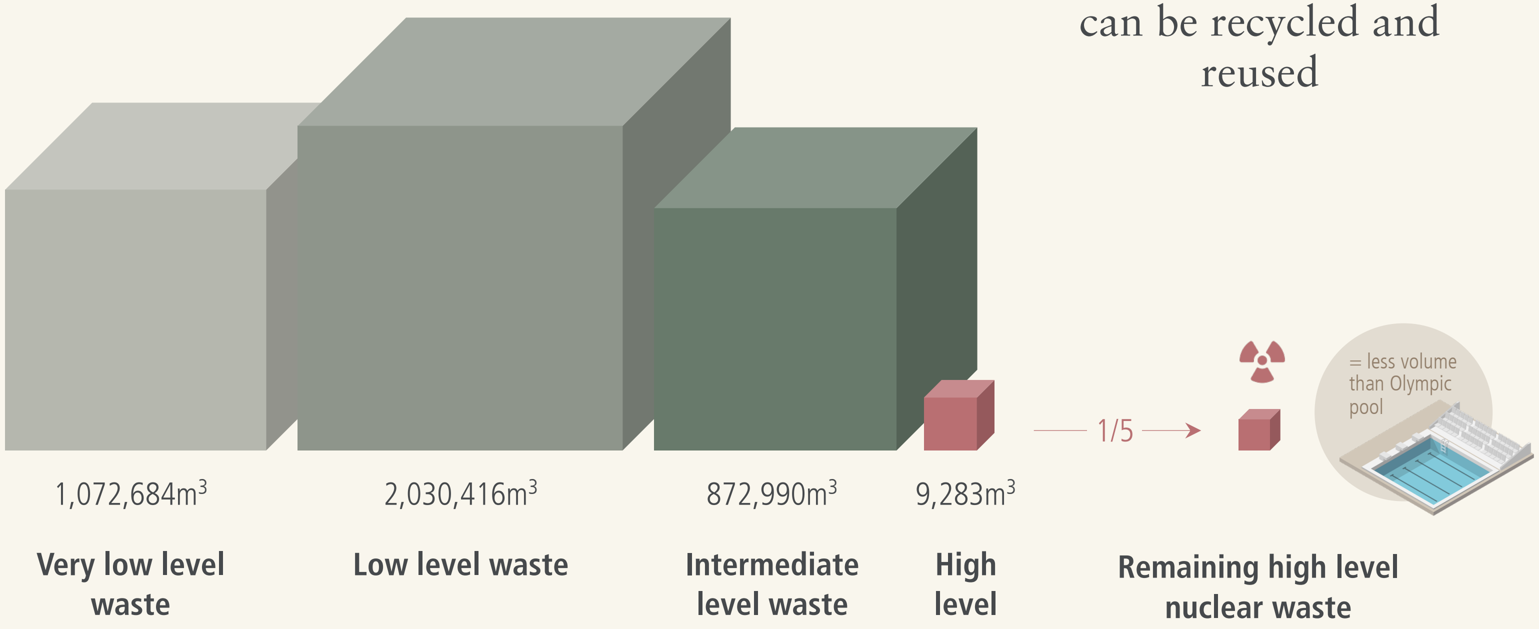
Most of the Nuclear waste can be recycled and reused, reducing high-level waste volume by five

Volume of all existing Nuclear waste

Stored and disposed radioactive waste reported to the IAEA

96%

of spent Nuclear fuel can be recycled and reused



“Long-lived nuclear waste is a major barrier to public acceptance of nuclear energy. This 'spent fuel' contains vast amounts of energy, but the real 'waste' is that often only 4% of the scarce uranium resources are utilized in nuclear reactors today.

As of the mid-2030s, fast reactor designs will be able to use long-lived nuclear waste as fuel, either directly to create carbon-free energy or to remake fuel for the existing nuclear fleet. Molten salt reactor technology, in particular, has the potential to continually reprocess this fuel, virtually eliminating long-lived waste and optimizing the utilization of nuclear resources.”

KIKI LAUWERS

CEO THORIZON

THORIZON

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Data is from the last reporting year which varies by reporting country, 2019-2023.
Source: https://www.orano.group/

Transmutation using widely available thorium instead of uranium has seen a major boost in 2024

"While fusion is not yet commercially available and fission hampered by waste, safety and proliferation issues, transmutation is a third path to generate energy and ready to be deployed on a global scale.

Accelerator-driven transmutation using widely available thorium instead of uranium has seen a major boost in 2024 in the U.S., Germany and India.

As Europe seeks sustainable energy independence, this CERN-tested technology represents its unique contribution to advancing nuclear for a sustainable future and reduce the radioactivity of nuclear waste from up to 1 million years down to a few hundred, while recovering valuable raw materials."

FRANKLIN SERVAN-SCHREIBER

CEO AND FOUNDER TRANSMUTEX

TRANSMUTEX

Many of these risks with Generation I Nuclear plants are relics of the past

On one hand, new Nuclear reactor designs for large and small power plants promise improved safety

Generations of Nuclear reactors over time

1950 | 1960 | 1970 | 1980 | 1990 | 2000 | 2010 | 2020 | 2030 | 2040

I
Early proto-type reactors

II
Commercial power reactors

III
Advanced LWRs

III+
Evolutionary designs

IV
Revolutionary designs

Valid for large powerplants & SMRs (III+ and IV)

1,000-1,600 MWe output per reactor

On the other hand, new form factors are being developed with SMRs to enhance safety and leverage the benefits of mass production

What does SMR stand for?

S

Small

Significantly smaller than typical large reactors

Capacity of 10-300 MWe generated per reactor or up to 1000 MWt thermal capacity

M

Modular

All or large part assembled at factory and shipped to site

Host several individual SMR modules, or single module

R

Reactors

Supplying electricity and other energy services to energy-intensive industries, to locations with small grids, or serving isolated and remote locations

50-300 MWe output per module

The different generations of Nuclear Fission power plants

Generation I

Mostly early prototypes such as Shippingport Atomic Power Station, research reactors, and non-commercial power producing reactors.

The last commercial Gen I power reactor was located at the Wylfa Nuclear Power Station and ceased operation at the end of 2015.

Generation II

Include most current nuclear power plants generally built between 1965–1996.

Generation II reactor designs generally had an original design life of 30 or 40 years. This date was set as the period over which loans taken out for the plant would be paid off. However, many Gen II reactors are being life-extended to 50 or 60 yrs, and a 2nd life-extension to 80 yrs may also be economical in many cases. By 2013 about 75% of still operating U.S. reactors had been granted life extension licenses to 60 yrs.

Chernobyl's No.4 reactor that exploded was a generation II reactor.

Generation III

A class of nuclear reactors designed to succeed Generation II reactors, incorporating evolutionary improvements in design.

This generation includes improved fuel technology, higher thermal efficiency, significantly enhanced safety systems (including passive nuclear safety), and standardized designs intended to reduce maintenance and capital costs. Fukushima was a generation III reactor.

Generation III+

Evolutionary development of Gen III reactors, offering improvements in safety over Gen III reactor designs.

Manufacturers began development of Gen III+ systems in the 1990s by building on the operating experience of the American, Japanese, and Western European light-water reactor.

A notable improvement of Gen III+ systems over second-generation designs is the incorporation in some designs of passive safety features that do not require active controls or operator intervention but instead rely on gravity or natural convection to mitigate the impact of abnormal events.

Generation IV

Nuclear reactor design technologies that are envisioned as successors of Generation III reactors.

The Generation IV International Forum (GIF) – an international organization that coordinates the development of Generation IV reactors – specifically selected six reactor technologies as candidates for generation IV reactors. The designs target improved safety, sustainability, efficiency, and cost.

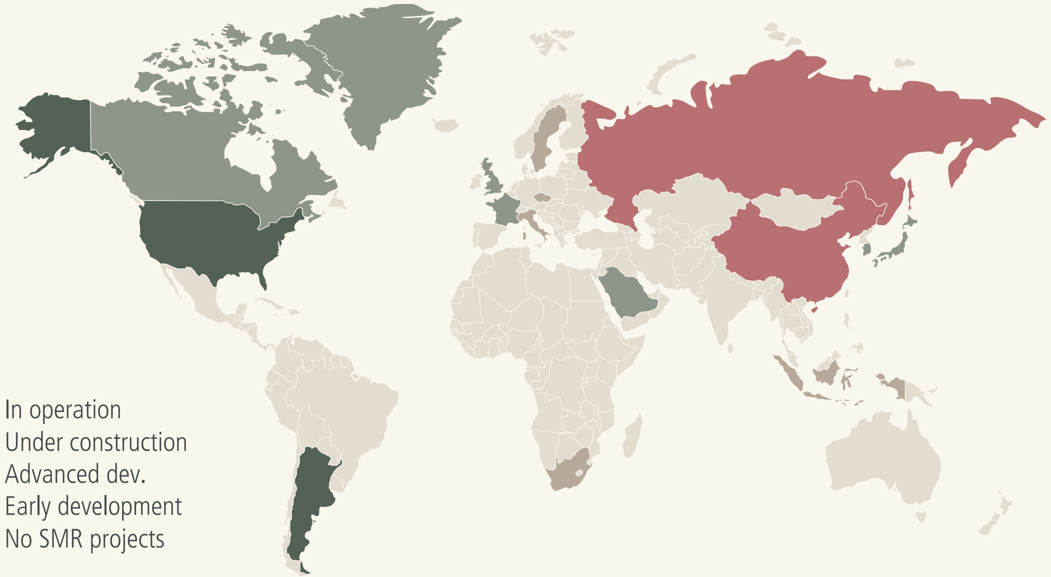
The first and only Generation IV reactor was connected to the grid and began commercial operation in China in 2023.

Various approaches to SMRs

SMR startups are attempting to build faster and cheaper by using mass production techniques to bring down costs and speed construction.

SMR reactors are categorized by the type of cooling system.

Status of the most advanced SMR projects in each country



- In operation
- Under construction
- Advanced dev.
- Early development
- No SMR projects

Generation III / III+ designs

- Coolant type
- Reactor type

Water-cooled reactors (WCR)[1]

Light water (LWR)
- **Pressurized water reactor** (PWR)
- **Boiling water reactor** (BWR)

Heavy water (HWR)
- **Pressurized heavy water reactor** (PHWR)

Generation IV designs

Non-water-cooled reactors

Gases (ex: helium and carbon dioxide)
- **High-temperature gas-cooled reactor** (HTGR/GCR)
- **Gas-cooled fast reactor** (GCFR/GFR)

Liquid metal (Ex: sodium and lead)
- **Liquid metal fast reactor** (LMFR/SFR/LFR/MFR/LMR/LMCR/LBE)

Molten salts
- **Molten salt reactor** (MSR/MSFR/FHR/FHTR)

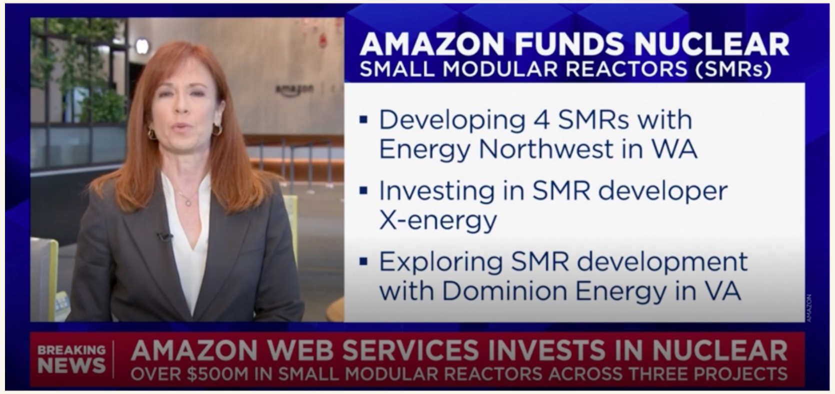
Other novel approaches[2]
- **Heat-pipe-based microreactor** (HPR)

Data centre power needs are driving renewed demand, SMRs are one option

IMAGE CREDITS: MENGWEN GUO / GETTY IMAGES

Google signed a deal to power data centers with nuclear micro-reactors from Kairos — but the 2030 timeline is very optimistic

Tim De Chant 3:33 PM PDT · October 14, 2024



Meta

DECEMBER 3, 2024 | ENERGY

Accelerating the Next Wave of Nuclear to Power AI Innovation

- Today, Meta announced it will release a request for proposals (RFP) to identify nuclear energy developers to help us meet our AI innovation and sustainability objectives — targeting 1-4 gigawatts (GW) of new nuclear generation capacity in the U.S.; qualified developers can fill out the intake form to receive further guidance on the RFP process.
- We are taking an open approach with this RFP so we can partner with others across the industry to bring new nuclear energy to the grid.

Three Mile Island nuclear reactor to restart to power Microsoft AI operations

Pennsylvania plant was site of most serious nuclear meltdown and radiation leak in US history in 1979

Regulation is catching up given the new surge in demand and safer modern reactor designs

The Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy Act of 2024, or the ADVANCE Act of 2024, is a piece of legislation passed by the 118th United States Congress to accelerate the development of Generation IV nuclear reactor technology and keep existing United States nuclear electric power plants online.

The bill passed amid bipartisan support for nuclear energy, which is popular with Democrats as a means to decarbonize electrical generation and with Republicans for jobs and reliable base load electricity.

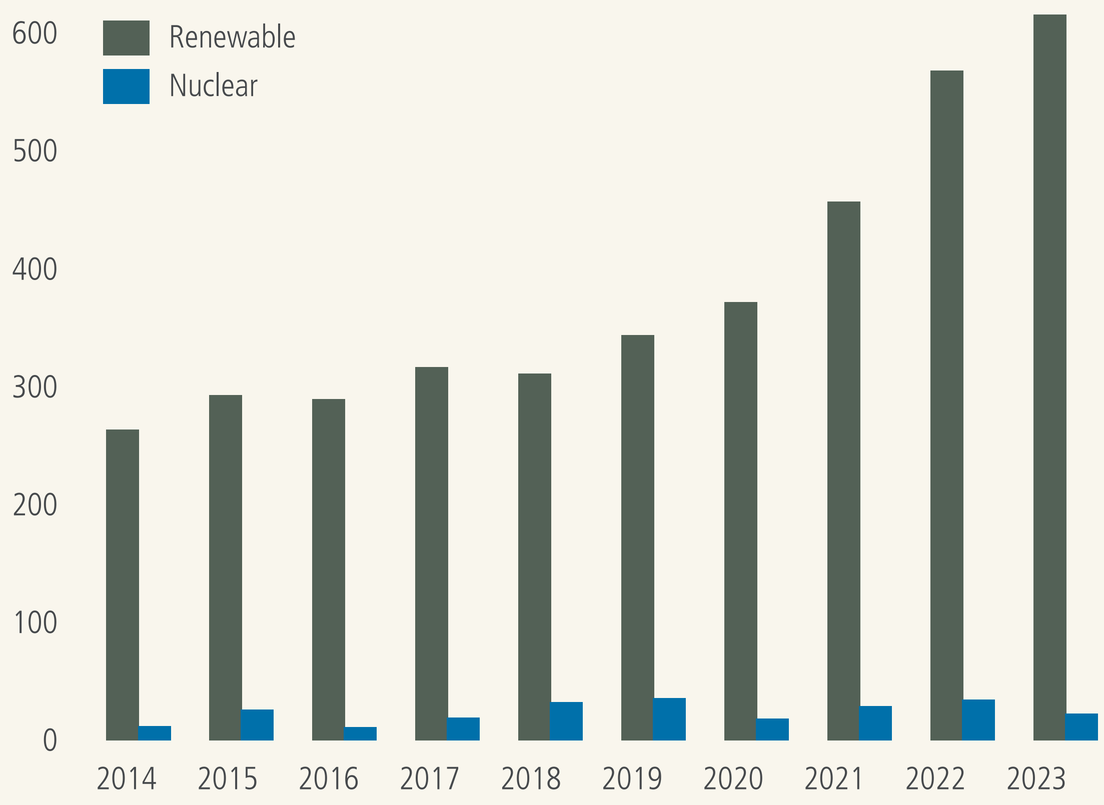
High costs, complex permitting requirements, and development difficulties for advanced nuclear reactors have slowed US nuclear expansion in recent decades.

The act's support of US nuclear exports and prohibition of Russian and Chinese nuclear fuels come after May 2024's Prohibiting Russian Uranium Imports Act, which aims to reduce global dependency on Russian fuel supplies.

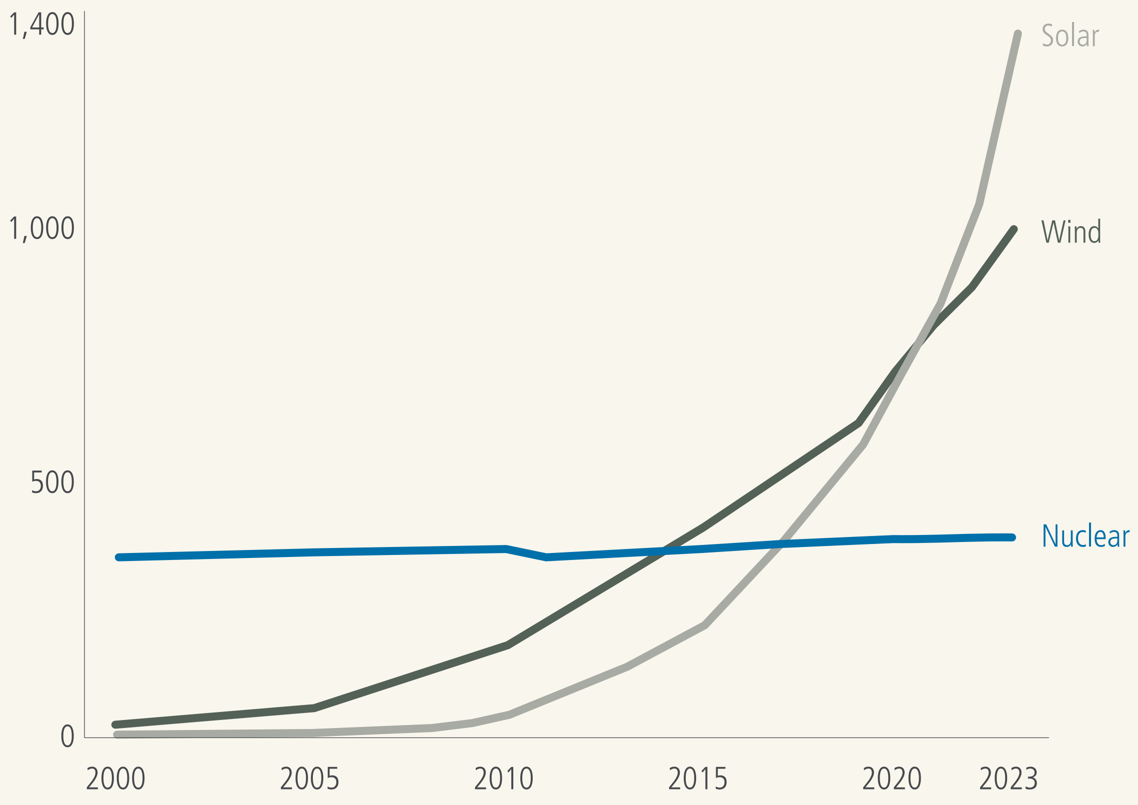
Images: Georgia Power; @POTUS on X

There is a lag to fulfil this new demand due to a lack of historical investment

Global Nuclear and Renewable Energy investment decisions
$ bn



Global installed capacity, 2000-2023
in GWe



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Source: World Nuclear Report

There are big opportunities across the entire Nuclear Fission Value Chain

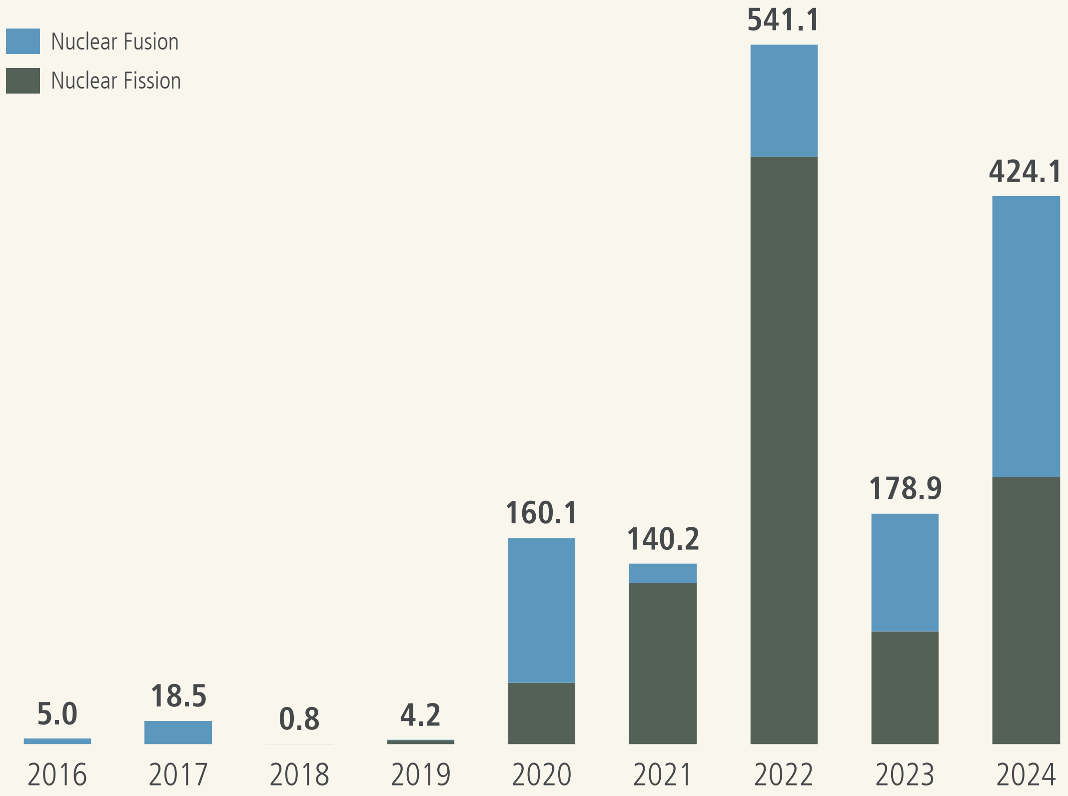
Design & Planning			Construction			Operations			Decommissioning		
Conceptual Design & Licensing	**Legal & Financial Services**	**Testing & Validation**	**Component Manufacturing**	**Construction & Testing**	**Fuel Procurement & Supply**	**Digital Systems**	**Site Manage-ment & Maintenance**	**Waste Management**	**Planning & Licensing**	**Dismantling & Radiation Protection**	**Site Restoration**
Reactor Design	Investment Structuring	Prototyping	Reactor Vessels & Pumps	Civil Infrastructure	Uranium Mining	Monitoring & Safety	Inspections	Interim Storage		Decontamination	Environmental remediation
Safety Frameworks	Risk Assessment & insurance	Simulation	Generators & Turbines	Systems Installation	Processing & Enrichment	Maintenance & AI Diagnostics	Emergency preparedness	Treatment & Conditioning		Reactor Core Removal	Repurposing Land
Feasibility Studies	Compliance	Stress testing	Safety & Control systems	Structural Integrity Testing	Fuel Fabrication	Cybersecurity & Control	Training programs	Geological Disposal			
			Cooling Systems & Shielding		Fuel Logistics	Digital Twin Simulation		Recycling & Reprocessing			
NuScale, TerraPower	AFRY	INL Idaho National Laboratory, Oak Ridge National Laboratory	JSW, Doosan	Fluor, Bechtel	Centrus, Westinghouse	Siemens, Rolls-Royce	EDF, exelon	Holtec International, orano	fortum	Energy Solutions, Studsvik	NRS

Regulatory Oversight (NRC, IAEA, National Regulators)

Nuclear fission, mostly SMRs, attracted more funding in Europe than fusion. 2024 was the second most active year in history

VC funding in European Nuclear Fission and Fusion startups[1]

$ m



Select European Nuclear Fission and Fusion VC-rounds in 2024

Startup	Funding round	Focus
newcleo	€135m Series A	Nuclear fission: Small Nuclear Reactor (SMRs)
Tokamak Energy	$125m Growth Equity VC	Nuclear fusion
Marvel Fusion	€62.8m Series B	Nuclear fusion
TRANSMUTEX	$23.3m Series A	Nuclear fission: nuclear waste recycling
Proxima Fusion	€20m Seed	Nuclear fusion
Steady Energy	€10m Early VC	Nuclear fission: Small Nuclear Reactor (SMRs) for heating

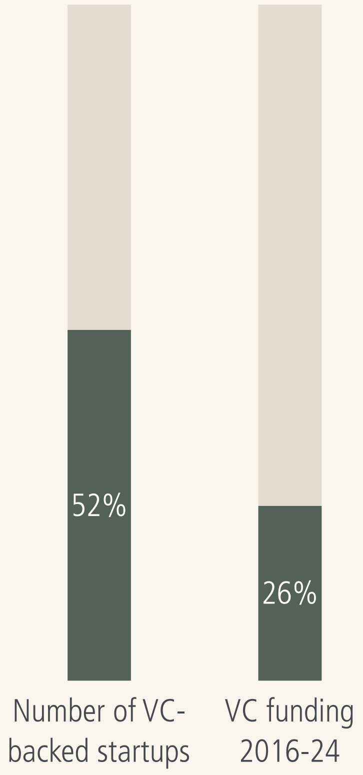
1) Newcleo, focused on SMRs, has raised €135m this year, but is targeting an overall financing round of up to €1bn

European funding is not enough to compete globally

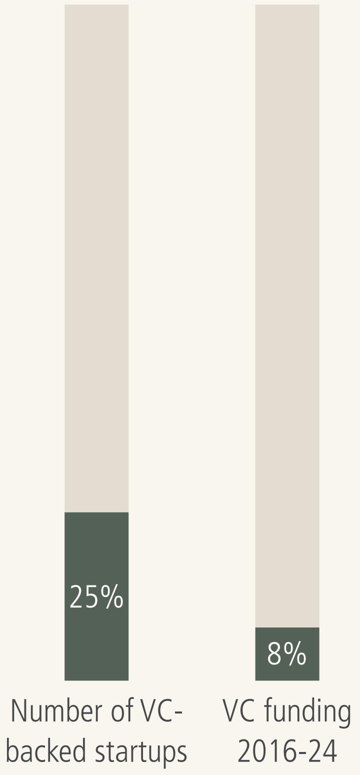
Europe hosts half of the world's VC-funded Nuclear Fission startups and one-quarter of its Fusion startups. However, many of these companies lack funding scale.

Since 2016, all Nuclear Fusion startups in Europe combined raised $546m, just slightly more than what a single US startup, Pacific Fusion, has raised in its Series A in 2024.

Europe share of Nuclear Fission startups and VC funding



Europe share of Nuclear Fusion startups and VC funding



What about Nuclear Fusion?

AN INTERVIEW WITH
FRANCESCO SCIORTINO

CO-FOUNDER AND CEO OF
PROXIMA FUSION

Proxima Fusion

What are the biggest challenges still facing nuclear fusion today?

Nuclear fusion encompasses a wide range of concepts, each with its own set of challenges but the core challenge is achieving a net energy gain of 10x. A major hurdle lies in materials—fusion systems must withstand extreme conditions that test thermal, structural, and other material limits.

Additionally, large-scale demonstrations of energy extraction, whether through neutron absorption or direct energy capture, are still needed. While critical technologies like high-temperature superconductors (HTS) and high-power, high-frequency lasers have been largely validated, they often require further testing in real-world conditions.

How does Europe compare to the US in terms of funding, regulation, and government support for nuclear fusion?

Public funding is similar in both regions, but half of the US funding goes to laser fusion (mainly for defence), whereas Europe focuses more on magnetic confinement, effectively investing twice as much in that area. The US leads in private investment, with multiple companies raising over $1B, while Europe has only a few surpassing $100M.

Regulatory frameworks are evolving, with the UK and US leading efforts to differentiate fusion from fission recognizing fusion's substantially lower risk profile. Countries like Japan and Germany are beginning to follow suit.

When can we reasonably expect the first commercially operating fusion power plant?

The first commercially operating fusion power plant is likely to emerge in the latter half of the 2030s. While some companies claim they will deploy a first-of-a-kind (FOAK) fusion power plant earlier, these efforts may be largely symbolic or may not come to fruition.

However, achieving a FOAK fusion plant within the 2030s is a realistic and essential milestone for the industry if fusion is to contribute meaningfully to climate goals.

What is most often overlooked in the discussion on fusion?

The difference between scientific and engineering risk. Engineering challenges can be addressed through structured roadmaps and allocated budgets, whereas scientific discoveries cannot be planned in the same way.

Fusion companies should concentrate on minimizing engineering risks, while universities and labs should focus on scientific uncertainties. However, both sides often blur this distinction.

Additionally, many non-specialists fail to grasp the vast differences in technical maturity between various fusion concepts. Not all fusion approaches are viable for VCs. Investors should make strategic, calculated decisions rather than simply gambling on the possibility of success.

SPACE TECH

DEEP DIVE

EXAMPLES

- GROUND INFRASTRUCTURE
- SPACECRAFT PARTS & PAYLOADS
- PROPULSION SYSTEMS
- SATELLITE MANUFACTURING & PLATFORMS
- LAUNCH VEHICLES
- STRATOSPHERIC BALLOONS
- SPACEPLANES & HYPERSONIC PLANES
- IN-ORBIT SERVICING
- SPACE DEBRIS & MISSION PLANNING
- IN-SPACE MANUFACTURING & TRANSPORTATION
- SPACE STATIONS & TOURISM
- SPACE MINING
- MOON & MARS ECONOMY
- EARTH OBSERVATION
- COMMUNICATION / CONNECTIVITY
- NAVIGATION

Space Tech – *What's new?*

1. The Age of Mega Rockets: A Revolution in Launch Costs

Test Flights and Launch Goals

SpaceX's Starship has completed several test flights, with plans to execute up to 25 launches in 2025, marking a significant operational ramp-up.

Ambitious Cadence and Capacity

The long-term target is a launch cadence of one flight per day, eventually scaling to several flights daily. Starship boasts a payload capacity of 100 tons.

Impact on Costs

These advancements are projected to reduce launch costs to just a few hundred dollars per kilogram, ensuring that launch expenses are no longer the primary constraint for Space Tech business models.

2. Rising Significance of Satellite Communications

Commercial and Gov't Collab

T-Mobile US and Starlink are collaborating to provide direct-to-phone connectivity. Meanwhile, the Italian government is negotiating a $1.6bn contract with Starlink for secure communication services, sparking debates on data sovereignty and security.

Military Applications

The conflict in Ukraine highlighted the critical reliance on Starlink for key military systems, including drones, tanks, and missiles.

Strategic Needs for Europe

To reduce dependence, Europe must bolster its capabilities, with ESA's Iris2 project as a step forward. However, bureaucratic challenges, such as geo-return policies, hinder efficient implementation.

3. The Emergence of a Moon Economy

Japan's SLIM mission marked its first successful lunar landing on 19 January 2024.

China's Chang'e 6 mission accomplished a lunar far-side sample return, landing on 1 June 2024, delivering samples by 25 June.

Intuitive Machines became the first private company to land a spacecraft on the Moon with its Nova-C lander, touching down near the south pole on 22 February 2024.

4. Space as the New Frontier of geopolitics & national security considerations

India’s Progress

India’s Chandrayaan-3 mission successfully landed near the Moon's south pole on August 23, 2023, showcasing its ambitions in space exploration.

China’s Resource Exploration

The Chang’e program may facilitate helium-3 extraction, a critical element for nuclear fusion and quantum technologies.

Hypersonics Advancements

US-based Varda received government funding for hypersonics testing, and European competitors are expected to follow suit.

5. Expanding European Launch Capabilities

Ariane 6 Maiden Flight

Europe’s heavy-lift rocket, Ariane 6, launched on July 9, 2024, from French Guiana after a four-year delay. While a milestone, its slower development, higher cost, and 10-ton payload capacity make it less competitive with SpaceX’s Falcon 9.

Small Launchers Set to Debut

European startups like Rocket Factory Augsburg (RFA) and Isar Aerospace plan their maiden flights in early 2025, despite setbacks like RFA’s engine explosion during testing in 2024.

Strategic Needs for Europe

To reduce dependence, Europe must bolster its capabilities, with ESA’s Iris2 project as a step forward. However, bureaucratic challenges, such as geo-return policies, hinder efficient implementation.

6. Moving Industries to Space as Launch Costs Drop

Emerging Opportunities:

Space-based solar power startups are gaining traction.

Data centres may shift to space to address the growing demand for energy-intensive AI and computational services.

In-space manufacturing is advancing in fields like organ production, pharmaceutical R&D, and semiconductor fabrication.

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> “The next decade in Space Tech will continue to be defined by reusable rockets and increased competition between incumbents and new players and the infrastructure that we will be able to bring to space.
>
> The complex geopolitical situation will accelerate advancements in space domain awareness. These – together with new breakthroughs in AI-supported decision making, in-space comms, quantum tech, and federated networks of ground and orbital assets – will continue to reduce cost and significantly expand the reach of space activities.”

CHIARA MANFLETTI

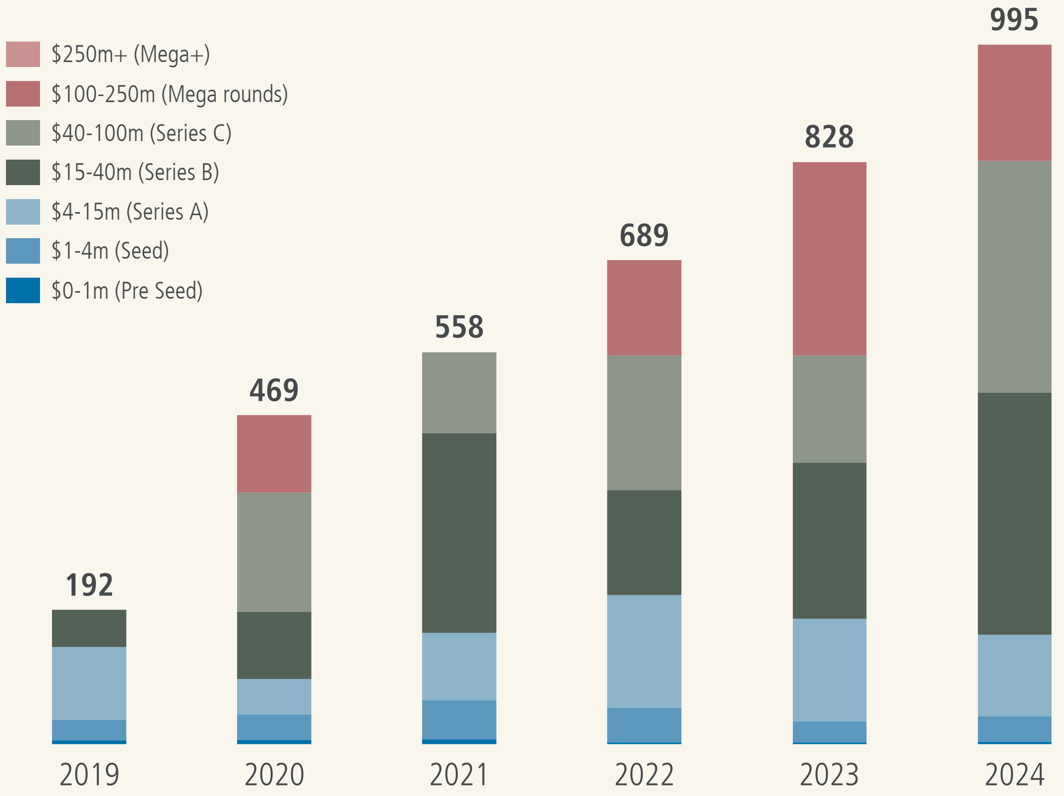
PROF. FOR SPACE MOBILITY AND PROPULSION AT TUM & CEO OF NEURASPACE

neuraspace

Space Tech funding reached a new record with nearly $1bn invested. In-space transportation, launch vehicles and earth observation are among the top segments

VC funding in European Space Tech startups[1]

$ m



Select European Space Tech VC-rounds in 2024

Startup	Funding round	Focus
The Exploration Company	€158m Series B	In-space transportation
ICEYE	$125.5m Series C	Earth Observation
isar aerospace	$70m Series C ext. ($220m full Series C)	Launch vehicles
unseenlabs	€61.6m Series C	Earth Observation for maritime surveillance
D-ORBIT	€50m Series C ext. (€150m full Series C)	In-space logistics and operations
ALL.SPACE	$44m Series C	Ground antennas for satellite connectivity

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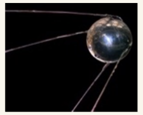
1) Notably not including OneWeb. Data of 14 January 2025

Space was historically dominated by two governments. However, many new players are entering the field – from national governments to private players

1960s | 1970s | 1980s | 1990s | 2000s | 2010s | 2020s | 2030s

1957
Sputnik I
1st man-made object in space

Sputnik II
1st living-being in space (dog "Laika")



1959
Luna II
1st man-made object on the moon

1961
Yuri Gagarin
1st man in space

1969
Neil Armstrong
1st man on the moon

1981
Space Shuttle
Start of Space Shuttle Program

1998
ISS
Largest cross-country collaboration

2015
Falcon 9 Return
1st re-usable rocket

SpaceX

2021
Private sub-orbital flight
Jeff Bezoz and Blue Origin make 1st successful sub-orbital flight

2022
Space Station Tiangong
China launches final module

2023
Moon's south polar
India successfully lands rover on the south polar region of the moon

Blue Origin | isar aerospace | RFA | SpaceX | Axiom Space

2024
Mega-Launchers: Successful first Starship flights (Spacex)

2025
NASA Artemis mission
Further private launch companies come online
1st Taikonauts on the moon (China)

2026
First private company on the moon (SpaceX)
First private space stations (Axiom)

Moreover, governments have realised, Space is the new frontier and a crucial infrastructure technology

Satellite images documenting 64km convoy of military vehicles moving into Ukraine

Ukraine turning to Elon Musk and Starlink as Russian forces have taken down ground-based internet

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“Europe is finally recognizing what the US and China have long understood:

Space capabilities are critical to securing and expanding economic output in an increasingly contested geopolitical landscape.

Large-scale satellite constellations and direct-to-device connectivity are making always-on communication a reality, ensuring resilience even when terrestrial networks fail. At the same time, advancements in space-based remote sensing enable near real-time monitoring of ground and maritime activity, even through cloud cover.

With its top-tier talent—much of which is locked out of the US space industry due to ITAR restrictions—Europe has the potential to be a global leader in space. Yet it remains years behind the US and China.”

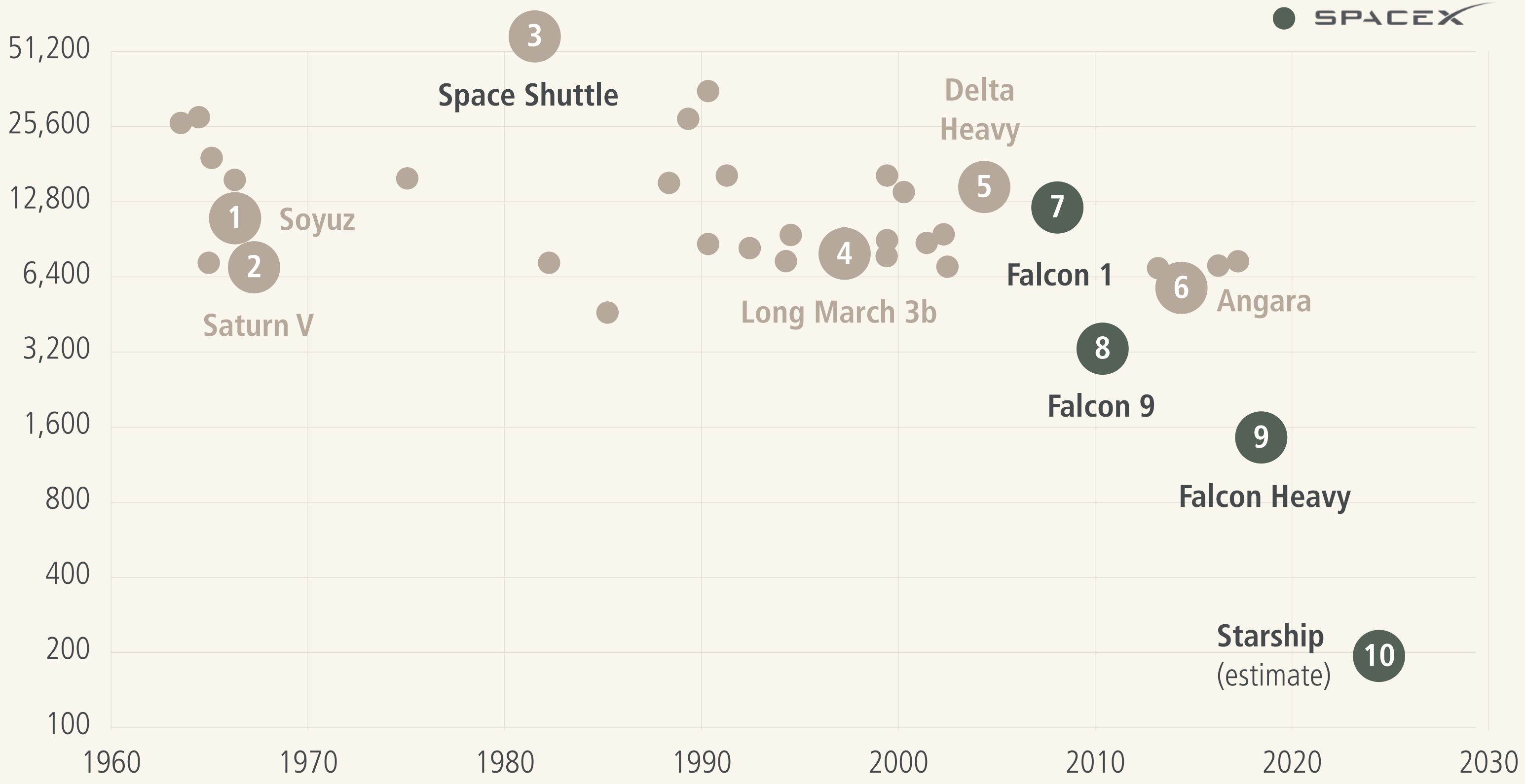
BULENT ALTAN

FOUNDING PARTNER AT ALPINE SPACE VENTURES

ALPINE SPACE VENTURES

Rapidly decreasing launch costs create fundamentally new business opportunities

Launch cost $ per kg (log scale)



"Remaining and new challenges, especially linked to protecting our countries and our planet at large, provide additional innovation incentives to the ecosystem.

Europe has a strong space history and all the assets to strive in these uncertain times. We will succeed as long as we all work as a team – institutions, legacy players, startups, investors and the entire ecosystem."

VINCENT CLOT

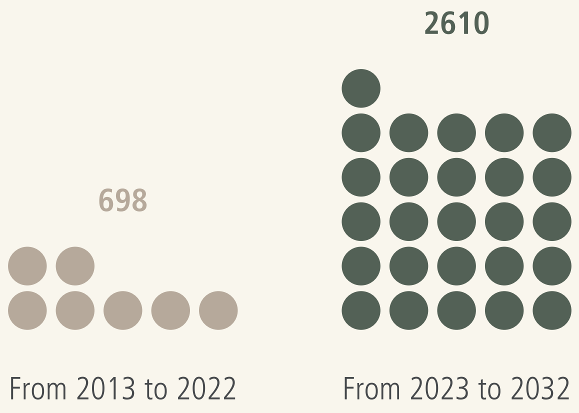
DIRECTOR OF
SPACE BUSINESS CATALYST

SPACE BUSINESS CATALYST
by Thales Alenia Space

The decrease in launch costs will lead to a wave of satellite launches and unlock completely new business models

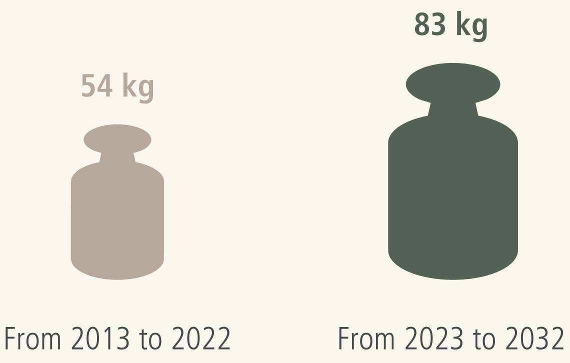
As launch capacity comes online, a new wave of satellite launches is expected

Average number of Smallsats (<500kg) launched per year



With decreasing launch cost per kg, satellite buses are expected to grow in size

Average launch mass per satellite



"Access to space stands as a pivotal infrastructure technology, essential for upholding a region's sovereignty.

In Europe, a parallel pattern emerges akin to the United States, where governments serve as the primary customers, while private enterprises act as the providers of launch services.

With national governments aiming to maintain authority over their assets and launch timetables, the significance of national launch providers continues to ascend.

Furthermore, as Starship focuses on accommodating super heavy payloads, Isar Aerospace zeroes in on catering to small to medium-sized satellites and constellations—representing the bulk of the market."

DANIEL METZLER

CEO AT ISAR AEROSPACE

isar aerospace

Source: euroconsult-ec.com

Non-space industries are beginning to understand the power of space for their businesses

"It is a pivotal time for space exploration – not only are we now able to reach orbit at a fraction of the price of the past, but we are starting to see the commercialization of low earth orbit, non-space industries beginning to understand the power of space for their business and a multitude of nations looking to build their space programs.

With Mars as a long-term goal, lunar missions will become more and more important, with the need for new technologies and vehicles to serve lunar orbit, lunar surface and our needs for habitation.

The Exploration Company hopes to play a significant role in this space future, building space vehicles collaboratively across nations to ensure we come together as humanity as the industry expands, and not apart as nation states."

HÉLÈNE HUBY

FOUNDER AND CEO OF
THE EXPLORATION COMPANY

The Exploration Company

Space Tech startups in Europe

(click to view live version)

Materials for space
Combined funding $ 180M

Airborne · PETROCERAMICS S · Fureho · NAWAH · Swegan · Surrey NanoSyst · Vulkam · Seram Coatings · Plasma Bound · ÉireComposites · Nanoker Researc

Semiconductors for space
Combined funding $ 188M

Solar MEMS Tech · MAGICS Technolo · Paragraf · ID Quantique · Pilot Photonics · Ubotica Technol · MBRYONICS · LiGenTec · Evince · Arquimea Ingeni · Emxys · AirMems · Saphyrion · ICsense · Cailabs

Propulsion systems
Combined funding $ 57M

ThrustMe · Enpulsion · Gama Space · Pangea Aerospac · ION-X · Aurora Propulsi · Magdrive · Ienai SPACE · Pulsar Fusion · Orbital Machine · Neutron Star Sy

Spacecraft parts, structures and payloads
Combined funding $ 124M

Mynaric · Oxford Space Sy · VEOWARE · Thorium · Satlantis · SWISSto12 · AAC Clyde Space · ANYWAVES · Osol · CreoTECH · SpaceTech · Picosats · First light ima · Almatech · DAS Photonics · TTI NORTE · Lambda-X · Hee photonic la · Space Structure · Dynamic Optics · DCUBED · Golbriak Space · Mission Space L · Space Composite

Cybersecurity for space missions
Combined funding $ 31M

Qascom · CYSEC · Secure-IC · Crypta Labs

In-space research
Combined funding $ 6.8M

SpacePharma · Yuri · Blue Skies Spac

Mission planning and control
Combined funding $ 42M

Taitus · Spaceit · Aldoria · Neuraspace · Leanspace · OKAPI:Orbits · SpaceAble · Aiko · Mission Space · Ephemersys · Exobotics

Spacecraft servicing; space debris removal and recycling
Combined funding $ 38M

ClearSpace · Future Space In · Kurs Orbital

Earth observation satellites
Combined funding $ 868M

ICEYE · SatRev · Aerospacelab · Unseenlabs · SatVu · OroraTech · Kuva Space · Sen Corporation · Kleos Space · Aistech Space · Karten Space · Hypernova Space · constellr · Open Cosmos · EnduroSat

Communication / connectivity satellites
Combined funding $ 4.7B

Eutelsat OneWeb · Kineis · E-Space · Hiber · Sateliot · Astrocast · OQ Technology · Methera global · Apogeo Space (

Satellite navigation
Combined funding $ 14M

Geoflex · Spaceopal · SYNTONY GNSS

Ground infrastructure
Combined funding $ 301M

Arralis · ALL.SPACE · Alcan Systems · CONTEC · Leaf Space · Groundcom · KSAT · Homeport

Launch vehicles
Combined funding $ 866M

PLD Space · Orbex Space · Isar Aerospace · Skyrora · Latitude · HyImpulse Techn · Sidereus Space · HyPrSpace

In-space transportation spacecraft
Combined funding $ 252M

Lúnasa · D-Orbit · Exolaunch · SPACEDRONE · Exotrail · SmallSpark Spac · porkchop · UARX Space

Stratospheric balloons and platforms
Combined funding $ 7.3M

Zephalto · EOS-X SPACESHIP · Zero 2 Infinity · B2Space

Spaceplanes and hypersonic flight
Combined funding $ 90M

Destinus · Dark · Dawn Aerospace · Orbit Boy

Space resource exploration
Combined funding $ 282M

PTScientists · Asteroid Mining · The Exploration · Team Tumbleweed · Puli Space Tech · Space Mining Te · Regolithix · Metalysis · SPACEBIT

Space utilities
Combined funding $ 0.3M

Maana Electric · Plus Ultra · Extraterrestria · indicium.space · The Lunar Grid · Space-power

In-space manufacturing
Combined funding $ 40M

CisLunar Indust · Space Forge · Moonfibre · Space Cargo Unl · ATLANT 3D

In-space human presence
Combined funding $ 94M

InterstellarLab · Solar Foods · Explaneta Space · SAGA · Spartan Space

RESILIENCE

DEEP DIVE

EXAMPLES

C4ISR

WEAPONS / DEFENCE SYSTEMS

UAVs & UGVs

NAVAL & MARITIME TECHNOLOGIES

AI x DEFENCE

TRAINING & SIMULATION

SUPER-/HYPERSONIC PLANES & PROPULSION SYSTEMS

CRYPTOGRAPHY & SENSING

CYBERSECURITY

STRATEGIC SEMICONDUCTORS

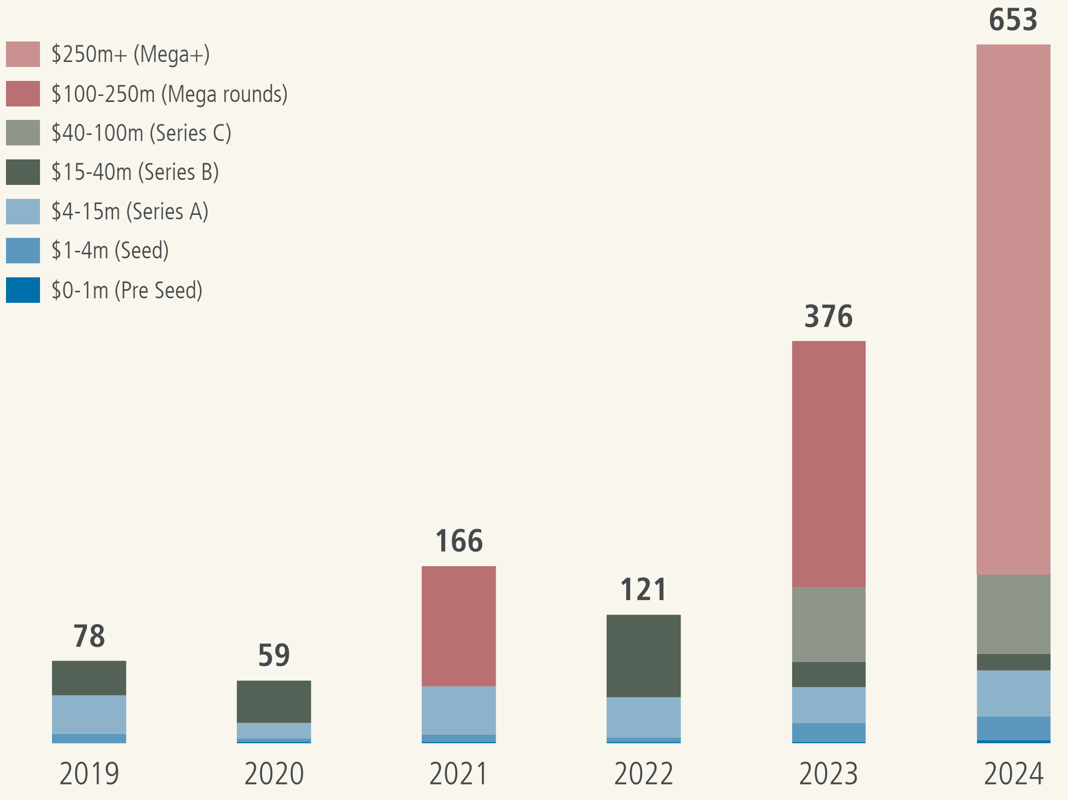
BIODEFENCE

ADVANCED MATERIALS

VC funding for Deep Tech x Resilience nearly doubled from last year driven by AI x defence, drones and other autonomous robotics

VC funding in European Deep Tech x Resilience startups[1]

$ m



Select European Deep Tech x Resilience VC-rounds in 2024

Startup	Funding round	Focus
Helsing	€450m Series C	AI x defence
TEKEVER	$74m Series B	AI-enabled Unmanned Aerial Systems for surveillance and monitoring
STARK INDUSTRIES	$14m Series A	Weaponized drones
MARITIME ROBOTICS	$12m Early VC	Autonomous surface vessels for surveillance and monitoring
ARX ROBOTICS	€9m Seed	Autonomous ground robots
COMAND AI	€8.5m Seed	AI-powered command for defence & security operations

1) Only includes startups focusing primarily on resilience and not assigned to another novel Deep Tech category. For instance, quantum or space are not included here. All Mega rounds have been raised by Helsing so far. Data of 14 January 2025

200+ European defence startups

(click to view live version)

Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance - C4ISR
Combined funding $ 290M

SensusQ, Adarga, Inex Microtechn, Revobeam, AVoptics, SECQAI, QuadSAT, Siren, Living Optics, Disruptive Indu, Matrix.org, Labrys, Element, Silicon MicroGr, SCALINX, Himera, Watch Bird, KNL Networks, Rcam, RFence, Focal Point Pos, Evitado Technol, Ajax Systems, Deniable

Weapons/Defence Systems
Combined funding $ 31M

Milrem Robotics, MyDefence, Aktyvus Photoni, Gwagenn, MirSense, SINTERMAT, Anybody Technol, Zvook, Ytsab Defence, Operational Sol, Accurision

UAVs and UGVs
Combined funding $ 346M

Delian Alliance, Quantum-Systems, ARX Robotics, Elistair, Alpine Eagle, Arktis Radiatio, KrattWorks, Unmanned Life, Zepher Flight L, Dronetag, TEKEVER, Shark Robotics, STARK, Baykar Technolo, Novadem, Unmanned Defens, Threod Systems, Angryeyes, SKAITECH, Aurea Avionics, Greenjets, RSI Europe, WARGdrones, Delair, Robot Aviation, Velos Rotors, Origin, Tidav, DroneUA, Avalor AI, HIGHCAT, Point Zenith, Orqa, Skya, Sky-Watch, Nordic Unmanned, Monopulse, Broswarm, Xplora Srl, Roboneers, Operational Sol, Skycorp Technol, Airvolve

Naval and Maritime Technologies
Combined funding $ 50M

Beam, dotOcean, Skarv Technolog, Lobster Robotic, Elwave, Sotiria Technol, Water Linked, SEABER, Hefring Marine, Havguard, Maritime Roboti, Optics11, Kongsberg Ferro

AI x defence
Combined funding $ 953M

Helsing, Stanhope AI, Comand AI, LatticeFlow, Grayscale AI, Preligens, Hala Systems, Blackshark.ai, Arondite, Labelfuse, Advai, Materials Nexus, Neurobus, GScan, Mission Decisio, Scaleout System, Unbound Autonom, TYTAN Technolog, Buntar Aerospac, GIGA Venture, Ask for the moo, Defsecintel, Sky Engine AI, Archangel Imagi, Faculty, Swarmer, Orbotix, Delfox

Training and Simulation
Combined funding $ 24M

Hologate, Skyral, Levato AS, 4C Strategies, Senseglove, VRAI, PSS by Logics 7, BlinkTroll Robo, IMPETUS AfeaS, Drill, EODynamics, MXR Tactics, Vrgineers

Space and Satellite
Combined funding $ 1.4B

ALL.SPACE, ICEYE, Unseenlabs, The Exploration, Reflex Aerospac, Isar Aerospace, Cailabs, Spacelis, Astroflight, Space Forge, Dark, Planetek Hellas, Tyvak Internati, Fossa Systems, Krono-Safe, SatVu, GomSpace, Satcube, Remos, Space Apps, MBRYONICS

Supersonic/ hypersonic planes and propulsion systems
Combined funding $ 72M

Destinus, AERALIS, Hypersonica, Axter, Magdrive, SYLPHAERO

Quantum computing, cryptography and sensing
Combined funding $ 434M

Terra Quantum, Quandela, Nu Quantum, KETS Quantum Se, QuSide, Quantum Dice, CryptoNext Secu, Qubitrium, levelQuantum, g2-Zero, Ephos, AegiQ, Q*Bird, IQM, eleQtron, Qubalt, QuantumDiamonds

Cybersecurity and critical digital infrastructure
Combined funding $ 198M

Countercraft, Goldilock, Anzen, 42Crunch, EclecticIQ, ByzGen, Lab 1, Arqit, 3IPK, Januus, Runecast, CyNation, DataFlowX, DeNexus, Osavul, Modirum, Sensity AI (for

Strategic semiconductors
Combined funding $ 119M

Kalray, Aquark Technolo, Swegan, Arceon, Black Semicondu, Nordic Air Defe, Fractile

Robotics
Combined funding $ 236M

ANYbotics, RobCo, GIM Robotics, Vimotek, Fernride

Energy (e.g. energy storage) and critical physical infrastructure
Combined funding $ 83M

LeydenJar Techn, Zelestium Techn, Ore Energy, McGuire Aero Pr, Advanced Materi, Kitepower, IONATE, Wpe Research &, IceWind, GaltTec, Nordic Batterie, Molyon, ReFaMo

Biodefence
Combined funding $ 26M

Ionlace, Neuromorphica, Aquila Bioscien, Delox, Fabentech, Untaphealth

Advanced materials and manufacturing
Combined funding $ 37M

ICOMAT, DECPT, ATLANT 3D

Wearables for Military
Combined funding $ 23M

Standard Fighti, Aristeia, Esper Bionics, Gravity

Advanced Sensing Technology
Combined funding $ 11M

Sensrad, ElFys

Service Providers
Combined funding $ 15M

Rowden Technolo, DigitalPlatform

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Russia's threatening stance toward Europe is becoming more obvious, yet Europe is struggling to develop a meaningful response

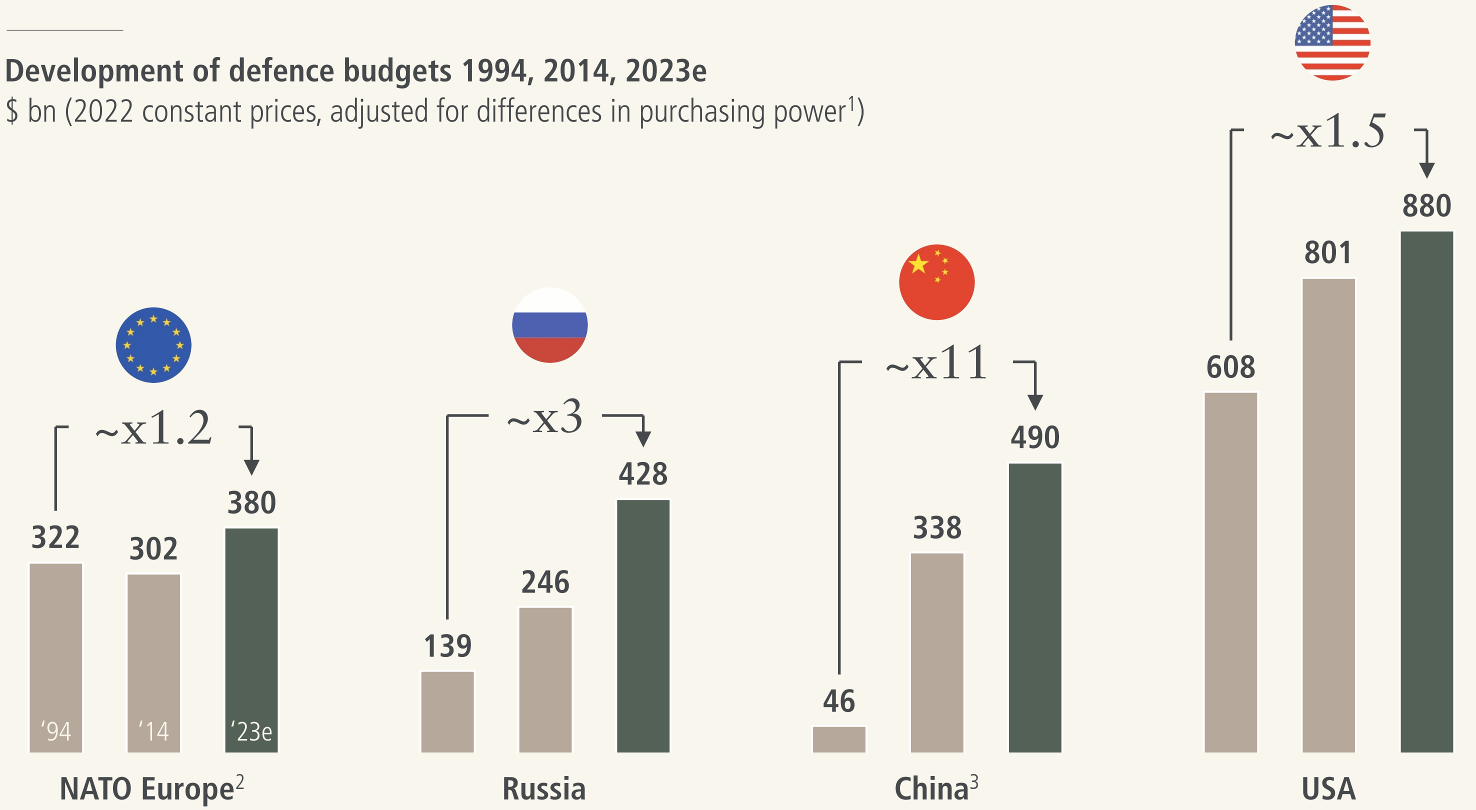
	Russia		Europe	
Military Force Structure	**2-8 years** for Russia to "re-build its army to the point where it could dare to attack NATO"	**280,000 recruits** p.a. training capacity in Russia	**25% Main Battle Tanks** In NATO Europe today vs. 1992	**70% Military personnel** In NATO Europe today vs. 1994
Funding	**€430 billion** estimated military spend in 2023[1]	**~2 times** more than 2014	**€1.6 trillion gap** Vs. 2% goal in NATO Europe since 1992 ("peace dividend")	**<2% GDP** GDP spent on defence in Germany in 2023
Industrial Depth	**3 million units ammunition** p.a. domestic production capacity for artillery ammunition – "more than all NATO members combined"[2]	**1,500 Main Battle Tanks** Delivered or refurbished in 2023 by Russia's industry	**~100 Main Battle Tanks** Annual production capacity in Germany	

1) Purchasing power adjusted; 2) Testimony of General Christopher Cavoli, Commander of the US European Command, before the US Congress House Armed Services Committee
Source: NATO reporting, SIPRI, militaryppp.com, The International Institute for Strategic Studies (IISS) – The Military Balance, government websites, expert assessment, German Council on Foreign Relations (2023): "Preventing the Next War Germany and NATO Are in a Race Against Time"

In absolute terms, NATO Europe's defence budget remained largely unchanged, while other nations significantly increased theirs

Development of defence budgets 1994, 2014, 2023e

$ bn (2022 constant prices, adjusted for differences in purchasing power[1])



1) Following multiples reported by militaryppp.com; 2) Based on 1994 NATO members excl. Canada, US and Turkey; 3) Based on officially collected figures from SIPRI, may potentially be higher e.g., as estimated by American Enterprise Institute; Source: SIPRI, militaryppp.com

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"The defence industry is at a turning point where speed—innovation in weeks, not years—defines success. To stay competitive, Europe must strengthen cooperation between governments and industry, cut bureaucracy, and enable new players to thrive.

With our efficiency and production potential, we can leverage strengths to build a robust and independent defence sector, positioning Europe as a global leader in cost-effective unmanned systems."

BALAZS NAGY

FOUNDER AND CEO OF TYTAN TECHNOLOGIES

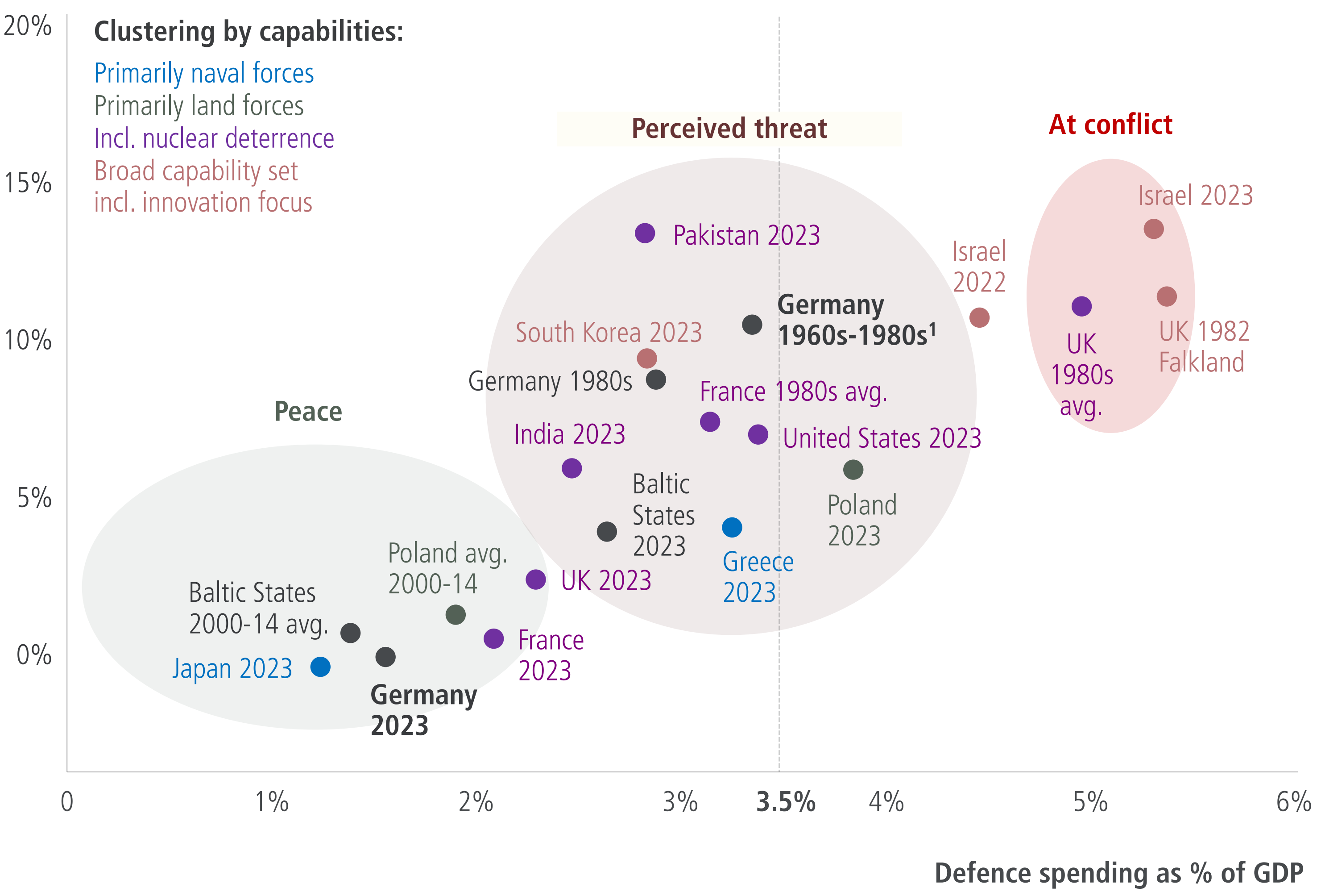
TYTAN TECHNOLOGIES

Countries under a perceived threat tend to spend more on defence – for Germany, this could be ~3.5%

Today, Western European nations spend a **lower share of GDP than Eastern European nations,** likely due to different threat perception.

Historic spend during **periods of perceived threats** was in a comparable range to today.

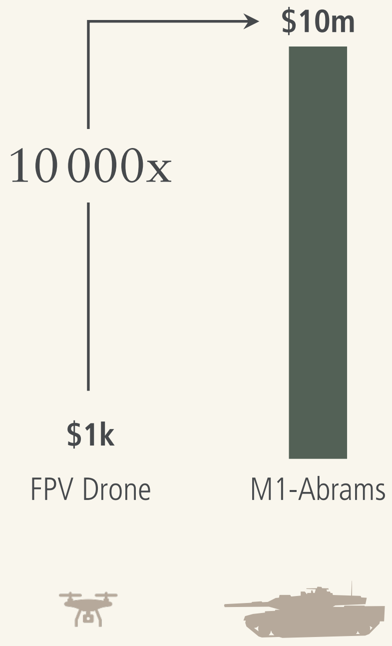
Higher spend ("perceived threat") may be seen as an **"insurance premium"** to the cost of direct conflict.



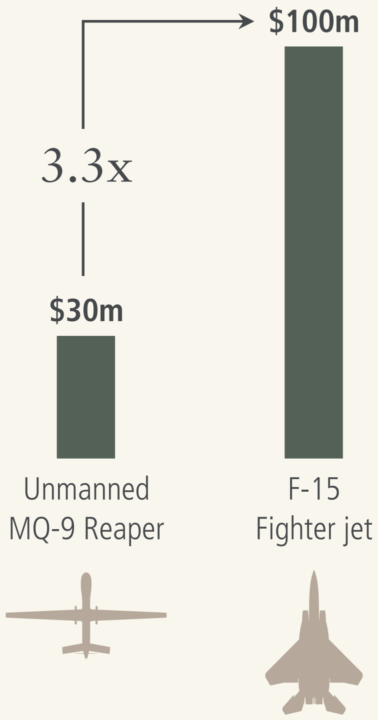
1) Average of German defence spend share of GDP 1960-1989 ~3.3%
Source: NATO reporting, World Bank, expert interviews

Trend towards low cost, modular, and one-off assets offer attractive market opportunities for startups

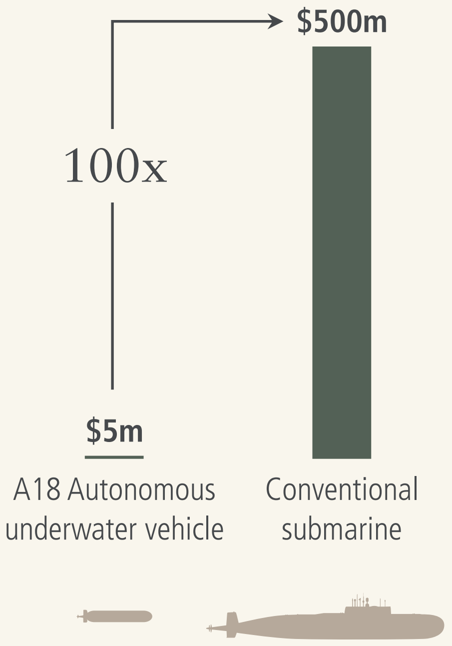
One $1k-FPV-Drone can destroy a $10m-Tank[1]



MQ-9 Reaper Drone costs a fraction of a Fighter Jet[2]



New AUVs are cheap and operate without staff[3]



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1) Source: The Telegraph; 2) Source: defencetalks.com; 3) Source: MarketsandMarkets

“From securing the resilience of our supply chain to protecting physical infrastructure, data and intelligence, Deep Tech is pushing the boundaries of what humanity can achieve.

Over the past few years, Deep Tech innovations have been deployed on the battlefield, by governments and by large businesses in order to boost European security and lay the foundations for a prosperous future for the region's citizens.”

KELLY CHEN

PARTNER AT
NATO INNOVATION FUND

NIF

The impact of defence investments on the broader economy becomes especially tangible in technological spillovers

Examples

iPhone

Multi-touch screens developed for US agencies

Internet & SIRI originally developed by DARPA

Medicine

High-resolution imaging diagnostics

Artificial limbs

Automotive

Lithium-ion battery cells for military equipment

Run-flat tires developed for battlefield vehicles

Future defence technologies with spillover potential

Autonomous defence systems

Realtime, AI-based data analytics

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“As Europe awakens to the urgent need for stronger defence, more founders are stepping up to safeguard our nations’ security. In tackling these complex challenges, they are not only advancing defence capabilities but also driving technological innovations that flow between military and civilian applications. Most importantly, as Europe adapts to a rapidly evolving security landscape, the over €100 billion market is seeking new solutions with a speed and intensity not seen in decades.”

CHRISTOPHER MAGAZZENI
INVESTMENT DIRECTOR
LAKESTAR SPECIAL PROJECTS
LAKE STAR

Five challenges to address to expand Europe's defence innovation ecosystem

Tender process complexity

Vast amount of documentation required in public defence tenders and multiple regulatory barriers (e.g., ban of early feasibility study participants for public tenders essentially rules out participation of startups and SMEs)

Speed of decision-making

Duration of public decision-making over many years significantly reduces appeal for fast-moving, high-growth seeking investors but also limits industry's ability to plan ahead

Public-private collaboration

Need for coordination of funding mechanisms in private & public sector (e.g., ability to multiply public funding through private funds)

Private businesses lack exposure to public needs (e.g., through innovation labs)

Sophisticated investors

ESG criteria and lack of awareness limit participation of many investors in funding rounds for defence startups or in investments into stock listed defence companies

Access to innovation & talent

Bans for military research at many universities limit access to innovation and exposure to next generation talent.

Broader societal concerns around defence impact talent availability

COMPUTATIONAL BIOLOGY & CHEMISTRY

DEEP DIVE

EXAMPLES

PROTEIN DESIGN

DRUG DISCOVERY

SCREENING & TESTING

CELL & TISSUE MODELING

BIOMEDICAL IMAGE ANALYSIS

MICROBIOME

COMPUTATIONAL GENOMICS

MATERIAL MODELING

Computational Biology & Chemistry – *What's new?*

Nobel Prize in chemistry awarded for AI in protein research

Demis Hassabis and John Jumper of Google DeepMind, along with biochemist David Baker from the University of Washington, were jointly awarded the Nobel Prize in Chemistry for their pioneering work in computational protein design and structure prediction.

Their contributions, particularly through the development of AlphaFold, have significantly advanced our understanding of protein structures, facilitating new avenues in drug discovery and development.

AI and automation across the drug development value chain

AI technologies have become increasingly embedded across the entire drug development process, from target identification and lab automation to end-to-end AI-driven drug development and patient stratification.

3.0

In May 2024, Google DeepMind introduced AlphaFold 3, an AI model capable of predicting the structures of protein complexes with DNA, RNA, and various ligands. This version marked a substantial improvement over its predecessors, offering at least a 50% enhancement in accuracy for protein interactions with other molecules.

Initially, AlphaFold 3 was available exclusively to academic researchers for non-commercial use, but by November 2024, it was open-sourced, allowing broader access to its capabilities.

Foundational models for drug development are picking up

Companies like Bioptimus or Latent Labs are working on foundational models for drug development. If successful, these models could help to improve clinical success rates and help reverse Eroom's law.

AI for materials discovery

In 2024, AI significantly advanced materials science.

Meta's Open Materials 2024 dataset, with over 110 million density functional theory calculations, enhanced AI's predictive capabilities for material properties.

Microsoft's MatterGen employed diffusion modeling to design inorganic materials with specific chemical compositions and structures.

Additionally, Amazon partnered with Orbital Materials to develop an AI-designed material aimed at carbon removal in data centres, demonstrating practical applications of AI in environmental sustainability.

“There have been considerable advances in the last year or two in protein structure prediction and protein design. On the prediction side, it is now possible to predict the structures of proteins in complex with small molecules and nucleic acids with reasonable accuracy. On the design side, it is now possible to robustly design proteins to bind to protein targets of interest, and to catalyze chemical reactions. I am excited about designing new proteins to solve current day challenges in medicine and sustainability.”

NOBEL LAUREATE DAVID BAKER

PROFESSOR OF BIOCHEMISTRY, HHMI INVESTIGATOR, AND DIRECTOR OF THE INSTITUTE FOR PROTEIN DESIGN AT UNIVERSITY OF WASHINGTON

UNIVERSITY OF WASHINGTON · LVX · SIT · 1861

“In 2020 science had available around 160,000 protein structures. 4 years later it's hundreds of millions. This same productivity change is coming right across the physical sciences, driven by AI. We also do not need 100s of millions of $ to build frontier models – that narrative only serves to scare away competition.”

STEVE CROSSAN

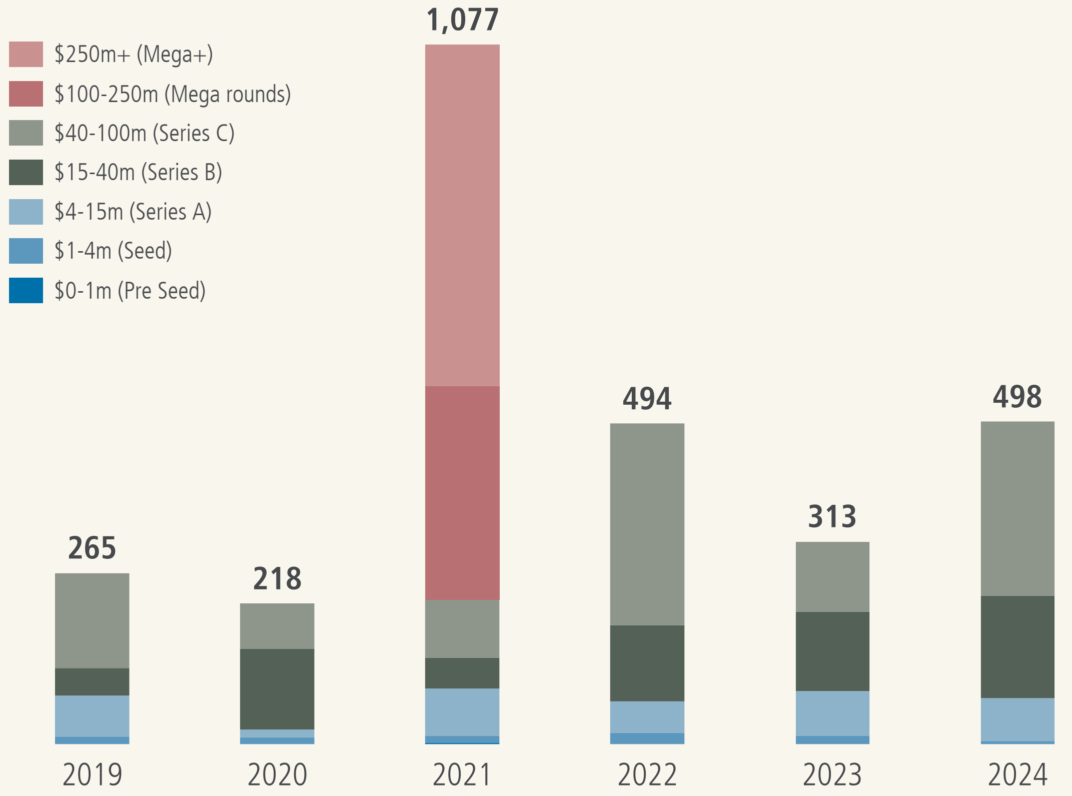
FOUNDER DAYHOFF LABS
OPERATING PARTNER DCVC

DCVC

CompBio funding rebounded in 2024, hits second best year ever, driven by AI drug discovery. Still no mega rounds in the last three years

VC funding in European CompBio startups[1]

$ m



Select European CompBio VC-rounds in 2024

Startup	Funding round	Focus
Cradle	$73m Series B	AI-driven protein engineering
BASECAMP RESEARCH	$60m Series B	AI-driven biological design
healx	$47m Series C	AI-enabled drug discovery platform for rare diseases
LabGenius	£35m Series C	AI and robotics for cancer antibodies discovery
NURITAS Life-changing Discoveries	$42m Series C	AI-powered peptide discovery for food applications
AQEMIA	$38m Late VC[1]	"Quantum-inspired physics" AI drug discovery

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1) Aqemia also raised a €30m Series A extension in January, bringing its Series A total to €60m. Data of 14 January 2025

CompBio startups in Europe

(click to view live version)

AI-drug discovery

Combined funding $ 2.8B

SOM Biotech	Isomorphic Labs	Aqemia
Molecule.one	MAbSilico	Molomics
Peptone - The P	Ardigen	Exscientia
BenevolentAI	CRISPR Therapeu	LabGenius
Nuritas	Healx	Mind The Byte
Alphanosos	Iktos	Antiverse
Celeris Therape	Omniscope	Arctic Therapeu
Chemify	CHARM Therapeut	Oxford Drug Des
Relation Therap	PharmEnable	Multiomic Healt
Baseimmune	CardiaTec	Sixfold Bioscie
Arctoris	Exogene	Ignota Labs
Turbine AI	AMPLY Discovery	Nucleome Therap
ANYO Labs AB	Micar Innovatio	Kantify
Silica Corpora	Scailyte	Evaxion Biotech
Allcyte	Cradle	Acellera Therap
Biotx.ai	Biomatter	GlamorousAI
Turing Biosyste	CellVoyant	Basecamp Resear
BioSimulytics	ChemAlive	Owkin
coding.bio	Epsilico	Whitelab Genomi
molab.ai	Adaptyv Biosyst	CoSyne Therapeu
Innophore	Deepflare	Atinary Technol
Bioptimus	Latent Labs	

Datasets/Research analysis and molecular modelling

Combined funding $ 99M

Causaly	iLoF	Iris.ai

Other high-throughtput drug discovery (not AI, but chemistry based, spectrometry etc)

Combined funding $ 256M

OMass Therapeut	PhoreMost	Micrographia Bi
pear bio	Zymvol	PAGE Therapeuti
Invitris	Generare Biosci	Avenue Bioscien

Quantum chemistry and AI for chemical and biotech fields

Combined funding $ 75M

Algorithmiq	Rahko	Quantistry
Kuano	Hafnium Labs	Pharmacelera
HQS Quantum Sim	Qubit Pharmaceu	Materials Nexus
Molecular Quant		

Compbio in food

Combined funding $ 15M

Protera	Eden Bio

Genomics for drug discovery

Combined funding $ 72M

GenomeKey	Genegoggle	Evonetix

“One of the most exciting advancements in computational biology is the combination of foundation models with primary biological training data – a match made in heaven. It allows us to harness collective knowledge of all, whilst tailoring solutions to the unique biology of every individual.

Models like Latent-X, which decode and design biological sequences at scale, and Bioptimus’ M-Optimus, which encodes and interprets biological information in context, are transforming how we understand and impact biology.

These breakthroughs are set to revolutionize personalized medicine and biotechnology by enabling treatments and solutions that are as unique as the individuals they’re designed for.

They even hold the potential to uncover the secrets of complex systems like the microbiome – billions of organisms interacting with every cell in our bodies – effectively ‘lifting the fog of war’ on the intricate relationship between biology, human health, and treatment outcomes.”

EDWARD KLIPHUIS
PARTNER AT SOFINNOVA

Sofinnova partners

“The evolution of computational biology and chemistry has advanced quickly over the past years. Initially, we observed the development of stand-alone tools utilizing AI to discover new materials and molecules. More recently, startups developing new chemistries (e.g. in energy, solvents, composites, etc.) have begun creating their own tools, leveraging new easily accessible AI technology, to accelerate their research, leading to a substantial reduction in cost and time. This has lowered the bar for the emergence of seed-stage startups in materials science.

We also recognized that in-silico alone is insufficient; real-world validation is essential. Introducing a new molecule or material to the market involves a challenging process of iterations, validation in real-life formulations and overcoming scale-up challenges. Partnerships between startups and corporations are one way to ensure scale up and market access challenges are overcome.”

COPPELIA MARINCOVIC
SOLVAY/SYENSQO VENTURES

SYENSQO

ROBOTICS

DEEP DIVE

EXAMPLES

HUMANOIDS

INTELLIGENCE FOR ROBOTS

COLLABORATIVE ROBOTICS

4-LEGGED ROBOTS

AI-VISION SOFTWARE

ADVANCED ROBOTICS SENSORS

MODULAR AND ADAPTIVE ROBOTS

SOFT ROBOTICS

EXOSKELETONS

CONSTRUCTION ROBOTICS

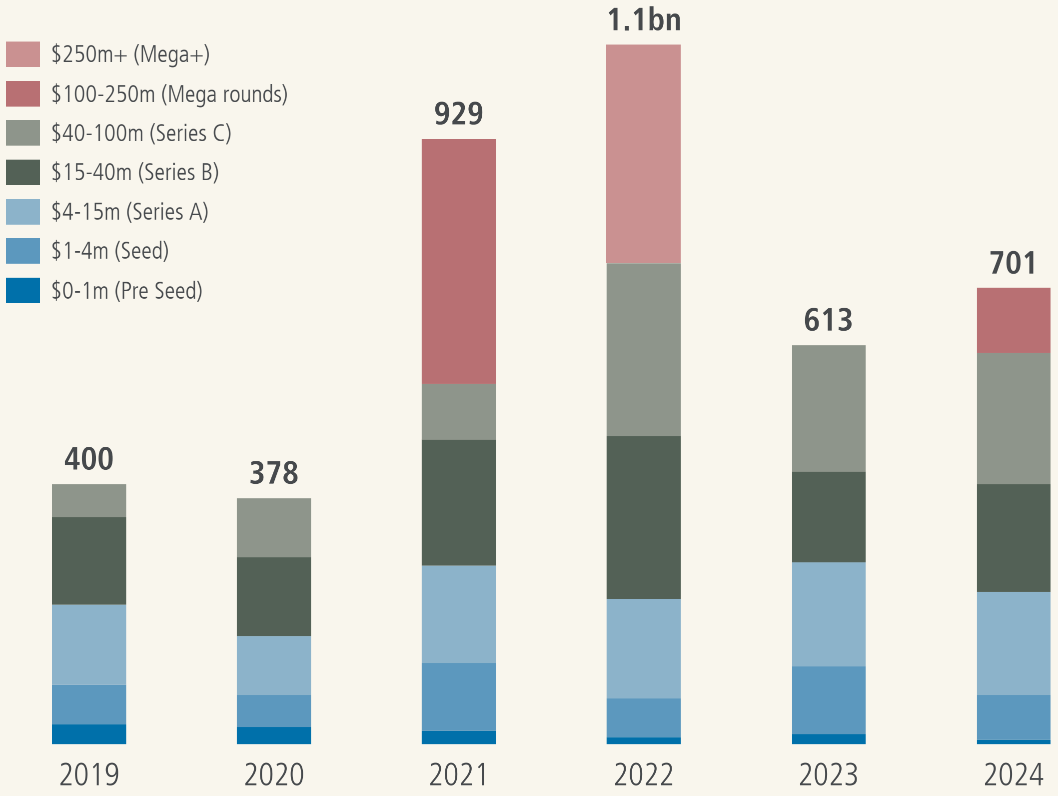
PROSTHETICS

SEA & SUBSEA ROBOTS

VC funding in Robotics is up from last year, partly due to single mega round in the last two years, but still far below historical highs in 2021-2022

VC funding in European Robotics startups[1]

$ m



Select European Robotics VC-rounds in 2024

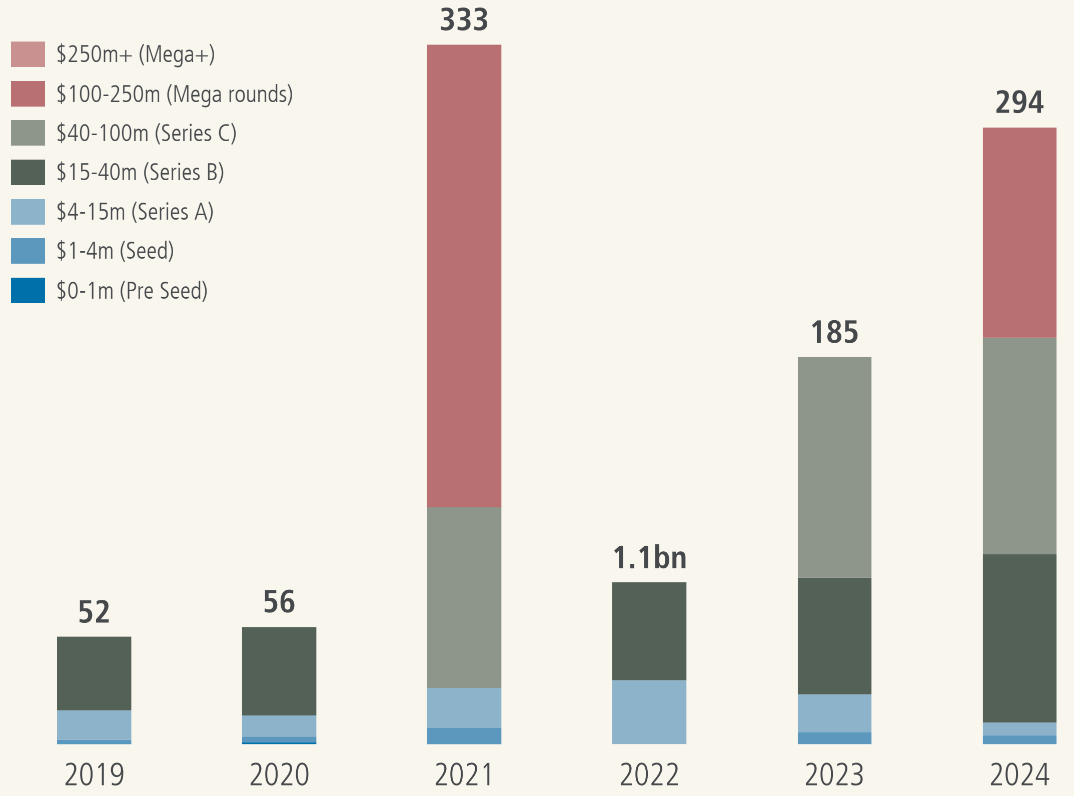
Startup	Funding round	Focus
1X	$100m Series B	Humanoid robots for home assistance
ANYbotics	$60m Late VC	Facility inspection and maintenance robots
DEXORY	$56m Series B	Robotics and AI logistics for warehouse automation
RobCo	$43m Series B	Low-cost and modular robots for small factories
ROBOVISION	$42m Series A	AI computer vision platform for industrial robots
MONUMENTAL	$25m Early VC	Automating on-site construction with robotics

1) Excluding autonomous mobility, drones, and surgical robotics. Data of 14 January 2025

VC funding in *Novel* Robotics is almost at all-time high with a particularly strong activity at early growth-stage

VC funding in European Novel Robotics startups[1]

$ m



Select European Novel Robotics VC-rounds in 2024

Startup	Funding round	Focus
1X	$100m Series B	Humanoid robots for home assistance
ANYbotics	$60mLate VC	Facility inspection and maintenance robots
RobCo	$43m Series B	Low-cost and modular robots for small factories
XOCEAN Ocean data, delivered.	€30m Series B*	Uncrewed surface vessels for information collection
MONUMENTAL	$25m Early VC	Automating on-site construction with robotics
RIVR	$22m Seed	4-legged wheeled robots

1) XOCEAN raised a subsequent €115m round in January 2025. Data of 14 January 2025

Europe has the unique ingredients needed to build the next generation of robotic giants

“As investors who have been following and investing in the robotics category for more than a decade, we have witnessed the incredible value that robots have delivered in manufacturing or warehouse logistics.

As a result, we are excited about the new era that is now opening up for the category, driven by new verticals using robotics, new applications and new form factors.

Of course, the technical complexity is compounded by the combination of hardware and software, not to mention design for manufacturability considerations and securing supply chains that can be fragmented.

However, we believe that Europe has the unique ingredients needed to build the next generation of robotic giants: cutting-edge research, a highly skilled talent pool, and advanced manufacturing capabilities and know-how.”

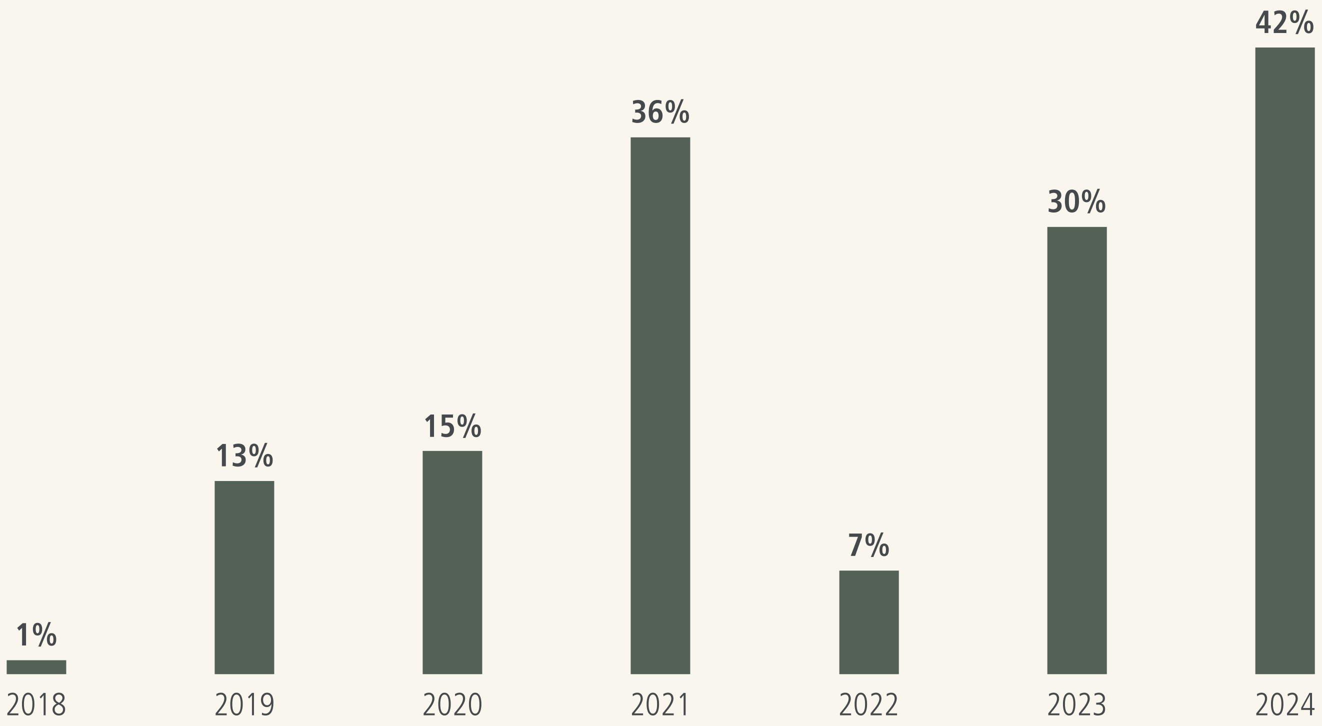
NICOLAS AUTRET

GENERAL PARTNER AT
WALDEN CATALYST VENTURES

(W)C
Walden Catalyst

The current wave of Novel Robotics started in 2019 to now make up a record high 42% of total European Robotics VC funding

Share of European Robotics VC funding allocated to Novel Robotics



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“The next frontier in Robotics is about supercharging machines to develop unprecedented capabilities in mobility, adaptability, and autonomy.

Breakthroughs in Deep Reinforcement Learning, coupled with fast, physically accurate simulators, allow AI to power robots with enhanced intelligence, enabling them to navigate through complex environments, be contextually aware of their surroundings, and adapt dynamically without human input.”

PÉTER FANKHAUSER

CO-FOUNDER AND CEO
ANYBOTICS

ANYbotics

Novel Robotics startups

(click to view live version)

Humanoids
Combined funding $ 149M
1X Technolo… Oversonic Clone
Enchanted T…

General purpose intelligence for robots
Combined funding $ 16M
Flink Robotics mimic robotics Opteran
Automatika …

Collaborative robotics
Combined funding $ 379M
Neura Robot… Agile Robots

4-legged robots
Combined funding $ 140M
ANYbotics Swiss-Mile

AI-vision software
Combined funding $ 0.4M
Cognivix Luffy AI

Advanced robotics sensors (touch)
Combined funding $ 4.4M
MotorSkins Touchlab

Modular and adaptable robots
Combined funding $ 52M
RobCo

Soft robotics
Combined funding $ 8.5M
Omnigrasp No-Touch R… Wootzano
Bioservo Tec…

Exoskeletons
Combined funding $ 36M
German Bionic

Construction robotis
Combined funding $ 23M
Monumental

Prosthetics (e.g. bionic hands)
Combined funding $ 60M
Open Bionics Aether Biom… BionIT Labs

Other advanced robotics hardware (torque sensors, grippers etc
Combined funding $ 2.4M
Bota Systems

Sea & subsea robots
Combined funding $ 48M
XOCEAN

TBD
Combined funding $ 2.3M
The Human …

Robotics – Waves of adoption

Foundational years

1950–1980

Unimate, the first digitally operated and programmable robot, was invented by George Devol in 1954.

1st wave of adoption

1980–1990

Manufacturing was the first vertical to embrace robotics.

Drivers: the need for improved yield, lower costs and labor shortages.

Car makers first experimented robotics and automation in the 1970s, before massively deploying it in the 1980s.

Rockwell Automation, KUKA, YASKAWA, ABB

2nd wave of adoption

2000–2015

Logistics drove the 2nd wave of adoption of robotics.

Drivers: Complex supply chain management, the need for flexible order fulfillment, escalating employment costs, or labor shortages.

Robotics now cover various warehouse areas: storage and retrieval, sorting, picking, packaging, transportation and replenishment.

GreyOrange, KIVA Systems, LOCUS ROBOTICS, EXOTEC

3rd wave of adoption

2015–Today

The development of autonomous cars was the spark for a third wave of innovation.

$ billions invested in the development of new sensing modalities (radars, lidars, cameras), compute and software.

A diverse crowd of companies, from startups, OEMs, and big tech drove innovation in the space.

NVIDIA, BOSCH, Velodyne, BMW, WAYMO

4th wave of adoption

2020 onwards

Recent acceleration in hardware and software innovation is now taking robotics in new territories, enabling mobility (vs. static robots) in uncontrolled environments (vs. manufacturing lines or warehouses).

4-legged robots, ground robots, drones, humanoid robots are being deployed by industrial players, yet there are still challenges to solve before mainstream adoption.

FIGURE, ANYbotics, UnitreeRobotics®, BostonDynamics

Robotics – Areas of innovation in *Hardware*

Next-generation sensors

Traditional spinning LIDARs replaced by affordable solid-state ones, offering unmatched performance in high-res, short-range 3D sensing with a wide field of view. Limitations remain in performance under challenging environmental conditions (e.g., rain, fog).

Tactile sensing

Tactile sensing still lags behind human abilities, presenting challenges in robotic manipulation. Tactile feedback remains limited in precision and robustness, particularly for soft or irregular objects.

Edge computing

Low-power, high-performance CPUs and GPUs now enable advanced techniques such as Model Predictive Control (MPC) and AI-driven real-time robot navigation. This reduces reliance on cloud computing, improving latency, but still faces constraints in compute power and energy consumption at the edge.

Energy-efficient AI accelerators

Developments in TPUs and neuromorphic computing aim to support AI models at the edge, crucial for robots operating in low-connectivity environments. However, commercial solutions are still limited, and neuromorphic computing is largely in research stages.

Locomotion systems

Electric motors with gears remain the dominant actuation method due to cost and reliability. Little innovation has occurred in drive trains, but more and more vendors (e.g., Maxon) are offering more robotics-dedicated solutions.

Batteries

Lithium-ion batteries' high energy density and long life cycles drive many mobile robot applications. Battery innovation, spurred by smartphone, laptop, and EV industries, has trickled down to robotics, making them smaller and cheaper.

Power consumption

Energy efficiency remains a major challenge, especially for mobile robots performing complex tasks autonomously. Although advancements in energy-efficient components exist, robots still struggle with the trade-offs between performance and battery life compared to humans.

Robotics – Areas of innovation in *Software*

Robot perception

Advances in AI and computer vision are enhancing robot perception, especially for object recognition and scene under-standing. However, robustness in unpre-dictable environments (e.g., changing lighting or weather) remains a challenge.

RL and Imitation Learning

RL-based and imitation learning approaches have made strides in robot locomotion and manipulation, improving mobility and dexterity. However, real-world deployments of learning-based algorithms still face high sample inefficiency, requiring large amounts of data, and safety concerns during learning for mobile manipulation.

Simulation

AI-aided programming and faster simulations accelerate development, but the gap between simulated environments and real-world variability remains an obstacle for robotic manipulation. Transfer learning techniques help but are not yet foolproof.

Generative AI / Foundation Models

Vision-Language Models (VLMs) have shown promise for open-vocabulary object recognition and scene understanding. However, these models face limitations in adaptability and real-time processing on edge devices due to their high computational demands.

LLMs and Speech-based Interfaces

While Large Language Models (LLMs) and speech-to-text technologies create more natural human-robot interfaces, they still lack contextual awareness of the robot's physical capabilities and struggle with reasoning and task planning.

Autonomy

Despite advancements, most mobile robots remain pre-programmed automata that can only execute predefined tasks and avoid obstacles with simple rules. True autonomy, where robots learn, adapt, and make decisions in dynamic environments, is still in its infancy. This lack of cognitive capabilities is a major bottleneck for widespread adoption in real-world applications.

Robot learning and Adaptation

While there have been strides in adaptive learning algorithms, these methods are far from being widely deployable. Current approaches do not scale well across different domains or environments, and learning from sparse data remains a critical challenge.

We are entering an exciting new era of more autonomous and versatile robots

“The convergence of multiple technology areas and the fast-paced progress in each are redefining AI-powered robotics and automation capabilities, enabling those to do more things, in more places, beyond the factory floor.

As we enter an exciting new era of more autonomous and versatile robots that are faster, safer and smarter, innovations supporting more robot intelligence (understand and adapt), mobility (navigate dynamic environment with ease), accessibility (lowering entry adoption barriers), versatility (opening up for emerging applications across industries) and safety are key areas to track.

The latter is paramount, even more as we see an increase of true fenceless, and more complex, human-robot collaboration, irrespective of the form factor.”

CLAUDIO JORDAN
ABB ROBOTICS & AUTOMATION VENTURES

Chasing the ChatGPT moment for Robotics

The rise of generative AI and large language models (LLMs) has marked a transformational moment. Similarly, robotics is approaching its own ChatGPT moment. Embodied AI gives robotic systems new capabilities, transforming the way they interact with the physical world.

Embodied AI enables the training of robotic systems, reducing the need for manual coding. Improvements in AI, physics-based simulation, and computing enable robots to learn autonomously by simulating real-world environments, optimizing movements, and adapting to new tasks without explicit programming.

Embodied AI is expanding the functional reach of robots by enabling capabilities that were previously infeasible: Robots equipped with vision, speech, and touch sensors can now perceive and interact with their surroundings in a more human-like manner, which leads to smarter, more autonomous, and highly flexible robotic systems. They will play a crucial role in industries such as healthcare, logistics, and personal assistance, while traditional robotics will still be predominantly used for precision manufacturing.

Key capabilities of embodied AI

Visual perception

Understands the 3D world around, can interact with previously unknown objects in unknown environments

Workflow planning

Understands user's intent; plans workflows to accomplish goals

Manipulation of object

Causal model of rigid and soft bodies to understand depen-dencies between robotic actions and environmental physical response

Market Size estimate

	Industrial	Home & Professional Service
CAGR 2024-2029	12%	16%
Estimated market size 2030[1]	~$8-12 billion	~$20-25 billion

1) Embodied AI in industrial robots accounts for 30-50% of the total industrial robotics market; rule-based robots are expected to remain preferred choice in manufacturing due to their precision potential (except for mobile robots (AGV), where a 100% takeover by embodied AI is expected)
Source: BCG, Goldman Sachs, MarketsandMarkets

The rise of Robotic Foundational Models

Robotic Foundational Model (RFM) is a generalized AI able to perform various tasks.

RFM integrates vision, language, motor control, and reinforcement learning to interact with the environment.

Generalized RFM can then be fine-tuned for specific tasks, similar to natural language processing.

Several factors are driving momentum in this space

Computing power

Enhanced computing power, faster training through simulation, and improved accuracy of LVMs[1]

Physical context

RFM expands application modalities to physical context moving beyond logical reasoning of LLMs[2]

Hardware and sensors

Advances in hardware and sensors allowing cheaper sensors and improved actuators

Increased Funding

Increased funding by OpenAI, Meta, Google targeting new wave of robotics

Rise of startups

Rise of robotic startups (e.g., Physical Intelligence, Skild AI, 1X, Nvidia)

1) Large vision models; 2) Large language models
Source: BCG

Data scarcity is a key challenge for Robotic Foundational Models

Data scarcity is a major bottleneck for robotics.

NLP & Vision AI models trained on billions of text/image datasets, RFM lacks equivalent datasets.

Robotics demands near-perfect precision due to direct interaction with physical world (while LLM/ChatGPT can tolerate errors).

To counter this, a combination of different learning and data acquisition strategies are deployed.

Potential data acquisition strategies

Method	Description	Pros	Cons
Real-world learning	Have robots perform actions in real world	High data quality	Costly and limited to existing robot fleet
Simulation learning	Have robots perform actions in a simulated world	Scalable	Sim-to-Real Gap
Imitation learning	Have robots watch humans perform task	High data quality	Costly and time constraint due to human interaction
Cross-embodiment learning	Learning across different robotic platforms	Data Synergies	Introduce potential 'hallucination'/errors in robot behaviour

Fostering robust collaboration between industry and academia remains essential

"In the coming years, we are likely to see an increasing number of robots transitioning beyond factory floors. Thanks to remarkable advancements in AI-driven control systems, we are witnessing a significant leap in the mobility of legged robots, including quadrupeds and humanoids. Over time, I am confident that these machines will reshape our society and economy by progressively automating tasks across industries such as manufacturing, retail, logistics, construction, agriculture, household chores, and more. This trend is further propelled by the emergence of large-scale language, vision, and action models, offering a promising outlook for equipping robots with a degree of common sense and enabling the generalization of robotic skills to tackle diverse and complex challenges. The vision of (super)human-level machines appears closer than ever, fueling a surge in companies commercializing this technology. While the United States and China are making substantial investments, Europe must unite and accelerate its efforts to seize this transformative opportunity in what is likely the most significant revolution of the century.

However, despite impressive progress and the current gold-rush atmosphere, reality underscores the substantial challenges that remain on the path to achieving general embodied AI. The complexity and diversity of our world present fundamental scientific hurdles that must be addressed before realizing truly super-human capabilities.

For this vision to become a reality, it is crucial for investors and companies to demonstrate perseverance, while fostering robust collaboration between industry and academia remains essential."

PROF. DR. MARCO HÜTTER
ETH ZURICH ROBOTIC SYSTEMS LAB
ETH zürich

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5.
FOUNDER RESOURCES

The Deep Tech Compass – What Deep Tech investors are looking for

	Seed	Series A	Series B
Round Size	€2-4m	€7-17m	€20-40m
Valuation	€12-15m	€50-60m	€125-150m
Dilution	15-25%	15-25%	10-20%
Team	Founders are technical experts and understand the market deeply.	Team have demonstrated an ability to hire great technical and non-technical talent around them	Senior leadership core team in place (may include: Tech, Product, Revenue, Operations, Marketing)
Market	– 1bn+ SAM (Serviceable Addressable Market) – Severe pain caused by intractable problem – Global scale	– 1bn+ SAM (Serviceable Addressable Market) – Severe pain caused by intractable problem – Global scale	– 1bn+ SAM (Serviceable Addressable Market) – Severe pain caused by intractable problem – Global scale
Technology	– TRL 5 minimum (Technology validated in relevant environment) – Technology is the best way for the product to solve the problem – Research-driven core technology moat	– TRL 6 minimum (System/Product validated in relevant environment)	– TRL 7 minimum (System/Product validated in production environment)
Product	– 10x improvement in key industry metrics – Validated/early signs of market demand/willingness to pay	– Strong experimental evidence they have product-market fit with a clear target user through a well-defined value prop – Favorable product metrics (e.g. CSAT, NPS, CRR, Sean Ellis test)	– Very clear product-market fit with a clear target user through a well-defined value prop – Strong growing pipeline, clear 3x growth rate, improving product metrics, etc.
Commercial-ization	– Clear wedge market with clear expansion potential – Well researched hypothesis for route to commercialization – Paid Pilot >> Unpaid proof of concept >> LOIs or JDAs signed (minimum)	– Validated hypothesis for route to commercialization – Pilot/POC signed revenue (ideally 1m+) – Validated hypothesis on revenue streams, pricing, LTV and margin profiles	– Commercial revenue (ideally €10m+) – Strong penetration into wedge market with proven scaling strategy and clear plan for expansion into adjacent markets – Proven revenue streams, pricing, LTV and margin profiles with clear understanding of how they scale

Pitchdeck storyline & scientific method

Have a clear narrative that is easy to follow

Structure is king

1. We solve a **problem** that is severe…	2. …with a **product** that is 10x better than existing solutions…	3. …and clearly **differentiated** from our **competitors**…
4. …in a **market** that is huge…	5. …leveraging a **technology** that works with a clear roadmap to commercialization.	6. We have significant **traction** – customer want our product and are willing to pay for it.
7. Our **vision** is to build a multi-billion-dollar company within VC horizons…	8. …for this, we assembled the triple-A **team** to pull it off.	9… Therefore, we are **raising x€** to achieve the following **milestones**…

+

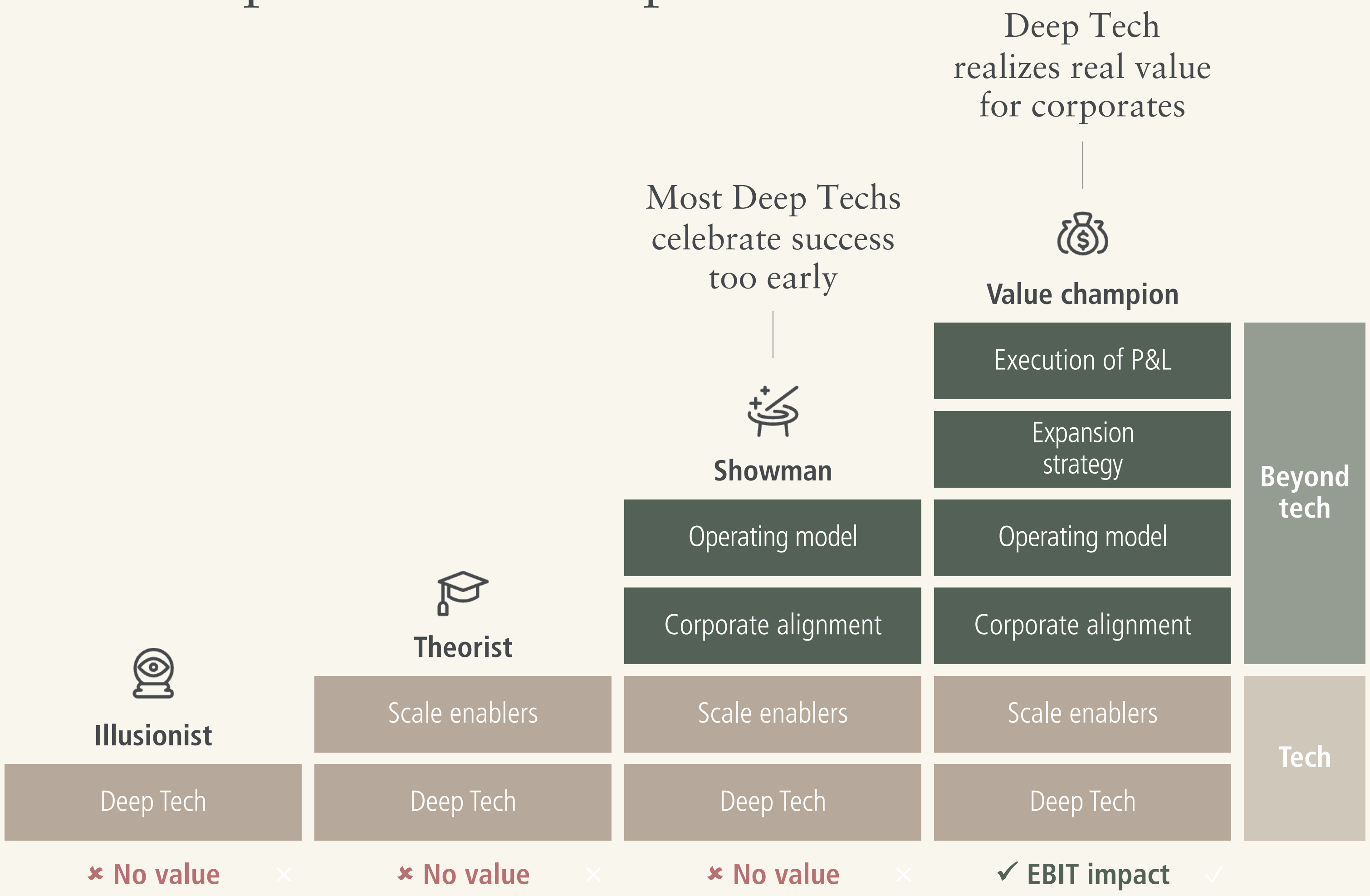
Test, collect data, refine/sharpen

Hypothesis-driven validation

…

Here is the data to prove these hypotheses and/or the experiments we want to run to test them…

From vision to value –
How Deep Techs win corporates



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Source: BCG

BCG

“Deep Tech startups' success is not defined by technology alone, but by how effectively they align their innovations with a corporate's core strategy and goals.

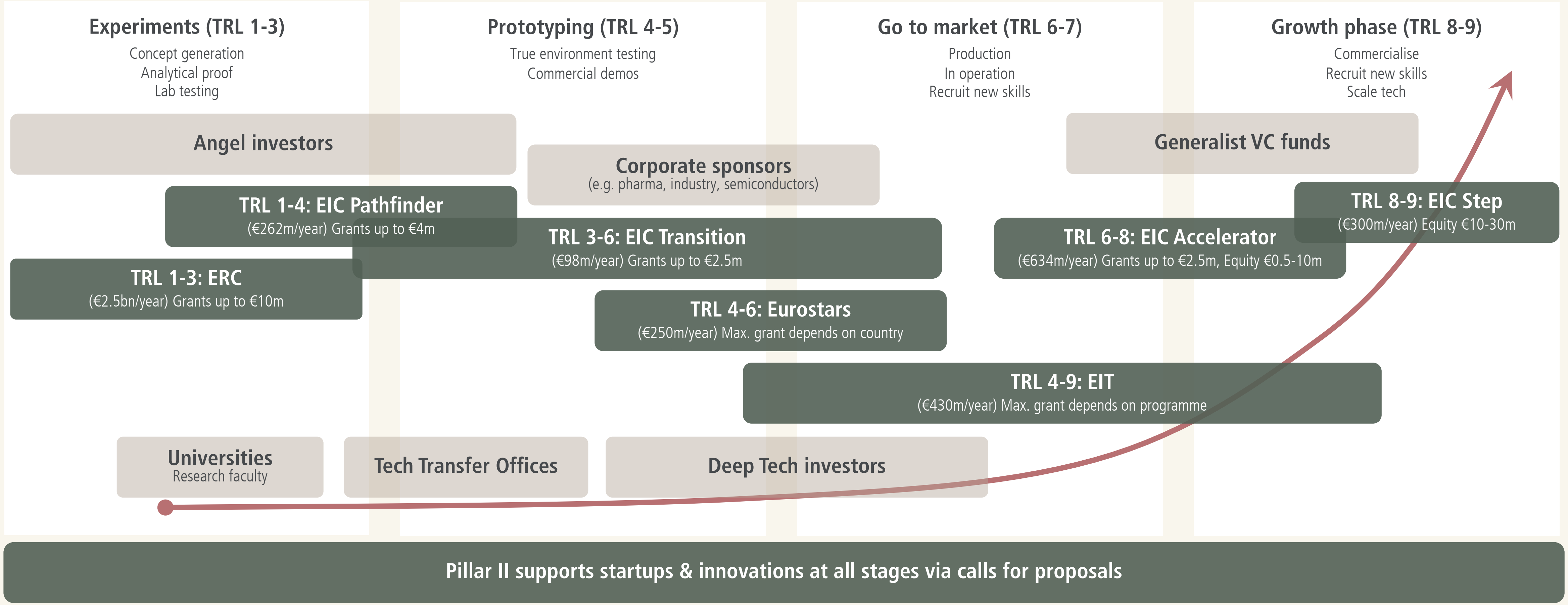
Startups can then act as catalysts for success, enabling corporates to achieve measurable EBIT impact through technology.”

DR. ANDREJ LEVIN

MANAGING DIRECTOR & PARTNER, BCG HAMBURG

BCG

Funding access – Within Horizon Europe, EIC, ERC, and EIT play a critical role for (Deep) Tech startups



Source: Dealroom.co, Deaflow.eu. EIC 2025 work programme. Stages based on Technology Readiness Levels used by governments.

How to fund your Deep Tech startups

What is your startup's immediate priority?

Developing early-stage technology or prototypes

Grants and research partnerships
Ideal for startups in the research or prototype phase, especially those working with advanced technologies

Validating market fit and scaling operations

Venture capital and corporate partnerships
Suitable for startups ready to scale or enter the market, with a working prototype or initial traction

Securing flexible funding without equity dilution

Debt financing and alternative funding
Best for startups with predictable revenue or clear paths to profitability

Key considerations

Grants provide resources without equity dilution but can slow progress. Consider faster funding options if needed

If speed is not a priority:
Apply for grants and establish research partnerships

If speed is a priority:
Explore VC or corporate partnerships

Selecting the right investors is critical. Deep Tech startups often require patient capital, expertise in technical domains, and alignment with long-term R&D cycles

If growth and resources are priorities:
Engage with Deep Tech venture capital firms

If strategic partnerships are beneficial:
Consider corporate partnerships or corporate VC

Debt financing is risky for Deep Tech startups without steady income. Assess revenue projections carefully

If you have predictable revenue:
Proceed with debt financing options

If revenue is uncertain:
Explore VC or corporate partnerships

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"Deep Tech innovation thrives when startups adopt a hybrid capital strategy. Grants and research partnerships support the high-risk, early R&D phases, while venture capital helps accelerate commercialization. Corporate partnerships bring invaluable market access and technical synergies, while debt financing can support growth in later stages without diluting ownership.

Each stage requires a thoughtful blend of funding sources tailored to the startup's evolving needs."

ANDREAS RIEGLER

FOUNDER AND GENERAL PARTNER AT APEX VENTURES

APEX VENTURES

New financing tools like *Early Credit* can help to build and scale profitable Deep Tech companies

Problem: The equity financing trap

European Deep Tech companies rely too heavily on equity financing for CapEx

- European venture funding relies strongly on equity financing
- For hardware-based startups, massive upfront cash is needed for production and assets
- Thus, they rely on equity financing to scale due to initial limited credit access
- Equity-driven growth prioritizes company valuation over profitability, creating unsustainable business models

Solution: Early Credit financing tools

New financing tools are required to build profitable hardware-heavy companies

- Credit financing works differently, by focusing on profitability and unit economics
- Product quality and revenue take priority over company valuation
- Credit is a much healthier form to finance production for asset-heavy startups
- Aligns incentives with long-term business viability rather than short-term hype

Case study example – Germany's WIN Initiative

The WIN Initiative ("Growth and Innovation Capital for Germany") is a collaboration between businesses, associations, policymakers, and KfW, aiming to invest around €12bn in Germany's venture capital ecosystem by 2030 to support startups and innovative companies. A key component of the 10-point action plan focuses on developing specialized credit financing tools for CleanTech scale-ups, particularly to support "first-of-a-kind" investments.

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"Building asset-heavy startups on only equity is impossible.

We need access to early credit to ensure profitability and make these new companies bankable."

TOBIAS LECHTENFELD

EXECUTIVE DIRECTOR OF NET TECH FOR ZERO AND PARTNER 1.5 VENTURES

1.5° Ventures
Climate Tech Venture Builder

For founders and venture funds, there are a number of public LP programmes in Europe

Public LP	Typical ticket size	Max contribution	Investment focus	Fund structure requirements	Investment requirements	Emerging managers programme	Direct investments in startups	Sources
European Investment Fund	Up to ~€100m	≤25% (up to 50–75% in strategic cases)	EU-based Deep Tech SMEs; early to growth stage	EU-domiciled fund, independent GP team, market-standard terms, ≥30% from private LPs	Significant investment in EU member or associated countries	Open to first-time teams	Yes - usually special programmes (EIC)	EIF Criteria, EIF VC & Infra Funds, EIF Investment Process
INVEST-NL	€5m–€50m	≤50% (≥50% from private LPs)	Dutch Deep Tech; early & growth	Dutch-focused investments, independent team, strong impact & ESG criteria	At least 2× Invest-NL's commitment invested in Dutch-active companies	Open to first-time teams	Yes	Invest-NL Funds, EIF & Invest-NL
British Patient Capital	£5m–£100m	Minority stake (<50%)	UK Deep Tech; primarily growth	UK presence, FCA-regulated, commercial basis, strong GP team	Significant investment in UK-based SMEs	Open to first-time teams	Yes	BPC Future Fund
bpifrance	Flexible (€5m–€50m+)	~20–50% (alongside private LPs)	French Deep Tech, early & growth	French-linked investments, independent GP, ecosystem impact	Substantial portion in French companies or projects benefiting France	Open to first-time teams	Yes	Bpifrance Large Venture
KFW	€10m–€50m	≤19.99% (25% for impact funds)	German Deep Tech, early & growth	EU-domiciled fund, German investment focus, GP experience required	At least KfW's commit-ment amount invested in German companies	Open to first-time teams with diverse teams	No - not yet	KfW Capital, KfW Emerging Managers, KfW First EMF Commitment

“ For KfW Capital, Deep Tech is an important building block of our diversified investment strategy.

Founders and VC funds that have demonstrated expertise in managing Deep Tech‘s opportunities and challenges by achieving product milestones, successful financing rounds and exits are vital to the VC ecosystem.”

CHRISTIAN RÖHLE

HEAD OF INVESTMENT
KFW INVESTMENT CAPITAL

KFW

“ BPC is bullish on the prospects for the European deep tech ecosystem. We believe the UK is a hotbed for groundbreaking research from which the category leaders of the future will be built.

We’re excited to continue driving this progress by investing in early and growth-stage fund managers who can commercialise and scale the most promising opportunities, while also directly investing in growth-stage UK companies. Our patient, long-term capital empowers these businesses to reach their full potential.”

CHRIS SMART

INVESTMENT DIRECTOR
BPC

British Patient Capital

6.
CHALLENGES & RECOMMENDATIONS

Recommendations

		Developments
Encourage *more entrepreneurs* to move into Deep Tech LIMITED PROGRESS	– Encourage a cultural shift towards embracing risk – Drive collaboration between researchers and startups and establish university programmes that integrate technology and business, mirroring successful models like Stanford – Attract more commercially-savvy and experienced operators – Implement framework to attract talent back to Europe	– Deep Tech Fellowship Initiative launched by Deep Tech funds in Munich get to get PhDs intro Entrepreneurship (Source) – Fifty50 launching Deep Tech founder bootcamp in Europe (Source) – ECB president Lagarde proposing to bring Europe can import disillusioned talent from Trump's US (Source)
Harmonise *spinout terms* and reduce bureaucracy LIMITED PROGRESS	– Harmonise and standardise processes across Europe, drawing inspiration from the UK spinout review – Streamline procedures to expedite the spinout process while minimising bureaucracy – Establish proper incentives for Technology Transfer Offices (TTOs) across academia – Implement a common framework for valuing intellectual property (IP)	– UK spinout review "significant victory" for academic founders. The report outlines 11 recommendations geared towards bettering the process of commercializing the best research coming out of the UK's universities (92% of the UK's Russell Group universities now have a university-affiliated venture fund for spinouts") (Source) – The European Startup Nations Alliance is working with founders, capital allocators, industry, and government to upgrade and harmonize conditions that enable start-up success in Europe. (Source)

Recommendations

		Developments
Strengthen talent / excellence *clusters* SOME PROGRESS	– Raise awareness for talent clusters to attract expertise into highly dense clusters for various technologies (e.g., Munich for space, Paris for AI, etc.) – Foster a framework that encourages coopetition rather than fragmented competition for scarce talent, public funding, and private investment	– AI summit in Paris, with EU and France committing 320B, 109B from France alone (Source) – Munich clearly becoming Europe hub for space and defence: European defence hackathons, Munich Security Conference innovation day, etc. (Source)
Increase *LP base* and institutional investors LIMITED PROGRESS	– Inform broader public about the asset class of Venture Capital and Deep Tech – Shift assets from public to private, especially institutional investors to democratise returns (e.g., Tibi initiative in France) – Remove regulatory hurdles to pave the way for a new asset allocation – Create broad access, e.g., by lowering investment thresholds	– Swiss' "Deep Tech Nation Foundation plans to mobilize 50 billion Swiss francs over the next 10 years for Swiss start-ups and scale-ups in the Deep Tech sector (Source) – EU launches InvestAI initiative to mobilise €200 billion of investment in artificial intelligence (Source)

Recommendations

		Developments
Shift *governments and corporations* to become customers LIMITED PROGRESS	– Design right framework where public entities and corporates have to involve startups (e.g., corporates should consider startups in their procurement process) – Highlight the benefits for public institutions and corporates of being a customer vs. project managers – Stress the importance and benefits of commercial contracts for companies over grants	– The European Union unveiled its first-ever defence industrial strategy, committing over $1 billion towards military innovation. This initiative aims to foster partnerships with startups specializing in cutting-edge technologies such as drones, robotics, and quantum computing (Source) – In the United Kingdom, the Procurement Act 2023, which received royal assent on 26 October 2023, seeks to overhaul public procurement by simplifying processes and giving a greater share of public sector supply opportunities to small businesses. (Source)
Review innovation *regulation* LIMITED PROGRESS	– Tie regulation and corporate responsibility to size of the company to not stifle early innovation ("stronger shoulders can carry more") – Install pan-European ESOP legislation as demanded by ESNA, mirroring new models like in Germany – Review & harmonise legal frameworks across Europe on an ongoing basis (e.g., how to set up a company)	– European Commission President Ursula von der Leyen has included the '28th Regime' for innovative companies in the Political Guidelines for the EU Commission. She emphasised the need to remove national barriers that hinder startups from operating seamlessly across Europe. This '28th Regime' aims to streamline cross-border operations, enhance competitiveness, and foster innovation across the European continent (Source) – Improvements in ESOP in some countries → seven countries match or beat the US on ESOP friendliness, example of Germany in particular (Source)

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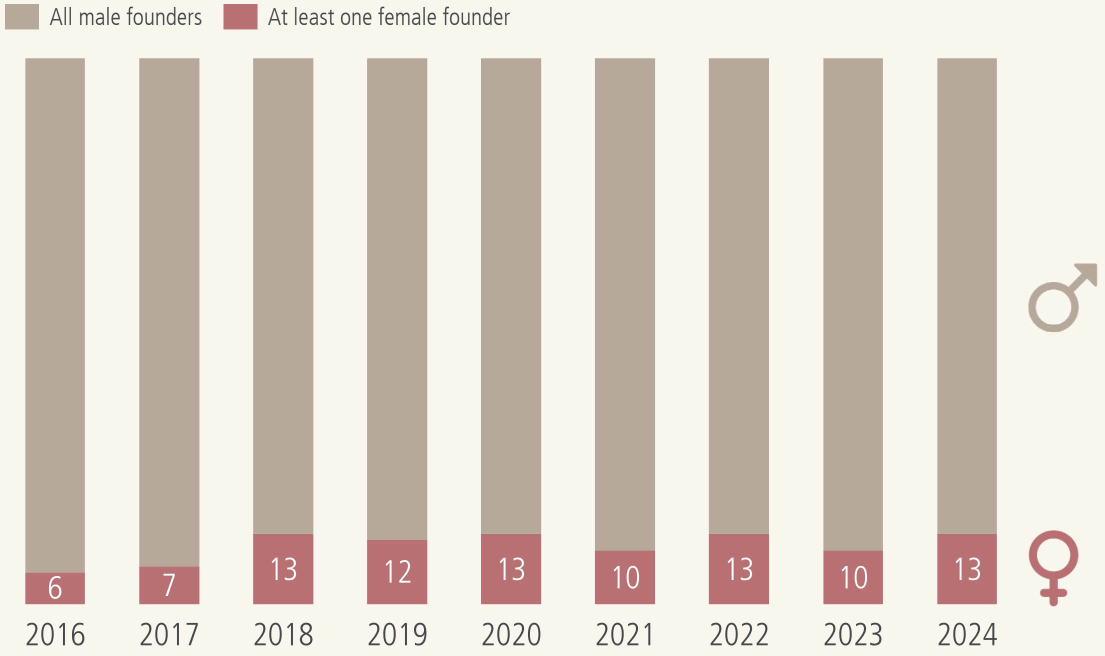
Recommendations

		Developments
Strengthen *exit channels / public markets* LIMITED PROGRESS	– Promote the Capital Markets Union to strengthen European liquidity pools – Adopt regulations to foster harmonisation and unification (e.g., EU Listing Act), including for secondary liquidity (e.g., Forge Europe)	– In 2023, fourteen European stock exchanges formed EuroCTP, a joint venture to create a consolidated tape for EU financial trading, enhancing market transparency and accessibility (Source) – Euronext plans to introduce a standardized, US-style single prospectus for companies raising funds across its seven stock exchanges. This uniform document, primarily in English with local language appendices, aims to streamline information access for investors and revitalize Europe's fundraising market (Source)
Promote *diversity* LIMITED PROGRESS	– Promote diversity across founders & investors – Stress importance of education, equal opportunity, and offer support to ensure individuals have the necessary resources for success – Shine light on role models	– There is still a long way to achieve inclusion in European Deep Tech. The share of funding going to startups with at least one female founder has stalled at 10-13% for the last seven years showing no sign of progress

There is still a long way to achieve inclusion in European Deep Tech

The share of funding going to startups with at least one female founder has stalled at 10-13% for the last seven years showing no sign of progress.

VC investment in European Deep Tech startups by founder gender
%



In 2024, 289 Deep Tech startups with at least one female founder raised a round, totalling over $1.9bn

Selected VC rounds in European Deep Tech with at least one female founder in 2024

Startup	Funding round	Focus
The Exploration Company	€150m Series B	In-space transportation
newcleo	€135m Series A	Nuclear fission (SMRs)
MMI	$110m Series C	Robotics surgery
Cradle	$73m Series B	AI-driven protein engineering
CYLIB	€55m Series A	Battery recycling
INBRAIN Neuroelectronics	€46.3m Series A	Brain computer interfaces

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European Deep Tech report 2025: Key numbers and takeaways

DEEP TECH MIS(CONCEPTIONS) CLARIFIED	**Similar exit timeline** Deep Tech has a similar exit timeline as regular tech	**More capital** Deep Tech requires more capital to reach revenue milestones	**Similar failure rate** Deep Tech companies do NOT fail more often	**Higher IRRs** in Deep Tech vs. Regular Tech portfolios
THE EUROPEAN OPPORTUNITY	**6 out of 20** best universities are in Europe	**Oxford, ETH, Cambridge** leading spinout value creation	**50%** of late-stage funding from outside of Europe	**London, Paris, Munich** main Deep Tech hubs
FUNDING LANDSCAPE	**$15.1bn** total invested money in Deep Tech	**28%** of all VC funding goes into Deep Tech	**$7bn (+56%)** record funding in Novel Deep Tech segments	**$12.2bn** in exit value created in 2024