The state of nature-inspired innovation in the UK

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Introduction

Facing global challenges such as climate change and resource shortages, how can the rising interest in nature-inspired innovation provide us with innovative solutions in harmony with our planet earth? This chapter introduces readers to the field of nature-inspired innovation, including its visions, definition, methodologies and case studies.

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Research

The research covers the frontier knowledge in nature-inspired innovation and the research network's depth and width in this highly interdisciplinary space. Furthermore, it concludes with insights from our research and surveys about the most common challenges and opportunities in turning academic knowledge into real-world impact.

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Industry

Industry introduces emerging companies that bring nature-inspired innovation into real-world products and services. It also looks at the strategies along the journey, such as the critical partnership with academia, aligning with governmental innovation strategies.

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Funding covers the landscape of current funding interest in the fields relevant to nature-inspired innovation. Further, it discusses funding opportunities and future strategies for interdisciplinary projects at different stages.

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Executive summary

In the face of global challenges, innovation is no longer defined solely by its commercial and technological successes, but more importantly, social and environmental performances. Coupling with the growing market need for sustainable, ethical and responsible consumer products and ambitious environmental policies, businesses have been driven to develop solutions for human and planetary wellbeing.

Nature-inspired innovation, the practice of drawing on solutions found in nature for human innovation and problem solving, seems to provide a hint in solving problems in harmony with our environment. Precision growth, homeostasis systems, self-organising materials, genetic storage, fluid dynamics through 4 billion years of evolution have already created a vast database of how life can prosper within the balance of ecosystems.

> **The sooner people stop thinking about biology and start thinking about the nature of the problem, the sooner people will understand nature-inspired innovation. It's a matter of thinking more at the system's level.**
>
> Professor Julian Vincent

Executive summary

However, one cannot draw a direct correlation between nature-inspired innovations and sustainability. Every mechanism works within its unique scale and context. We advocate a rigorous attitude towards the underlying premises of any specific mechanisms and the systemic complication when applying it to another context.

As we are using more and more advanced tools to learn from and imitate nature, the field of nature-inspired innovation has been growing unprecedentedly. As a result, over the past ten years, we have seen a steady increase in the number of patents, publications and news articles regarding nature-inspired discoveries.

Definition - Nature-inspired innovation is about the solution space. Our research has made it clear the words/phrases, biomimicry, biomimetic(s), bioinspired, bio-inspired, bioinspiration, biologically inspired, biological inspiration, bionic(s), nature-inspired, nature inspired and ecomimicry, are all fundamentally the same. They look at the natural world as a starting point and the end result - a better solution. Processes and methods evolve over time, but as long as you understand the underlying mechanisms of the natural world you are on the right track.

Executive summary

While there are many correlated terminologies such as bionic, biomimicry and nature-inspired technologies, this report aims to capture a comprehensive picture that unites the common thread of these areas - translating mechanisms in nature into real-world applications.

Throughout the report, we propose a solution-oriented approach when looking into nature, as well as provide insights of potential interventions based on our analysis of opportunities and challenges from the perspective of different stakeholders. To introduce our readers to the field, a rich repository of case studies will be listed to demonstrate visions and methodologies of nature-inspired technologies and its current academic, industrial and funding landscapes.

We've seen growing traction and activeness in nature-inspired technologies from academia, industry, and investments during our research. Based on year-long research with intensive interviews, surveys, desktop research and data analysis, we identified a widespread network of over 1500 correlated academics and 150+ industry entities, laying a solid foundation in understanding the challenges and opportunities of this highly dynamic and interdisciplinary field. We have observed recurring challenges such as a lack of resources, funding or skills, and differences in visions and workflows in the academic and commercial systems, which can be significantly improved by a stronger network that enables more synergic, active dialogues, mutual understanding and partnership among different disciplines and stakeholders. Noticing an absence of a common language in the field, this report aims to facilitate cross-pollination across borders by providing a multi-perspective roadmap in nature-inspired innovation from initial ideas in translation to reality and strategic analysis of common challenges and opportunities along the journey.

> **We need a fundamental shift in how we live on Earth, what we call the Great Transition. Achieving the Great Transition will require rapid, deep, structural change across most dimensions of human activity.**
>
> Sao Paulo Declaration
> on Planetary Health

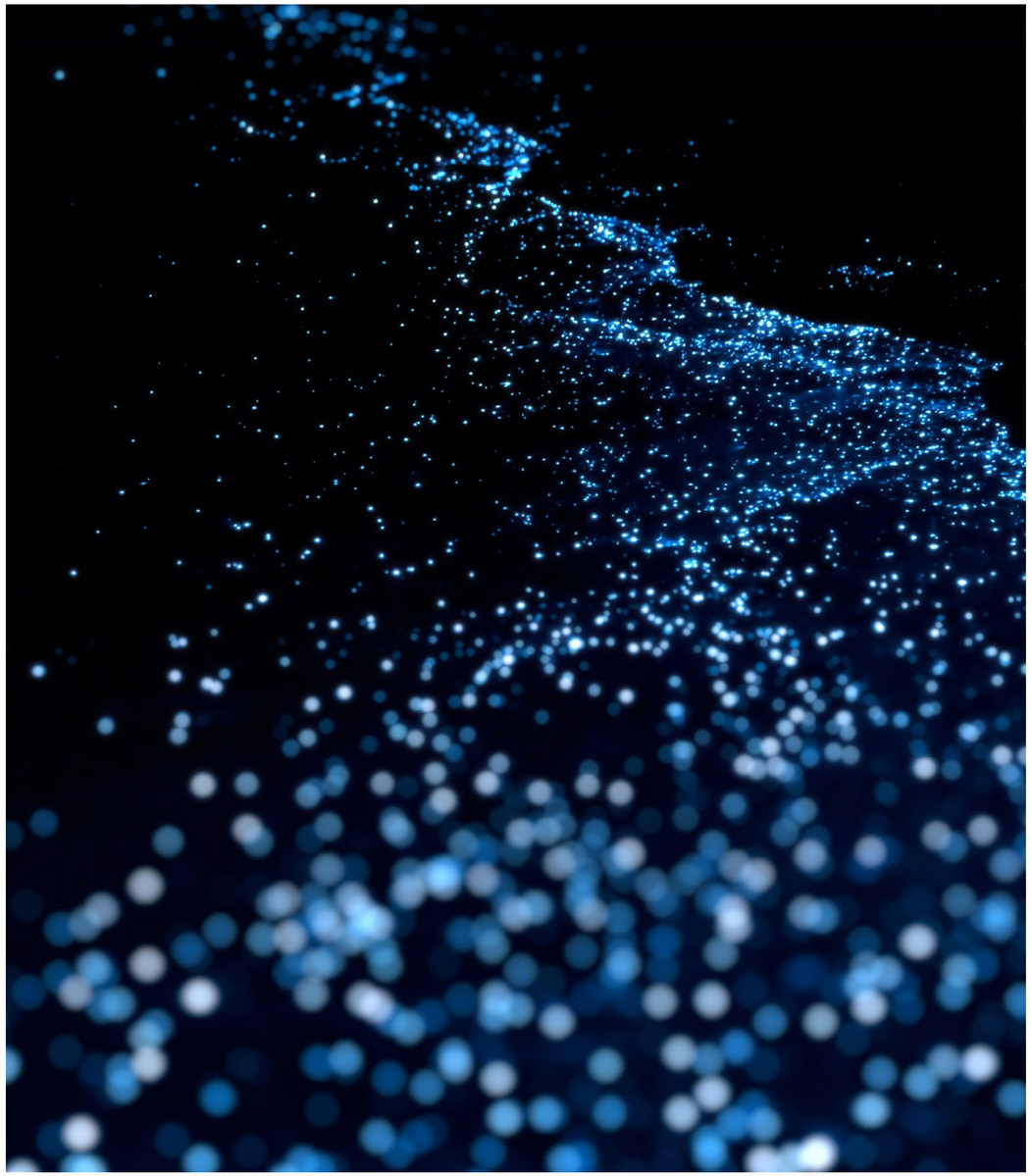
Acknowledgements

We would like to extend our thanks to the myriad of researchers, academics, and industry leaders who we communicated to help shape this report.

The authors would also like to thank the researchers, academics and industry experts, who gave their time to complete the surveys, be interviewed or contributed their expertise to this report.

The authors also wish to thank dogeatcog for their work on producing this report, Quilt AI for their help with data analysis, along with the team from Biomimicry Innovation Lab, past and present.

Download figures and diagrams from the report tool kit here



Meet the Biomimicry team here

Biomimicry Innovation Lab

Biomimicry Innovation Lab is a design agency focusing on manufacturing, agriculture and urban innovation. With a team of innovators and change-makers worldwide, we bring expertise from across the design, engineering, science and financial sectors.

We work with company's at the early stage of project development through initial consultation, in-depth research and analytics. We achieve this via Defining the problem, Identifying the competing desires and Developing a series of prototypes and experiments to clarify how, together, we can reach a successful outcome. Our services help you develop new business models, find biological strategies, identify existing solutions for faster technology transfer, and access investors and other sources of capital.

Close

Richard James MacCowan

Richard James MacCowan is Principal, Biofuturist and Founder of Biomimicry Innovation Lab. With a background in real estate asset management, urbanism and technology development, he pushes the boundaries on developing innovative solutions for clients worldwide.

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Yuning Chen is a design researcher with a background in environmental science. Yuning recently graduated from Innovation Design Engineering at Royal College of Art and Imperial College London. Her research interest mainly lies in the intersection of biology, informatics and design. Yuning has exhibited her work at the Dutch Design Week, Milan Design Week, London Design Biennale, and STARTS Festival.

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Visit the Biomimicry Innovation Lab website here

Meet the Biomimicry team here

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Nadathur Group

Nadathur Group is a Family Office (FO) in India, Singapore, and the UK. The group focuses on building new businesses and supporting entrepreneurship (angel & venture investments), especially in long gestation, high risk, innovation-based ventures. We prefer companies with significant market potential/impact. Life sciences, Healthtech, Foodtech, Traveltech, Cleantech, Nature-inspired innovation, and Circular economy/sustainability are our sectors of interest.

We also have significant involvement in impact investments & philanthropic efforts across geographies. We engage our time, effort and resources on causes close to our hearts and where we can help make a difference. We support nature conservation, scientific research, education, care for differently-abled children, and the arts. The Family office also manages a portfolio of public equity, fixed income, private equity, real estate and alternative asset classes.

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Sriram Nadathur

Sriram Nadathur is an entrepreneur, an angel investor, a philanthropist, and co-head of the Nadathur Group. He is responsible for the group's investments in Life Sciences, Health, Cleantech, Nature-inspired innovation, and Circular economy/sustainability.

He is a biomimic, an engineer, and a business person based on educational degrees. Most importantly, he is a dreamer and a catalyst in helping make the world a better place by merging the heart (people, nature, and planet) and the mind (deep tech, innovation and start-ups).

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Introduction

Translation of research to real-world impact is not always straightforward. Emerging disciplines is one area that is proving to be even more accurate. Facing complex challenges, we need to harness the expertise and values from different fields to solve problems from all angles.

Reaching key development milestones such as Technology Readiness Levels (TRL's) by themselves do not necessarily lead to commercial relevance or success. However, bringing the market into the lab is critical to steer research and development towards real-world solutions. We believe that early-stage engagement of academic and industry stakeholders can ensure a better translation process from discoveries to impact at many levels.

Nevertheless, we lack an effective network and a mature innovation ecosystem to enable these partnerships and fully unfold the potential of the vast knowledge in nature-inspired research in the UK.

Our aim with this report is to identify and analyse the challenges faced by stakeholders within nature-inspired innovation and suggest potential opportunities for intervention.

Download figures and diagrams from the report tool kit here

Photo credit: Marita Kavelashvili @Unsplashed

Context

We are on a collective shift for the need to protect our planet. Over the past century, we have been developing technologies that support the livelihoods of an exponentially growing population while externalising the cost of nature.

Facing global climate challenges, aligning technological development with planetary wellbeing has never been more urgent. In light of the 17 sustainable development goals set up by the United Nations and myriad other sustainable initiatives around the world, the most transformative innovation in the 21st century would be the ones that harness the synergies among social, technological and environmental boundaries. Nature-inspired solutions can be one of those important methods.

> **As innovators we look around for fresh ideas, and with advances in technology we are able to understand the natural world like never before.**
>
> Dr Rupert Soar,
> Nottingham Trent University

Context

Find out about Earth Overshoot Day here

We are on a collective shift for the need to protect our planet. Over the past century, we have been developing technologies that support the livelihoods of an exponentially growing population while externalising the cost of nature.

The 2021 Nobel Prize winners in Physics identified that we have more tangible responsibilities to restore our planetary health through research into human activities and the negative relationship with climate change. Facing global climate challenges, aligning technological innovation with sustainable development has never been more urgent. In an age of transition, how might we find solutions that lead us to a symbiotic future?

From a physical science perspective, limiting human-induced global warming to a specific level requires limiting cumulative CO2 emissions, reaching at least

net zero

CO2 emissions, along with strong reductions in other greenhouse gas emissions.

Innovation trends

The last ten years have witnessed a growth in patents and publications in nature-inspired innovation worldwide, with China and the USA having the most extensive patent library. In addition, these two nations heavily invest in commercialising academic research, with the foundations set for this in the mid-20th century.

The growing trend in biotechnology, such as synthetic biology, has attracted an increasing number of companies to look into natural systems that are searching for circular, resource-efficient solutions across various industries. According to the OECD, the increase in patents plays a pivotal role in developing technological transactions, leading to a rise in economic output.

Since 2010 there has been...

171% increase in patents

161% increase in publications

2000% increase in news articles

Sources: Google Patents, Google Scholar, Google News

Nature-inspired innovation

Nature-inspired innovation is an interdisciplinary collaboration of biology and technology that solves practical problems by transforming the abstracted models of biological systems into solutions. Living organisms have evolved well-adapted structures and materials over a geologic time-scale through natural selection. Looking to nature has given rise to multiple new technologies focusing on biomechanics, biochemistry and systems biology, from nano to macroscales.

Humans have always looked to nature for inspiration and solutions. Although the concept may not be an entirely recent phenomenon, it is only in the last few decades that biomimetics and its adjectival forms, bio-inspired, biomimicry, bionics, and nature-inspired, have gained prominence in scientific and entrepreneurial discourse. Several other related terms accompany this sharp increase, indicating a practice area increasingly relevant to researchers and innovators. Notably, this increase correlates to technological advancements that enable us to interrogate nature and its functioning in unprecedented detail. For example, research in 2006 by Professor Julian Vincent (et al.) highlights using TRIZ a 12% similarity between biology and technology in the principles that solutions to problems illustrate. While technology solves problems primarily by manipulating energy usage, biology uses information and structure, two factors mainly ignored by technology. With our greater understanding, we wish to increase the figure.

Nature-inspired innovation is drawing on mechanisms found in nature to develop designs for human innovation and problem-solving. Therefore, we wish to bring this together in one innovation space, nature-inspired innovation.

Why nature-inspired innovation?

CASE STUDY — CLICK HERE TO READ

You can find references to the wonders of nature's engineering in the earliest recorded writings and the parallel wish to import ideas and mechanisms into modern technology. The earliest success was flight, foretold by the sketches of da Vinci, with the following how nylon was invented by looking at polymeric fibres

Nature leverages nanotech, uses renewable energy, does green chemistry, depends on radical resource efficiency, does all of this across varied ecological conditions, and, at the highest systems level, the earth itself.

Biological materials perform various functions with only a small range of biopolymers such as proteins, polysaccharides, and nucleic acid.

At the same time, synthetic chemistry produces over 300 polymers and inorganic compounds to perform similar functionalities.

What if we could replicate such a wide range of properties with less than ten polymers?

Nature represents around 4 billion years of inspiration and R&D, resulting in the evolution of millions of species, including us humans. It also means a highly resilient low-entropy system, having survived and thrived over billions of years despite rapid and, on multiple occasions, catastrophic changes.

Thus, learning from and emulating nature offers a reliable, tested, and broader canvas for innovation that can help address global challenges.

Close

Sharklet

Sharklet Technologies is the world's first technology to inhibit bacterial growth through pattern alone. The Sharklet surface is composed of millions of microscopic features arranged in a distinct diamond pattern. The structure of the pattern alone inhibits bacteria from attaching, colonizing and forming biofilms. The Sharklet technology contains no toxic additives or chemicals and uses no antibiotics or antimicrobials.

In 2002, Dr Brennan, a materials science and engineering professor at the University of Florida, visited the U.S. naval base at Pearl Harbor in Oahu with universities from the United Kingdom. The U.S. Office of Naval Research solicited the team to find new antifouling strategies to reduce the use of toxic antifouling paints and trim costs associated with drydocking their fleet and drag the increasing growth of biofouling on the hulls.

Sharklet draws inspiration from the shape and pattern of the dermal denticles of sharkskin. Sharks are resistant to fouling organisms in the water, including algae and barnacles. As a result, the primary Sharklet micropattern is very small – about 3 microns tall and 2 microns wide.

As of 2017, Sharklet Technologies has raised $5.1 million via grants and Series A and B funding and offers products in the medical industry, adhesive-backed film, and materials for multiple uses.

Find out more

Methodologies

Download figures and diagrams from the report tool kit here

Research led

In the research-led approach, the starting point is a new result from basic biological research promising for nature-inspired innovation and, for example, developing a material after analysing a biological system's mechanical, physical, and chemical properties. For example, Jacobs (2014), during their study of successful bio-inspired solutions, identified that the majority of these are research-oriented solutions.

Industry led

In the industry-led approach, new ideas are sought for already existing developments that have been successfully established on the market. Thus, the cooperation focuses on the improvement or further development of an existing product. In this instance, the research identifies relevant biological systems that can improve upon or solve technical or environmental challenges.

Close

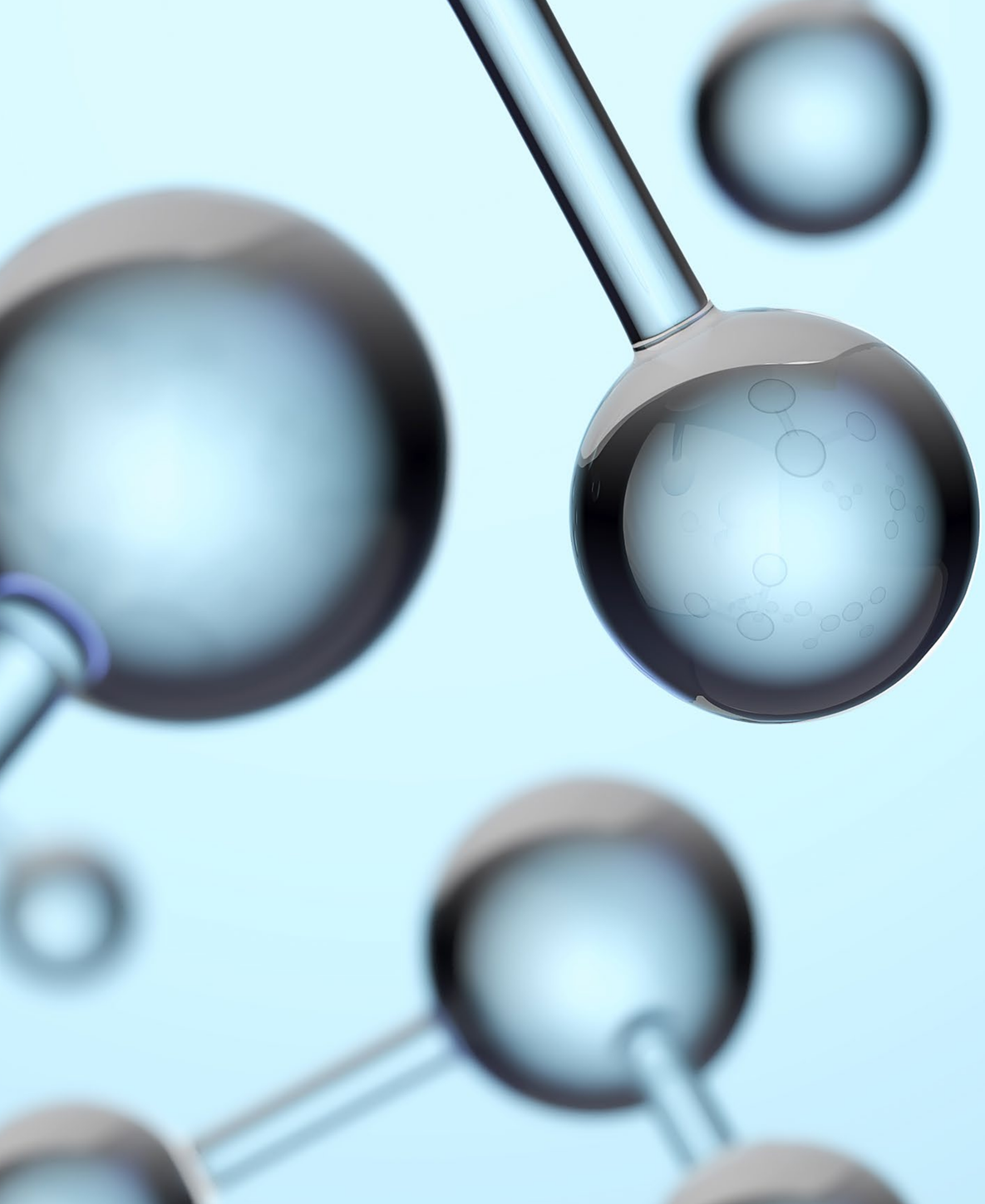
Eden Project

The Eden Project, the most significant greenhouse globally, was designed with various inspirations drawn from nature. By looking into the structure of soap bubbles, the architects created a way to construct buildings without being restricted by the ground level's evenness, which led to the iconic main form - the dome structures.

Inspiration came from various biological structures, including soap bubbles, carbon molecules, radiolaria and dragonfly wings. The result is one of the lightest structures ever created and a largely self-heating building using passive solar design principles. In addition, they selected an extremely lightweight material, ETEE, instead of the traditional use of glasses and plastic in modern buildings in terms of material used. ETFE offered multiple benefits resulting in a virtuous circle of efficiency: the ETFE pillows could be made much more extensive than glass and were 1% of the weight (a factor 100 saving in embodied energy). This substantially reduced the amount of steel required and allowed more sunlight into the building.

The result was a radical reinterpretation of the greenhouse - an extremely lightweight self-heating enclosure for most of the year. The weight of the superstructure for the Humid Tropics Biome is less than the weight of the air that it contains. The scheme has won numerous awards and contributed £0.5 billion to the local economy during its first three years of opening.

Find out more



Close

Fabric Nano

The team at Fabric Nano, learning from how organisms create biochemicals, have created a highly efficient cell-free biochemical flow reactor. By producing enzymes that can directly bind to DNA and harnessing the precision of DNA-scaffold manufacturing, they aim to replace the heavily polluting fermented and petrochemistry industry with the next generation of cell-free biofabrication.

Fabric Nano was founded in 2018 by a group of researchers from Oxford University and the London Business School through the Entrepreneur First program.
By creating a novel DNA-based flow reactor, they produce biochemicals by engineering enzymes that can bind directly to DNA. The use of DNA as a scaffold allows high spatial precision, while the power of enzymes to attach anywhere along a string of DNA provides deep flexibility.

Their FabricFlow reactor technology has reduced the cost of manufacturing by introducing many technical innovations that vastly improve the efficiency of the cell-free biomanufacturing process. Moreover, the binding between DNA and the enzyme can happen anywhere along the string, enabling a high level of flexibility in the production process. With the introduction of various new technologies, they successfully improved the efficiency in biomanufacturing with lower costs. To date, they have raised $15.5 million.

Find out more

Research

As showcased in the case studies, the highly interdisciplinary characteristic of nature-inspired innovation enables a tentacular network among a broad range of academic fields. For there is no subject breakdown in nature, every unique phenomenon can be learnt from multiple angles and lead to applications in different fields.

For example, if you look at how living organisms capture, store and utilise carbon in a cyclic manner within their local environments, we can derive a series of materials, energy and waste management solutions with significantly reduced or even reversed carbon footprints.

Research overview

Our steps to understand the state of nature-inspired innovation was achieved using the following research methodology:

1500+

researchers identified

Our team carried out an intensive scan of every further education institution in the United Kingdom and Northern Ireland focusing 12 different words and phrases. This identified over 1500 researchers (masters-level and above) across the country, and 125 research labs either fully focused on nature-inspired innovation, or is part of their innovation process. Our focus is on the subjects, research focus areas, and funding sources available from publicly available information.

233

survey responses

An extensive survey for both industry professionals was developed to allow for the understanding of the challenges and opportunities in terms of innovation development, access to investment, and the challenges of academic-industry collaborations. This survey was sent to all of the identified researchers, and the respective technology transfer offices. We received 233 responses to survey questions.

140+

people interviewed

To fully understand the challenges and opportunities of academic-industry collaboration, we subsequently interviewed 140 people during a 6 month period and anonymised the information for natural language processing (NLP).

112,00

data points

Working in conjunction with Quilt.ai using anonymised information, we identified a number of insights that are highlighted in the subject chapters of this report. These include terminology, regional variations, desire to commercialise, barriers to innovation and access to investment opportunities amongst others.

Research methods

Our steps to understand the state of nature-inspired innovation was achieved using the following research methodology.

Desktop

Our team carried out an intensive scan of every higher education institution in the United Kingdom and Northern Ireland, focusing on twelve keywords and phrases. As a result of this extensive search, we identified over 1500 researchers (masters-level and above) across the country. In addition, we found 100+ research labs, either entirely focused on nature-inspired innovation or included in their innovation process. Our focus is on the subjects, research focus areas, and funding sources available from publicly available information.

Surveys

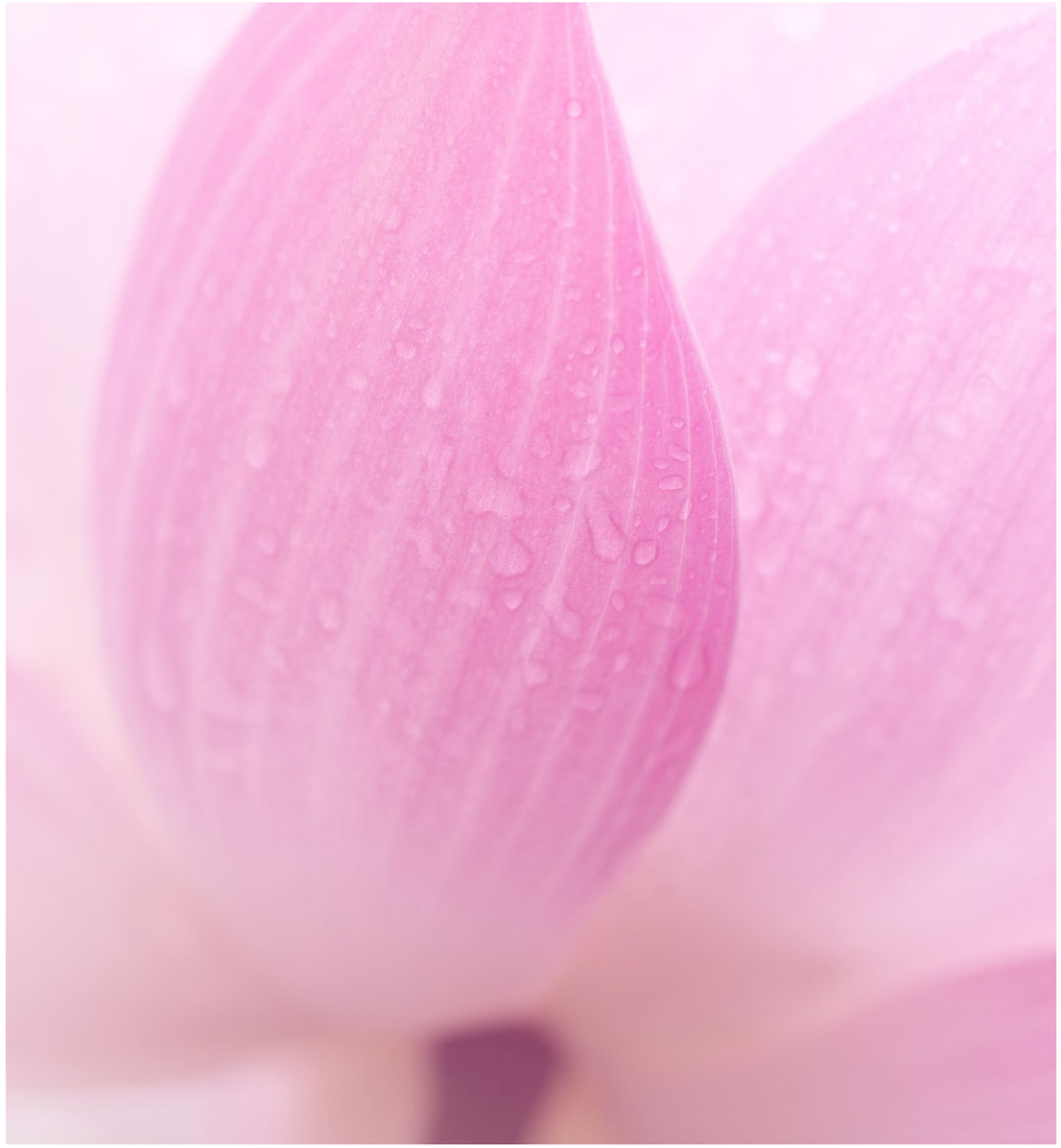
We developed an extensive survey for academic and industry professionals to understand the challenges and opportunities within innovation development, access to investment, and the challenges of academic-industry collaborations. We sent the survey to all of the identified researchers and the respective technology transfer offices. We received 233 responses to survey questions.

Interviews

To fully understand the challenges and opportunities of academic-industry collaboration, we subsequently interviewed 140 people over six months. The information is anonymised for cooperation with our analytics partners to understand the semantics using natural language processing (NLP).

Analysis

Working in conjunction with Quilt.ai using anonymised information, we identified several insights highlighted in the subject chapters of this report. These include terminology, regional variations, desire to commercialise, barriers to innovation and access to investment opportunities.



Terminology variation

Based on our desktop research of higher education in the United Kingdom, we summarised the various terminologies of nature-inspired innovation.

Our research used a range of keywords and phrases from biomimicry, biomimetic(s), bioinspired, bio-inspired, bioinspiration, biologically inspired, biological inspiration, bionic(s), nature-inspired, nature inspired and ecomimicry.

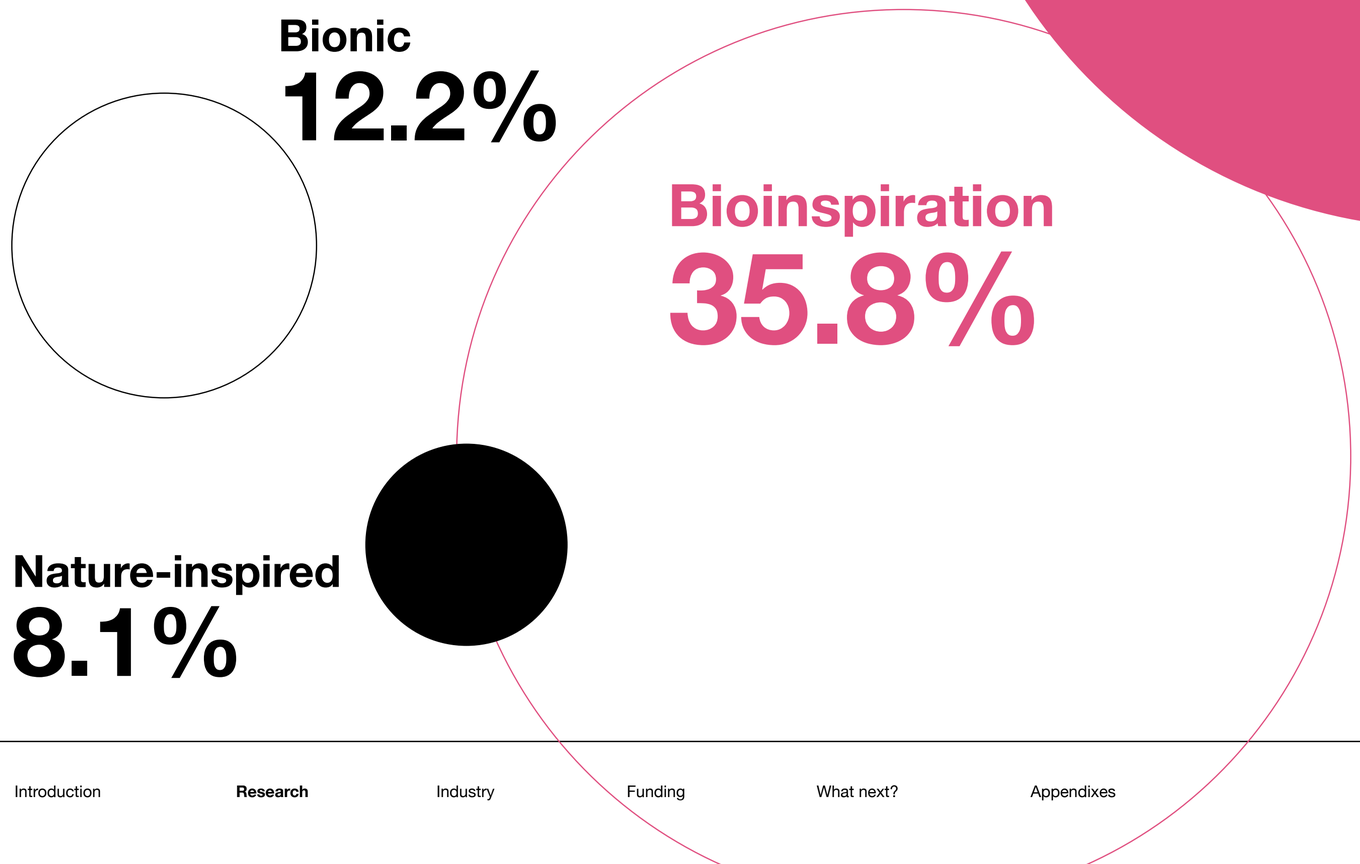
Similar terms were grouped Bioinspired (bioinspired, bio-inspired, biologically inspired, biological inspiration), and Nature-inspired (nature-inspired, nature inspired). In 2020, of the 9767 publications, bio-inspired, biomimetics and bionic were the most common phrases based on Semantic Scholar.

Nature-inspired and biomimicry followed on.

In our survey, we asked the respondents to identify which words and phrases we used during our desktop research align with their practice the most. Very few chose only one word or phrase, with many selecting more than two. Bio-inspired (50.2%) was the most common, followed by Nature-inspired (21.1 %).

We concluded that despite various terminologies, a common thread connects them, creating innovative solutions inspired by biological systems.

Desktop searches



In our survey we asked the respondents to identify which of the words and phrases we used during our desktop research. Very few chose only one word or phrase with many selecting more than two. Bio-inspired (50.2%) was the most common followed by Nature-inspired (21.1%). It is clear that the keyword/phrase is not important in academia, it is about scientific discoveries and solving problems.

Geographical overview

We've mapped out the geographical distribution of various research institutes active in the field of nature-inspired innovations, among which London and south east England have the highest number of related institutions.

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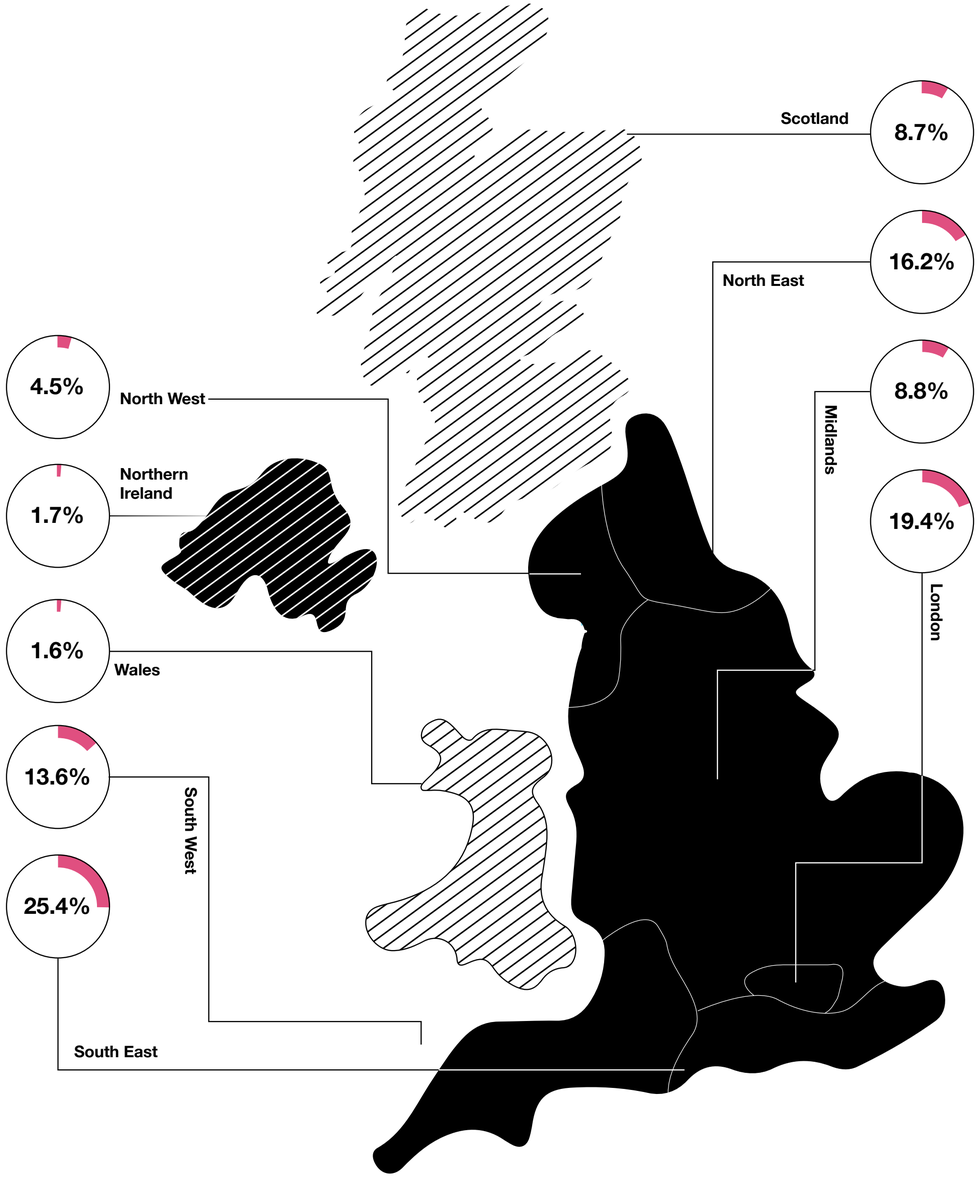
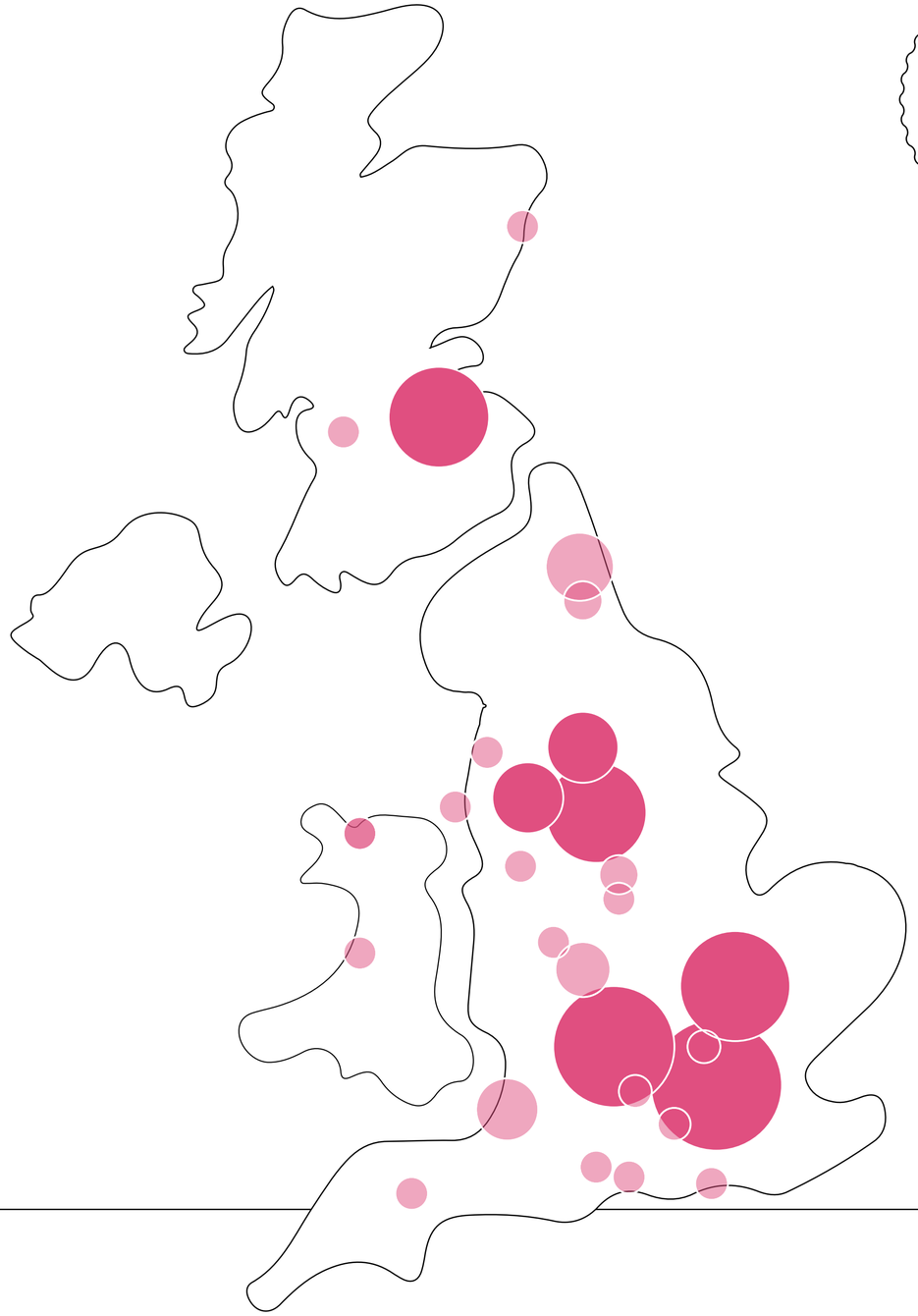


Regional variation

London	19.6%
Oxford	10.7%
Bristol	8.9%
Cambridge	8.4%
Sheffield	6.4%



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33.6%

of research is practised away from traditional research-intensive institutions.

15.3%

N8 Research Partnership*
The N8 Research Partnership is a collaboration of the eight most research-intensive universities in the North of England: Durham, Lancaster, Leeds, Liverpool, Manchester, Newcastle, Sheffield and York. The research identified **292 researchers and academics**.

9.2%

The University Alliance
University Alliance is the voice of twelve professional and technical universities working at the heart of their communities. The research identified **71 researchers and academics**.

6.8%

Scottish Research Partnership in Engineering*
Currently working to future-proof Scotlands position of a world-class centre of research excellence and competitive driving force in engineering. The research identified **185 researchers and academics**.

2.0%

Million Plus - The Association for Modern Universities in the UK
Representing 23 research universities. The research identified **49 researchers and academics**

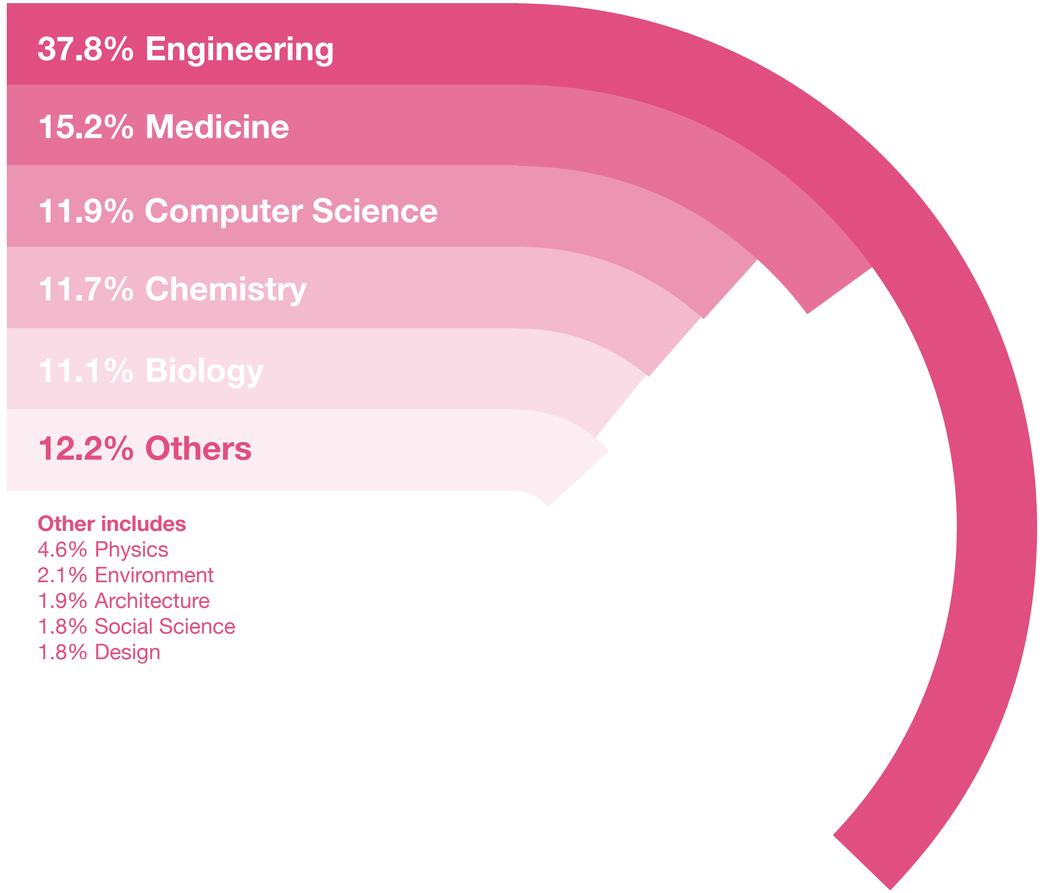
0.3%

Guild HE
The research identified **5 researchers and academics**.

* Disclaimer: Many of the universities sit within a number of research partnerships, for example, Russell Group universities found are within the N8 Research Partnership and Scottish Research Partnership.

Mapping fields of research

Following our research into researchers across the United Kingdom and Northern Ireland, we identified the most widely researched fields related to nature-inspired innovation. We aim to present the width and depth of its knowledge network by showing the connections between areas and their broad sub-topics.



Other includes
4.6% Physics
2.1% Environment
1.9% Architecture
1.8% Social Science
1.8% Design

Innovation across disciplines

Following our research into researchers across the United Kingdom and Northern Ireland, we identified the most widely researched fields related to nature-inspired innovation. We aim to present the width and depth of its knowledge network by showing the connections between areas and their broad sub-topics.

Engineering

CASE STUDY — CLICK HERE TO READ

Top five subtopics in engineering research

14.9%
Materials Science

13.8%
Bioengineering

11.6%
Robotics

8.8%
Mechanical Engineering

8.2%
Biomedical Engineering

> **I believe that teaching and researching Nature Inspired Engineering will be of increasing importance in a century when the world is facing profound existential problems. As we transition from our production-oriented thinking process, we owe it ourselves to reconnect to Nature to find in her some of our much needed solutions.**
>
> Professor Marc Desmulliez

Close

Consequential Robotics

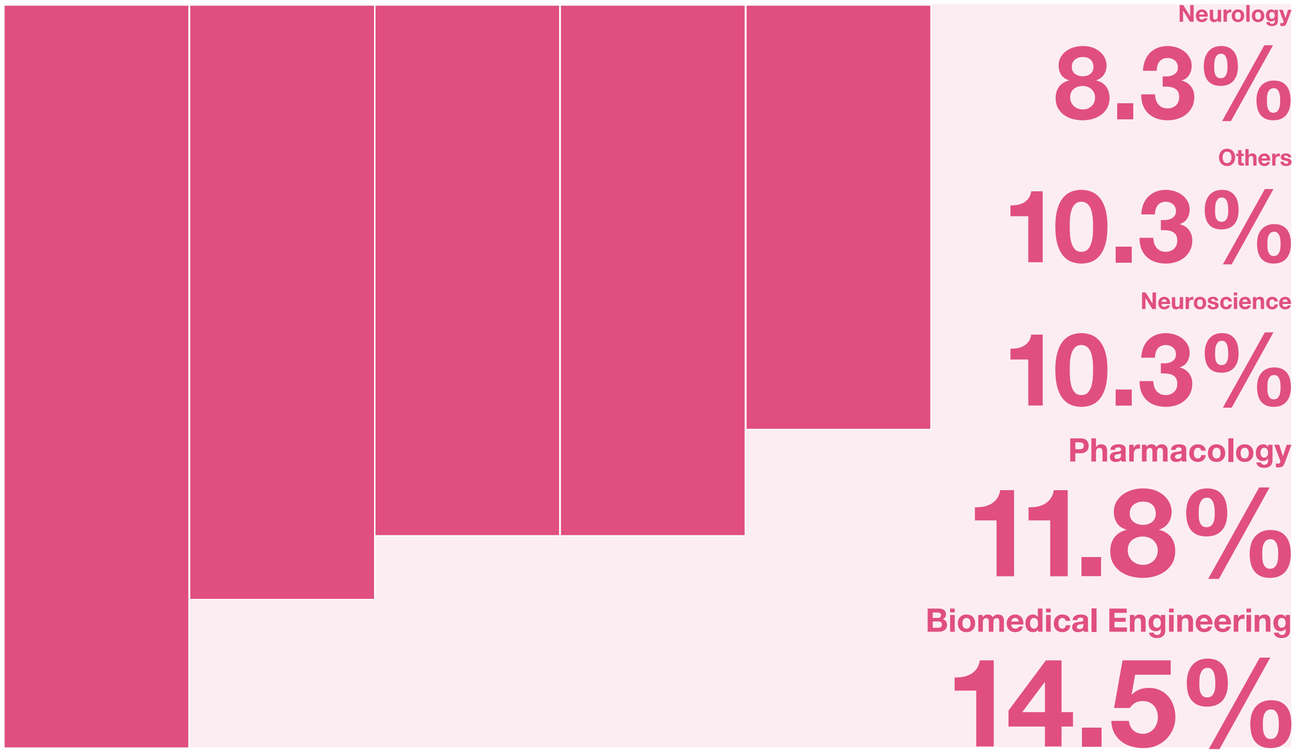
Amount of fundraised: $200k

Nature Inspired Strategies:
Founded by award-winning product designers and highly experienced biomimetic roboticists, Consequential Robotics creates ‘brain-based’ biomimetic robots by emulating animal intelligence in designing their control and operation systems. Highly inspired by the robustness, adaptability and communicative skills in animal intelligence, they aim to create efficient and safe robots that serve human purposes in an elegant manner. For example, MiRo is a robot series created to provide services both in labs and classrooms such as education, companionship and public engagement (companion robot Miro - B and educational robot Miro - E). Embedded with in-depth models of animal behavioural patterns enabled by simulating their sensory-motor systems and decision-making processes, MiRo can exhibit very life-like behaviours and perform intuitive interaction with the users.

Find out more

Medicine

Top five subtopics in Medicine



One of the limits of minimally invasive neurosurgery is that if you want to get to a deep seated site through a burr hole in the skull, you generally are constrained by a straight line trajectory between the two. It took five years to abstract [the] key concepts behind the [wasp ovipositor] biological inspiration.

Professor Ferdinando Rodriguez y Baena

CASE STUDY — CLICK HERE TO READ

Close

Eden 2020

Amount of fundraised: €8.3M

Biology Strategies: Initially inspired by biomimicking an ovipositing wasp, the EDEN2020 system has been designed to have wide applications across minimally invasive neurosurgery including drug delivery, laser ablation, taking diagnostic readings of brain signals, and delivery of electrical stimulation. The catheter is driven by an innovative robotic platform and in the future could help to diagnose and treat brain tumours, epilepsy, and neurodegenerative diseases like Parkinson's.

EDEN2020 aimed to develop an integrated platform for one-stop diagnosis and minimally invasive treatment in neurosurgery. Our aim was to exploit the unique track record of leading research institutions and key industrial players in the field of surgical robotics to overcome the current technological barriers that stand in the way of real clinical impact.

We aspired for EDEN2020 to provide a step change in the modelling, planning and delivery of diagnostic sensors and therapies to the brain via flexible surgical access, with an initial focus on cancer therapy. We engineered a family of steerable catheters for chronic disease management that can be robotically deployed and kept in situ for extended periods.

The system featured enhanced autonomy, surgeon cooperation, targeting proficiency, and fault tolerance with a suite of technologies that are commensurate to the unique challenges of neurosurgery.

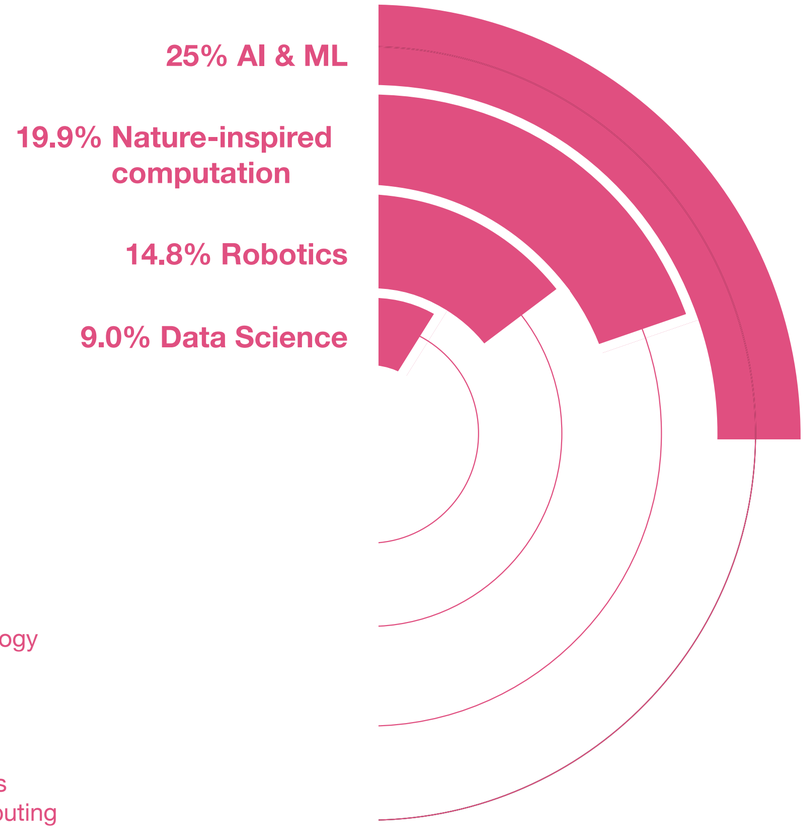
Find out more

Computer science

“

Natural systems provide unique examples of computation in a form very different from contemporary computer architectures. Biology also demonstrates capabilities such as adaptation, self-repair and self-organisation that are becoming increasingly desirable for our technology. To address these issues a new computer model and architecture with natural characteristics was created... Systemic computation is Turing Complete; it is designed to support biological algorithms such as neural networks, evolutionary algorithms and models of development, and shares the desirable capabilities of biology not found in conventional architectures.

Professor Peter Bentley.



7.4% Other
6.3% Simulation
5.7% Computation Biology
3.9% Neuroscience
2.3% HCI
1.7% Cybersecurity
1.7% Computer Vision
1.1% Complex Systems
1.1% Concurrent Computing

CASE STUDY — CLICK HERE TO READ

RESEARCH

Close

Opteran Technologies

Opteran Technologies have achieved a paradigm shift in machine intelligence that provides a path to genuine general purpose autonomy. Co-founder and Chief Science Officer Professor James Marshall chose to map insects' neurons, specifically the honeybee, which exhibits sophisticated navigational skills using a brain the size of a pinhead with only a million neurons.

Following eight years of research led by Professor James Marshall and Dr Alex Cope from the University of Sheffield's Department of Computer Science, Opteran is pioneering lightweight, low-cost silicon brains to enable robots and autonomous vehicles to sense, see, navigate and make decisions.

Inspired by the brains of social insects, the company believes its approach to autonomy, called 'Natural Intelligence', will significantly expand the potential addressable market for autonomy in machines and robotics.

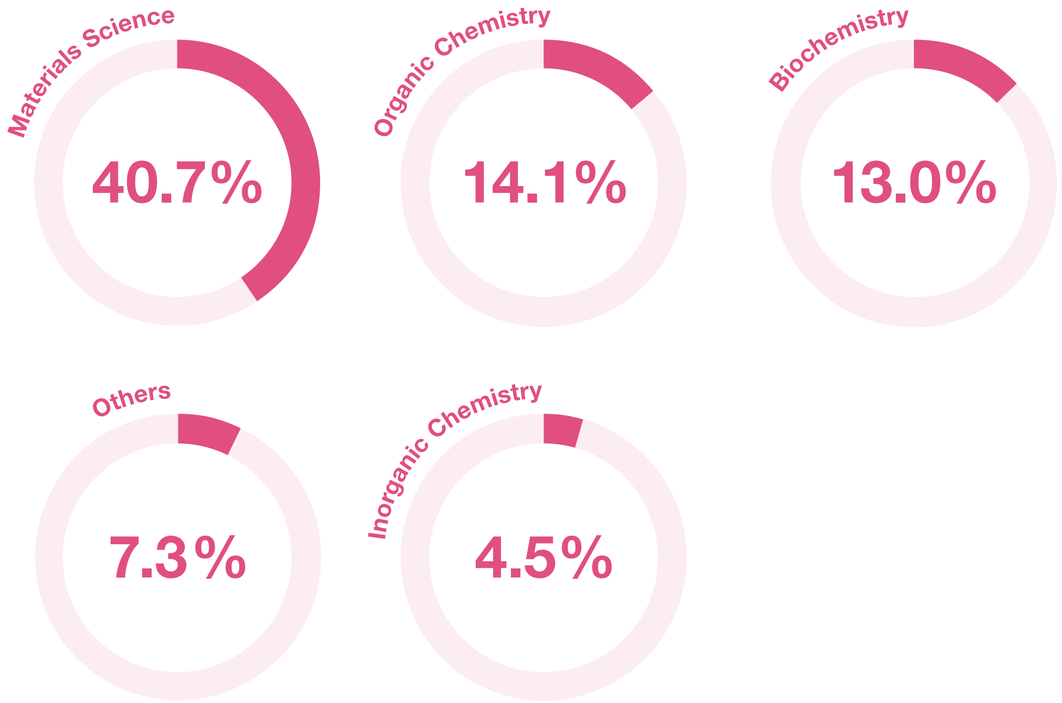
Although insects have smaller brains than humans, they can sophisticated decision-making and navigation using optic flow to perceive depth and distance.

Opterann Technologies' autonomous solutions can mimic tasks such as seeing, sensing objects, obstacle avoidance, navigation and decision making. In a recent trial, Opteran's AI was able to control a sub-250g drone, with complete onboard autonomy, using fewer than 10,000 pixels from a single low-resolution panoramic camera.

Following a £6m EPSRC grant to initiate the initial research, the company has raised £1.91m through seed funding as of November 2020.

Find out more

Chemistry



Scalability, efficiency, and resilience are essential to nature, as they are to engineering processes. They are achieved through underpinning fundamental mechanisms, which are grouped as recurring themes in a nature-inspired solutions approach: hierarchical transport networks, force balancing, dynamic self-organization, and ecosystem properties. To leverage these universal mechanisms, and incorporate them effectively into engineering design, adaptations may be needed to accommodate the different contexts of nature and engineering applications.

Professor Marc-Olivier Coppens

CASE STUDY — CLICK HERE TO READ

Close

Carbonmetrics

Amount of fundraised: N/A

Nature Inspired Strategies:
Biomimeti glucose binding molecules - Our mission is to help people with diabetes to live more normal and longer lives. We are using our proprietary Biomimetic Glucose Binding Molecules (GBM) to develop a new glucose sensor chemistry that will enable market-leading Continuous Glucose Monitors (CGM)

Carbometrics is one of the latest companies to feature in the web series ‘Science in Action’ by Horiba scientific, which showcases cutting edge and innovative companies using their state-of-the-art analysis equipment. Scientists from Bristol University, as part of the Russell Group, a collection of 24 world-class research-intensive UK universities, discovered a glucose binding molecule that can sense the presence of glucose in the bloodstream. The molecule is a cage-like structure that only a glucose molecule fits into. It can be used as a receptor or sensor for blood glucose.

“The core structure is simple and symmetrical, yet provides a cavity which almost perfectly complements the all-equatorial β-pyranoside (glucose) substrate. The receptor’s affinity for glucose, at Ka ~ 18,000 M–1, compares well with natural receptor systems. Selectivities also reach biological levels.[i]

Find out more

Biology

Top five subtopics in biology

12.1%
Bioelectronics

8.7%
Biophysics

11.4%
Biochemistry

7.4%
Zoology

10.7%
Others

Biological structures are amazingly robust and resilient, despite the great restrictions in materials and design. How do biological structures respond to the environment, and why? How do the structural functions influence the construction and evolution of biological architecture?

Dr Naomi Nagayama

CASE STUDY — CLICK HERE TO READ

Close

Phycosera

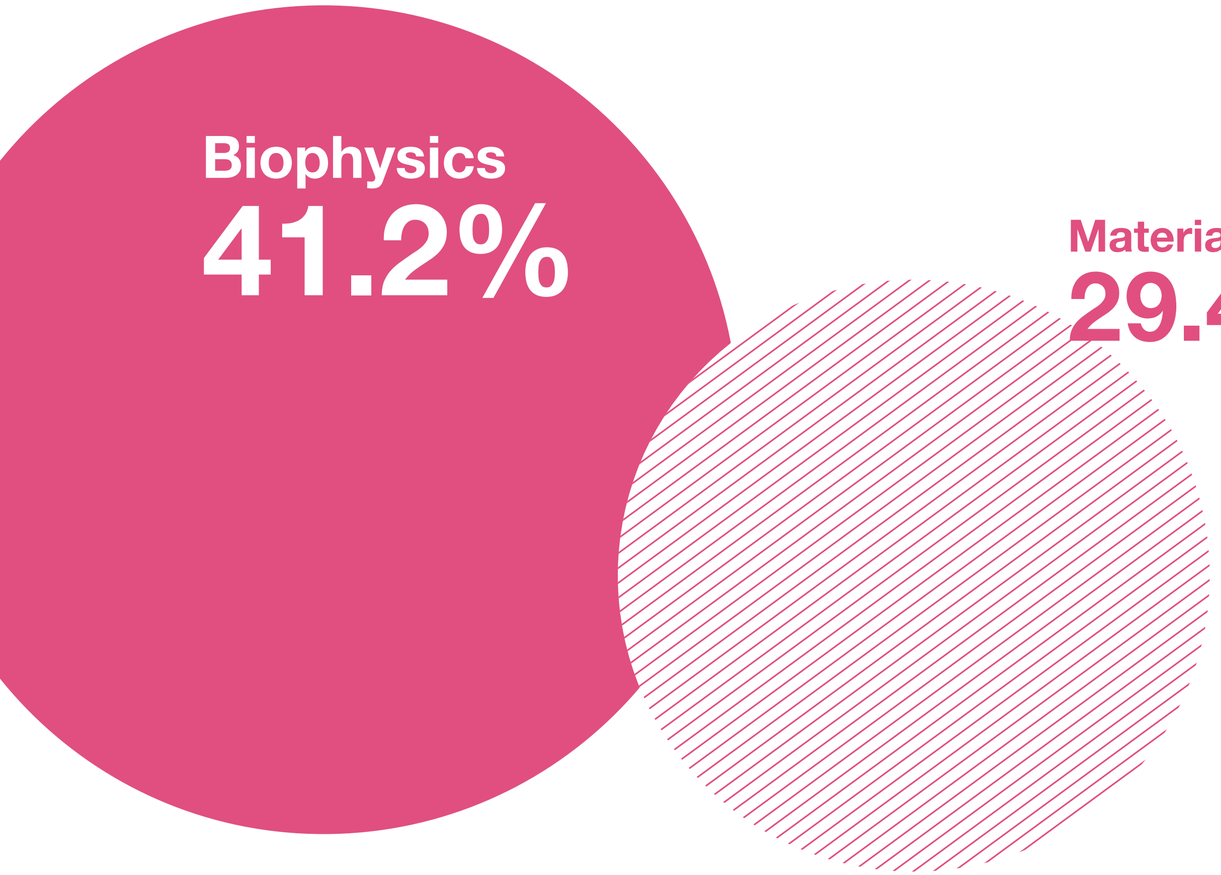
Amount of fundraised: N/A
Nature Inspired Strategies:
To harness the value of microalgae, Phycosera is innovating technologies to serve the emerging pharmaceutical/ biotech sector. The great potential values of microalgae come from its robustness under various environmental conditions, extremely fast growth rate and accumulation of biomass, as well as its immense diversity in metabolic properties.

From a practical angle, they can be applied into generating biomass and biofuel, nutraceutical farming such as Spirulina and Chlorella, additives in cosmetics with potential regenerative and anti aging effects, or agents for bioremediation and biomining.

Working with academics and other industry partners, Physosera has been applying synthetic biology to develop a green production platform powered with transgenic eukaryotic microalgae to produce high value compounds. Considering economic and biosafety factors, the systems are designed to be fully enclosed for fermentation as well as inducible under economically viable conditions. These essential features enable the production of recombinant protein in a biosafe environment.

Find out more

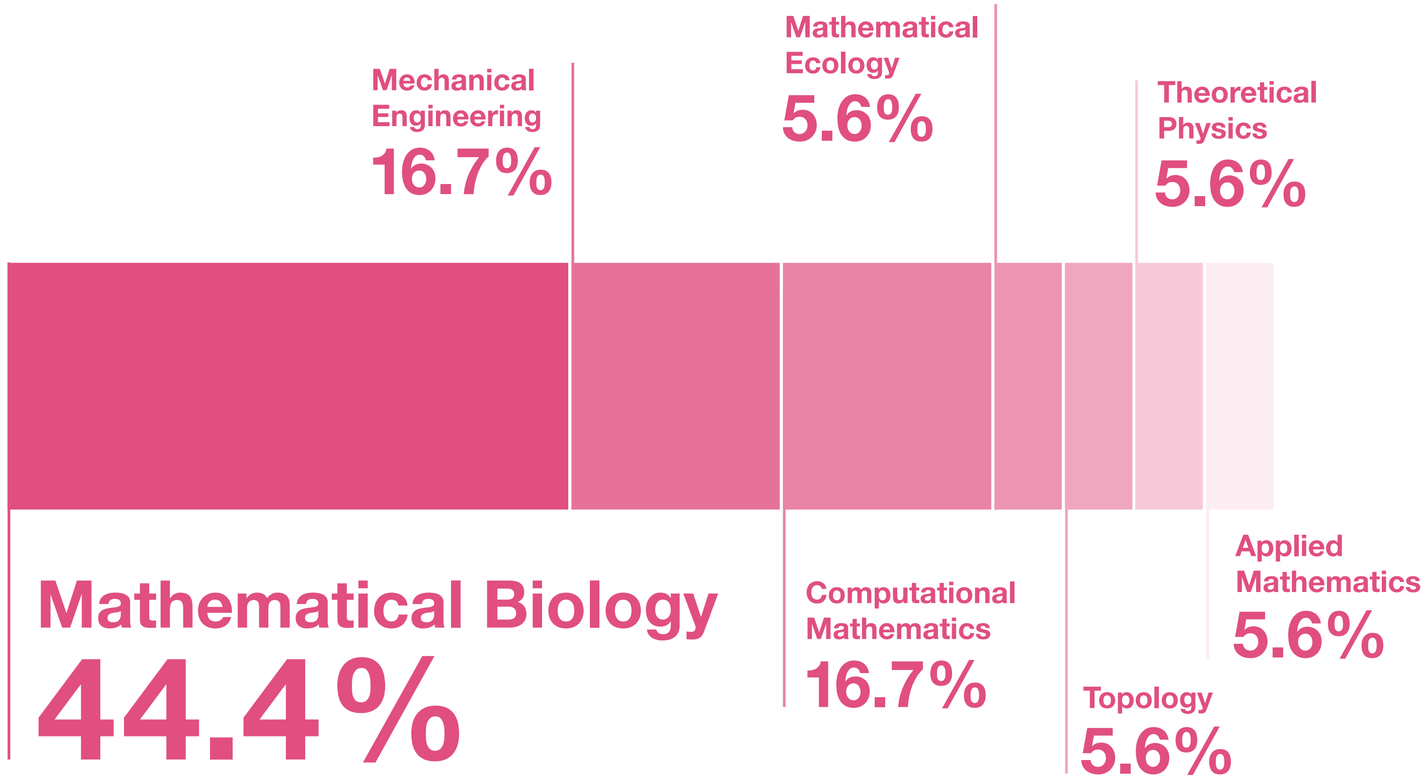
Physics



Nature is an excellent source of inspiration when it comes to colours. Different organisms developed elegant nanostructures capable of the most variegate optical appearances, from iridescent metallic colours to matt ones, without the use of any pigments. Inspired by such natural architectures we use cellulose to produce more sustainable pigments with the same variegate optical response.

Professor Sivia Vignoli

Mathematics



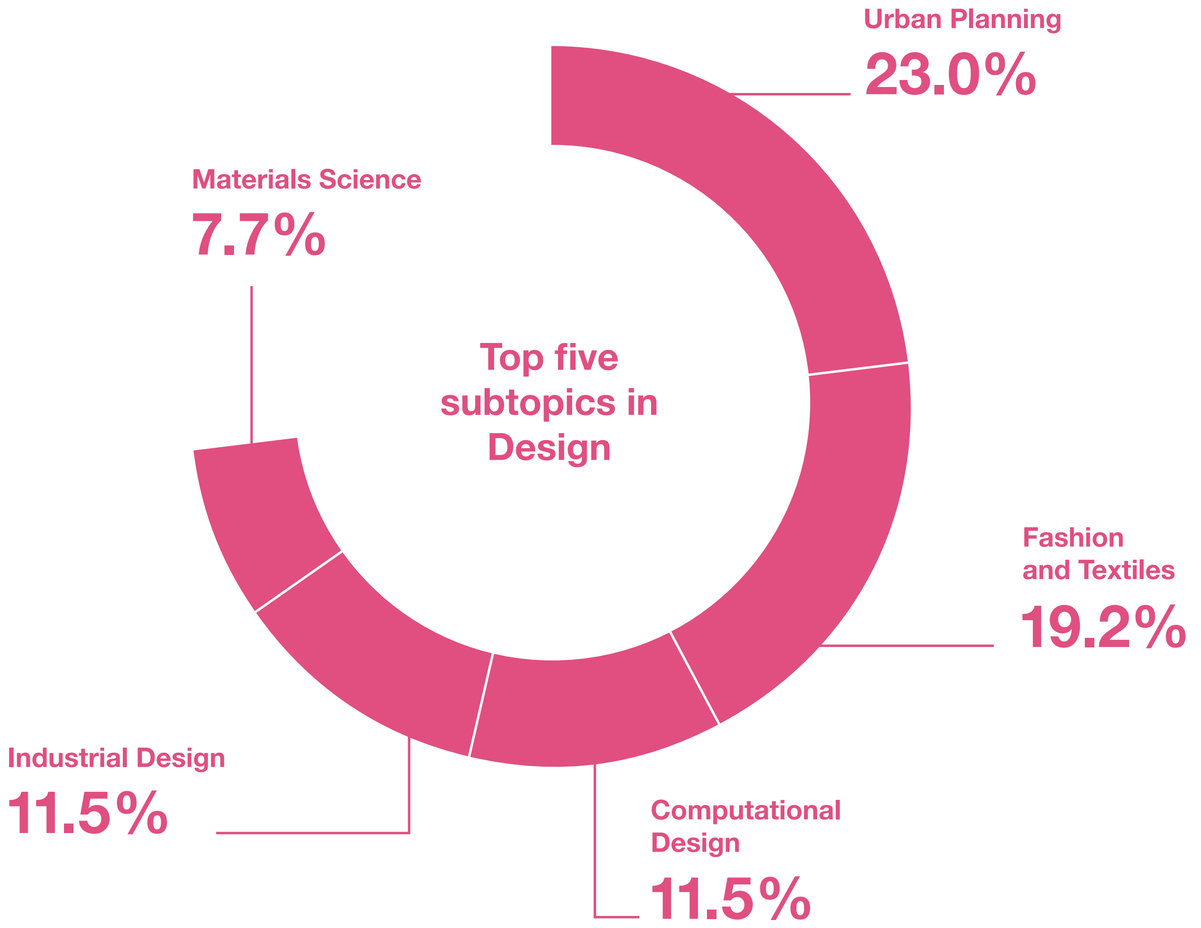
A detailed look at the biological world generates endless new problems in fluid mechanics - new in the sense that they occur in a basic setup or regime very different from problems in the physical world.

Professor Eric Lauga

Design

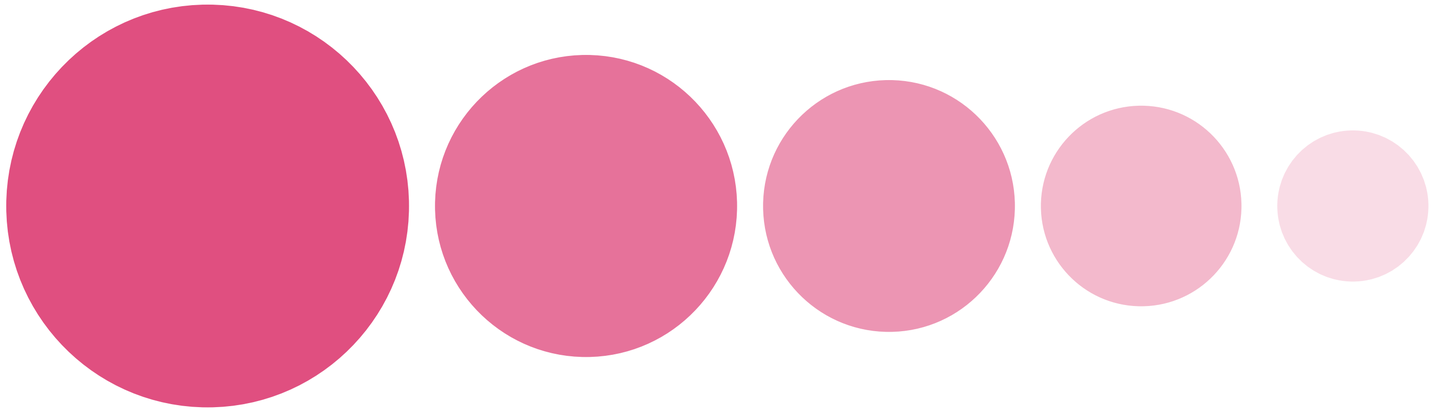
Recent interest in biomimicry has been expedited by the enormity of existing knowledge in the biosciences and the apparent possibilities to be creatively inspired by nature. Biomimetics necessitates knowledge across the diverse sub-disciplines of Life Sciences and Design in order to seek bio-inspired solutions and epitomises the interdisciplinary challenges that face the modern design practitioner. For Designers to engage with biomimetics, collaboration with biologists and scientist across multiple disciplines is currently viewed as crucial.

Dr John McCardle



Architecture

Download figures and diagrams from the report tool kit here



Sustainable Architecture 25.0%

Materials Science 18.8%

Biomimetic Architecture 15.6%

Energy Systems 12.5%

Smart Cities 9.4%

> **The similarities between the structures built by social insects and by humans have led to a convergence of interests between biologists and architects. This new, de facto interdisciplinary community of scholars needs a common terminology and theoretical framework in which to ground its work.**
>
> Dr Tim Ireland

Environment

Top five subtopics in Environment research

14.3%
Ecology

11.4%
Energy Systems

11.4%
Other

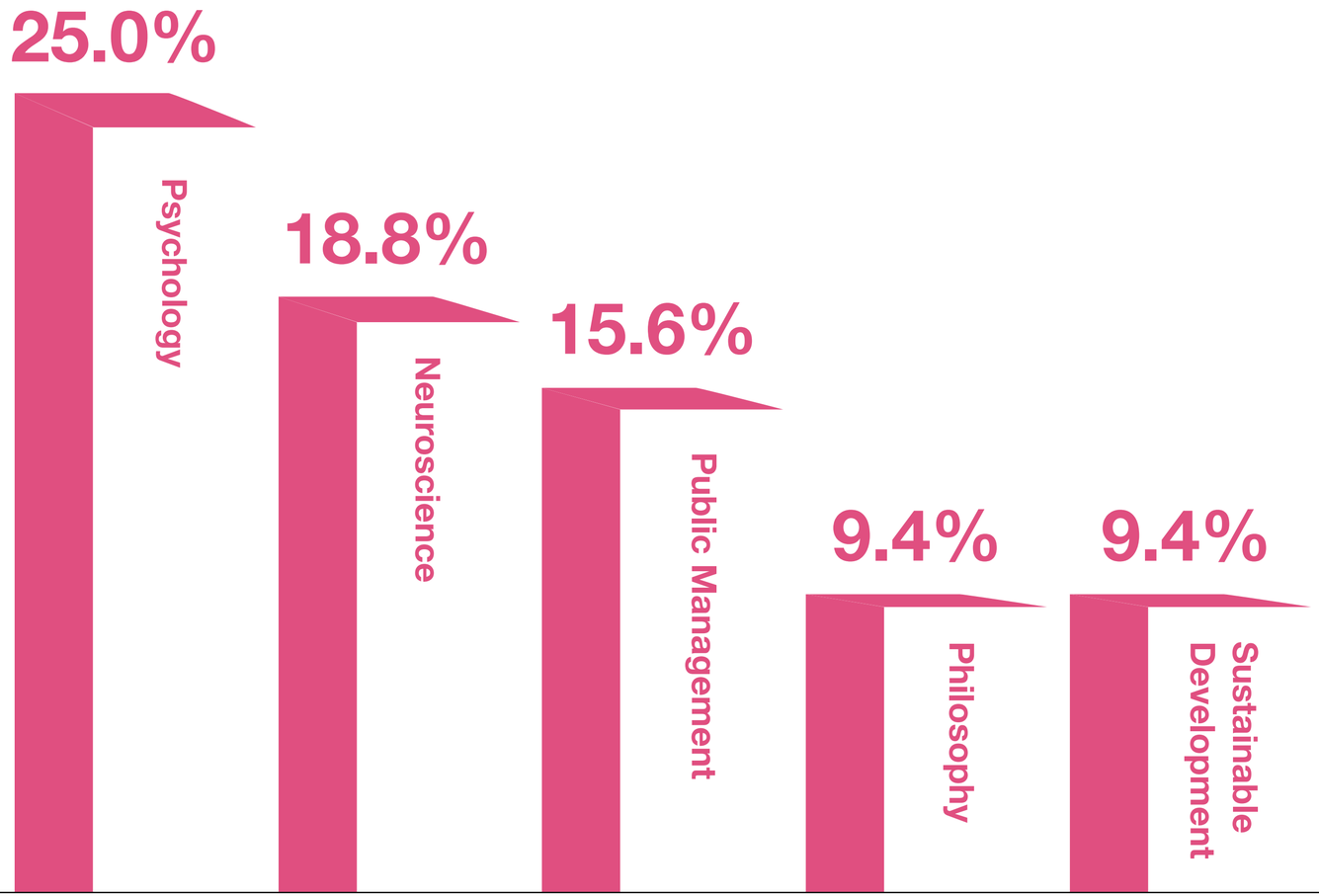
11.4%
Environmental Management

8.6%
Sustainable Development

Understanding the computational basis of spatial cognition requires observations of natural behaviour and the underlying neural circuits, which are difficult to do simultaneously: however, recent studies show how we might achieve this, combining rich virtual reality set-ups and the use of optogenetics in freely moving animals.

Professor Paul Graham

Social Science



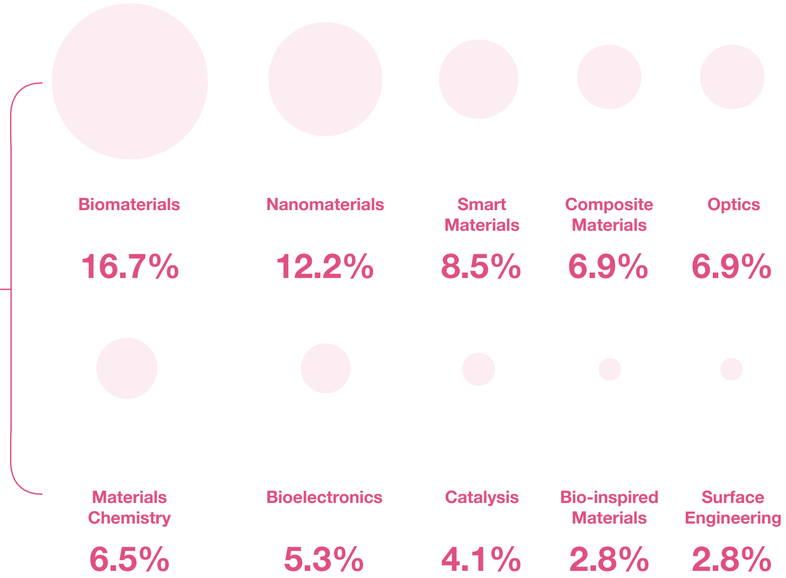
Investigations into different biological systems have offered the physical sciences community a plethora of new ideas in the pursuit of more mechanical and energy efficient architectures to develop the ‘products of the future’. Beyond correctly characterizing the biological system (material, composition, architecture and functional role), the key challenge is the extrapolation of this new insight to engineering length scales, using current tools and existing manufacturing schemes f or the targeted application in physical products for human endeavour.

Professor Katharine Robson-Brown

Materials science

The top ten subtopics of Materials Science made up

65.8%



I'm a firm believer that nature has evolved materials over the years to optimise function for the application. So we're trying to understand how nature makes materials auxetic, why it's done that, and where we can then apply that in new materials and potential applications.

Professor Andrew Alderson

CASE STUDY — CLICK HERE TO READ

Close

Materials science

Zentraxa

At the core of our platform is scalability, ensuring the ingredients we create are commercially viable and can easily be integrated with existing systems. Zentide is particularly effective at producing difficult-to-make materials which can be the key performance-enhancing ingredients in everyday products. Combined with our extensive technical know-how, Zentide allows us to push boundaries to develop sustainable products with improved performance. Nature has found solutions to some of the most difficult problems. With Zentide, we can circumvent the limits of conventional biopolymer synthesis to access the full diversity within natural systems.

Find out more

Challenges

Researchers within the nature-inspired innovation space face several challenges in scaling up their research and potentially creating commercially viable products and services despite being a vibrant research area.

Investment opportunities

The majority of respondents have been approached by potential investors or business partners at relatively early stages, from TRL 3 (23%), 4 (27%) to 5 (15%). Yet despite opportunities with investors, many actors in the space are unable to transition from validated technology to system completion.

Barriers to commercialisation

All interviewees admit that this is a relatively challenging and complex undertaking. As a result, researchers lack the skills and experience to commercialise and scale their work successfully. Moreover, the complexity of the process, high administration cost and the equity stakes negotiation with the university create much friction in creating spinouts.

Funding, both government and private, is another big challenge faced by the ecosystem

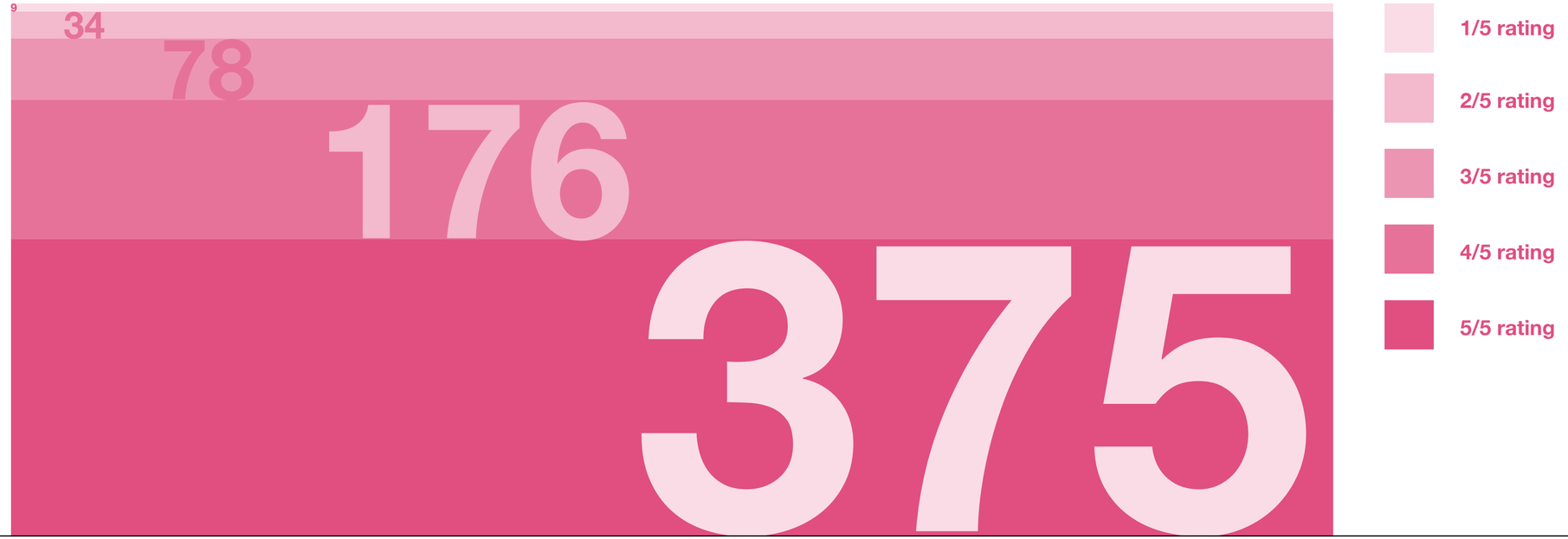
- Funding bodies tend to be risk averse, especially in the earlier stages of TRL
- Government and university funding is limited and generally short-term; most of the time they are unable to sustain a complete TRL cycle
- University spin-outs often are not eligible for startup / UKRI grants.

70%

of survey participants expressed a strong desire to commercialise their research. About half of them have been approached by potential investors for commercialisation.

Desire for commercialisation

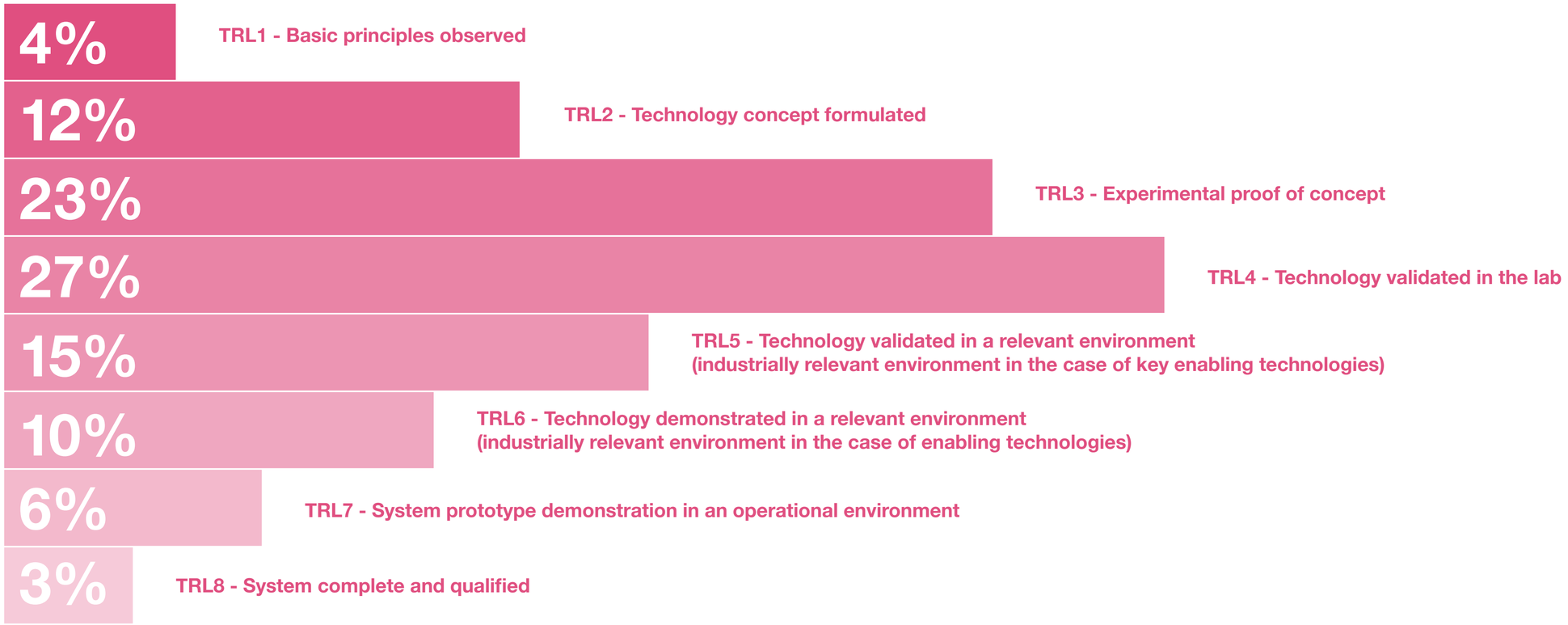
On a scale of 1 to 45, how would you rank your desire to commercialise your research (or innovation)?



Technology readiness

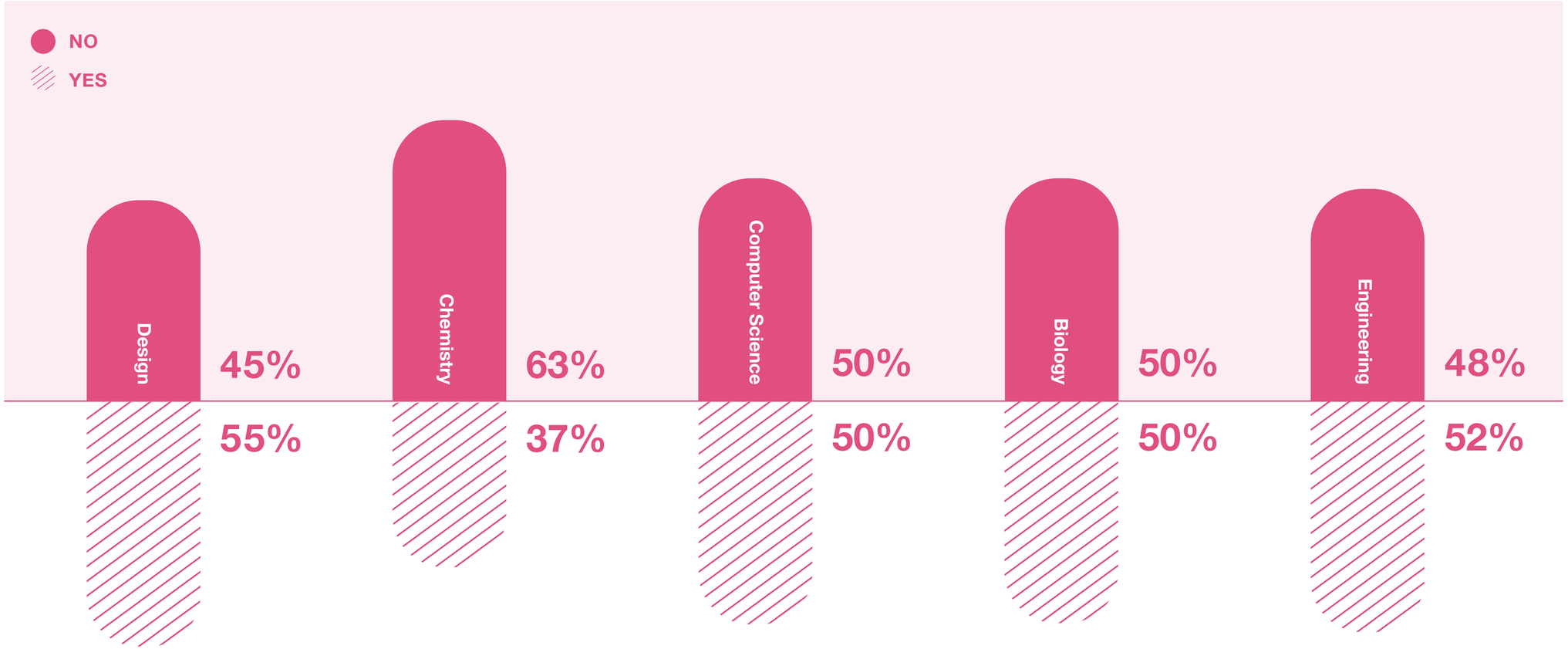
Download figures and diagrams from the report tool kit here

What was your technology readiness level when approached by investors?



Desire by subject

Download figures and diagrams from the report tool kit here



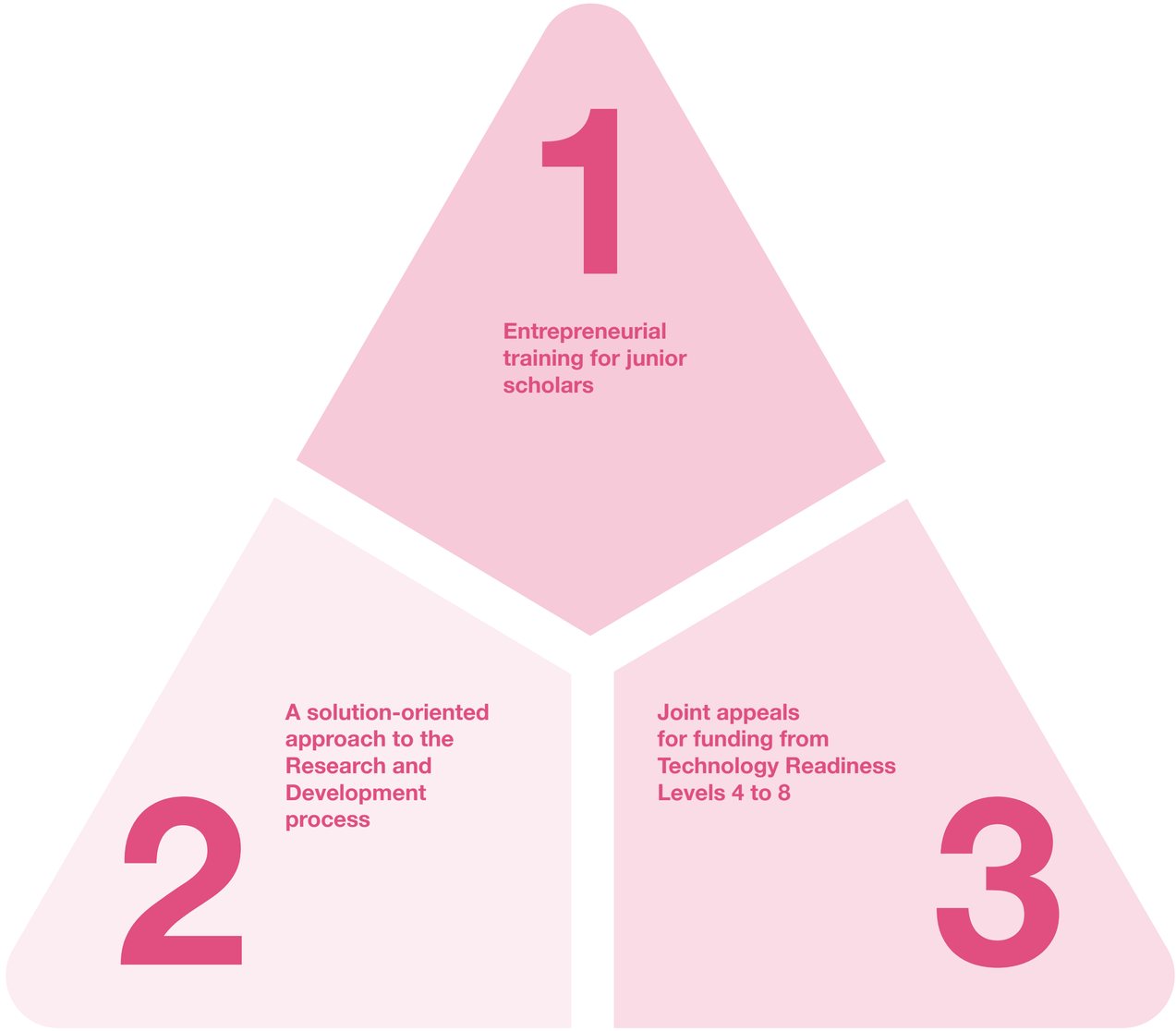
Moving forwards

The main challenges and opportunities lie in creating effective connections between fundamental research and applied science for industrial applications.

It is critical to mentor the next generation of researchers by training them to understand a business mindset for better collaboration with industry partners and adopting a solution-oriented approach in the research development process.

Based on our survey results, doctoral researchers with 12-18 months remaining are the ideal group for entrepreneurial support, as they are often in the process of deciding on their careers between academia and industry. Either route requires consistent support and mentorship to advance the biomimetic practice.

Finally, we better propose a more substantial alignment between research and UK national innovation strategies on a systems level. For example, a more interdisciplinary connected network and holistic funding schemes recognising the characteristics of a nature-inspired development cycle would enable a more effective knowledge-transfer process.


1
Entrepreneurial training for junior scholars
2
A solution-oriented approach to the Research and Development process
3
Joint appeals for funding from Technology Readiness Levels 4 to 8

Industry

The UK Government has laid its plans in the 2021 policy paper, 'UK Innovation Strategy' to develop "private sector innovation by making the most of the UK's research, development and innovation system".

Download figures and diagrams from the report tool kit here

The UK Prime Minister's agenda is placing science, innovation, and technology at the heart of his vision for the UK to be a 'science superpower' by 2030. The UK Innovation Strategy will be achieved via four pillars:

Biomimicry Innovation Lab, via our membership of the Bessemer Society, were one of the many stakeholders who contributed to this strategy.

So how does nature-inspired innovation align with these objectives?

By exploring the seven technology families identified in the report: Advanced Materials and Manufacturing; AI, Digital and Advanced Computing; Bioinformatics and Genomics; Engineering Biology; Electronics, Photonics and Quantum; Energy and Environment and Technologies; Robotics and Smart Machines, we carried out a keyword search of related terms to identify trends in academia.

1

Unleashing Business – We will fuel businesses who want to innovate.

2

People – We will make the UK the most exciting place for innovation talent.

3

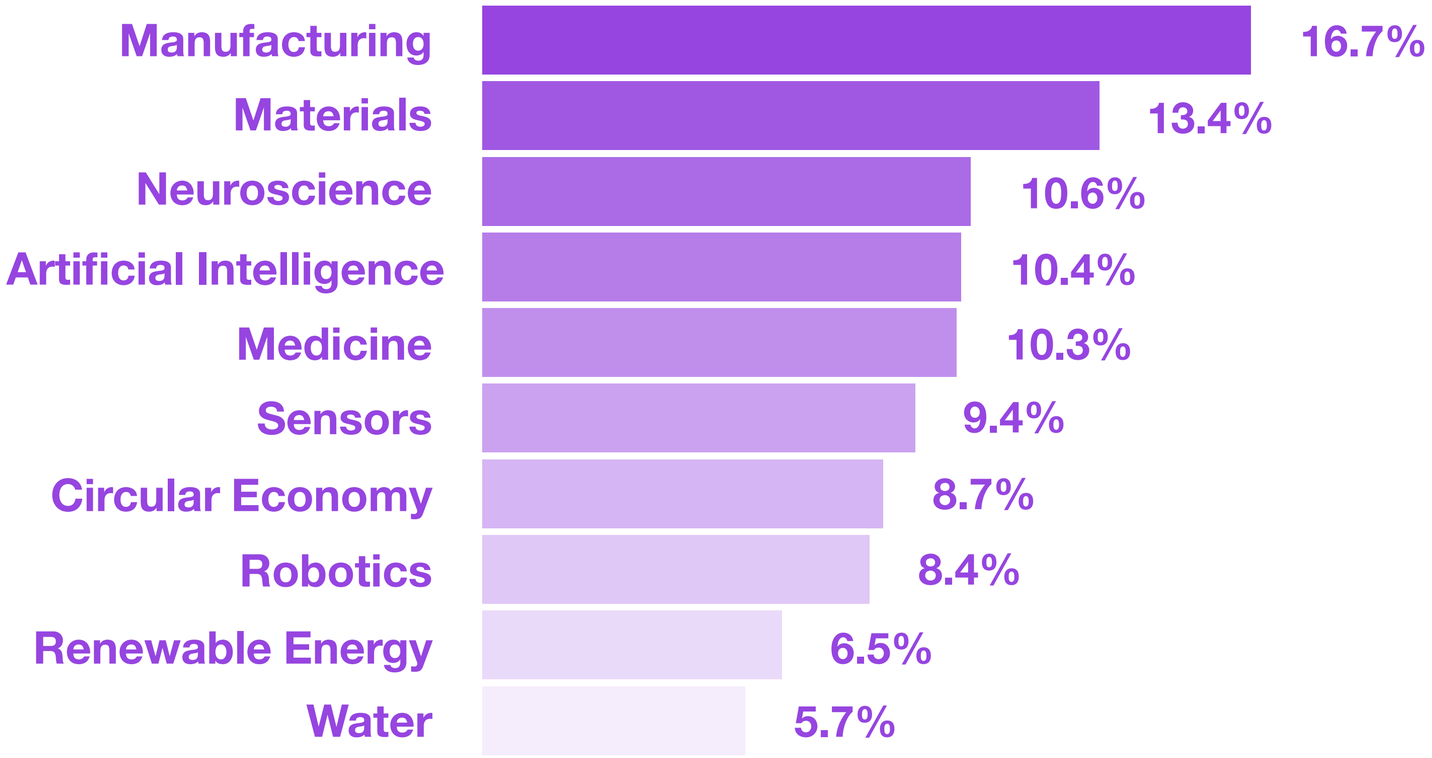
Institutions & Places – We will ensure our research, development & innovation institutions serve the needs of businesses and places across the UK.

4

Missions & Technologies – We will stimulate innovation to tackle major challenges faced by the UK and the world and drive capability in key technologies.

Keyword trend

Download figures and diagrams from the report tool kit here



Although this search was not exhaustive, it is clear the UK has solid academic research into nature-inspired manufacturing, materials, and AI+machine learning. In addition, there are strong links to each of the four pillars that align with the Joint Action Plan on Standards for the Fourth Industrial Revolution. We will be exploring this in further detail in the next stage of this project.

How does nature-inspired innovation align with UK Government Net-Zero targets?

The UK's new target that passed into law in 2019 is to slash emissions by 78% by 2035, as detailed in the Net Zero Strategy. The Net Zero Strategy aligns with the Industrial Decarbonisation Strategy launched in 2021. These link up with the ten focus area of Net Zero Innovation Portfolio, ranging from future offshore wind through to industrial energy efficiency.

How does nature-inspired innovation align with the UK’s net zero targets?

Materials[715], Medicine[329], Robotics[230], Neuroscience[127], Manufacturing[81], Sensors[78], Modelling & Simulation[68], Machine Learning[65], Water[54], Artificial Intelligence[51], IoT[50], Optimisation[42], Composite Materials[32], Building[30], Bioinformtics[29], Healthcare[28], Data Science[27], Renewable[25], Fuel[25], Plastic[24], Intelligence[24], Form/structure Innovation[24], Wave[23], Infrastructure[20], Wind[20], Construction[19], Cardiovascular[19], Fluid Dynamics[19], Mining[18], Renewable Energy[17], Genetics[17], Additive Manufacturing[16], Biotech[15], Semiconductor[14], Turbine Development[12], Biopharmaceuticals[11], Fuel Cell[10], Conservation[10], Reinforcement Leaning[10], Circular Economy[7], Energy Storage[7], Gut Health[7], Future Mobility[7], Hydrogen[6], Energy Conversion[6], Automation[6], Carbon Capture[6], Image Analysis[6], Natural Materials[6], Translational Research[6], Data Analysis[5], Minerals[5], Autoimmune[5], Bioscience[5], Immune Systems[5], Nutrition[5], Respiratory[5], Supply Chain[4], Oil and Gas[4], Packaging[4], EEG[4], Waste Management[3], Investment[3], VR[3], Structural Engineering[3], System Engineering[3], Agent-based Modelling[3], Cyber Security[3], Decarbonisation[3], Inflammatory[3], Vaccines[3], Green Operation[2], Biofuel[2], Energy Efficency[2], Natural Language Processing[2], XR[2], Digital Twin[2], Geoscience[2], Reduce, Reuse, Recycle[2], User Experience[2], Industry 4.0[1], Greenhouse Gas[1], Impact Assessment[1], Caron Footprint[1], LCA[1], Clinical Research[1], Pharmaceuticals[1], Borates[1], Coal-fired Power[1], Computational Material Science[1], Copper[1], Digital Healthcare[1], Energy Management[1], Environmental Footprint[1], Oxidant[1], Smart Systems[1], Net Zero[1], Salt[1]

Here we highlight the range of keywords and phrases in nature-inspired research fields and topics that align with various environmental targets proposed by the UK government, the top 10 companies on the FTSE100, and environmental and sustainability targets by various leading NGOs.

Creating connections

One cannot draw a direct correlation between nature-inspired solutions and sustainability. However, we can harness their great potential in generating positive-sum solutions between humanity and nature with a rigorous and critical perspective.

Successful nature-inspired innovations always tend to align commercial, environmental and social interests in a variety of ways. During our research, we identified significant connections between the UN Sustainable Development Goals and some promising nature-inspired research in different fields such as energy, carbon and materials, painting us an emerging picture of next-generation climate-positive innovations.

We curated a series of UK focused nature-inspired innovation case studies based on an environmental-focused taxonomy developed by Terrapin Bright Green's report, Tapping into Nature.

Read the Terrapin Bright Green report here

Sustainable development goals

View the Sustainable Development goals here

Nature-inspired innovations align with a number of the Sustainable Development Goals, directly and indirectly via a systems-led approach.

Sustainable development, as coined in Our Common Future (1987) report, “is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains two key concepts:

The concept of ‘needs’, in particular, the essential needs of the world’s poor, to which overriding priority should be given;

The idea of limitations imposed by the state of technology and social organization on the environment’s ability to meet present and future needs.”

The pyramid model or ‘wedding cake’ created by the Stockholm Resilience Center crucially highlights how we should consider the SDG’s in a system by aligning the biosphere, social and economic pillars that Brundtland laid out in Our Common Future. Nature-inspired innovation needs to ensure that it works towards these targets directly or indirectly if it wishes to be sustainable or contribute to a regenerative future.

We are building up the case studies linking nature-inspired innovation to Sustainable Development Goals. Please feel free to add to this list your projects. You can access the list here.

Close

Sustainable development goals

Carbon

How might we harness carbon as an abundant resource? How might we apply nature-inspired technologies to leverage the circularity of carbon flows within the natural systems?

As the fourth most abundant element in mass in our universe, carbon has always been in a complex relationship with human societies. While it is the most fundamental element of living organisms, it is also a great contributor to climate change in greenhouse gases. How might we harness carbon as an abundant resource? How might we apply nature-inspired technologies to leverage the circularity of carbon flows in the natural systems?

Sustainable Development Goals

CASE STUDY — CLICK HERE TO READ

Close

Biohm

Amount of fundraised:
£1.25m funding drive

Nature Inspired Strategies:
Drawing inspiration from natural materiality, Biohm creates regenerative biomaterials such as Organic Refuse Bio-compound and Mycelium Insulation tiles which can be widely applied in building and construction industries.

Regenerative Biomanufacturing
Our approach to manufacturing is regenerative. Our community led facilities re-use waste, growing responsible, healthy construction materials.

We convert one of the world's fastest growing waste streams - food waste - into valuable and functional materials that are formed into sheets or moulded to create intricate three dimensional products.

Our newest biomanufacturing facility is scheduled for completion at the end of this year. We will be servicing mycelium insulation from this facility in the new year.

As a biomanufacturer, Biohm works with natural materials to grow our insulation. By generating local partnerships, we utilise waste products to manufacture our materials.

Our community led, biomanufacturing facilities are regenerative, transforming waste and industrial by-products. We are also beginning to take on waste management partnerships with industrial partners to transform waste into new materials, such as Orb.

Orb is 100% biodegradable, vegan, sustainable and renewable. We achieve this by sourcing waste by-products from the food production or agricultural sectors and processing it into a homogenous filler which is bound together with our unique and completely organic binder to form an affordable and sustainable replacement for wood-based sheet materials.

Find out more

Water

How might we learn from the ways nature harnesses water as an essential resource for the living processes?

According to the UN Water Report 2021, water use has been growing more than twice the population growth rate in the last century. At the same time, water scarcity has affected every continent.

Our agriculture, industrial processes and daily life are deeply dependent on it. How might we learn from how nature harnesses water as an essential resource for living and thriving out of scarcity?

Sustainable Development Goals

CASE STUDY — CLICK HERE TO READ

INDUSTRY

Close

The Sahara Forest Project

Amount of fundraised: N/A

Nature Inspired Strategies: Deforestation, deseration, losing vegetation and habitat
Learning from the organism that have evolved to live in deserts, adaptations to water scarcity.

This is the Namibian fog-basking beetle, and it's evolved a way of harvesting its own fresh water in a desert. The way it does this is it comes out at night, crawls to the top of a sand dune, and because it's got a matte black shell, is able to radiate heat out to the night sky and become slightly cooler than its surroundings. So when the moist breeze blows in off the sea, you get these droplets of water forming on the beetle's shell. Just before sunrise, he tips his shell up, the water runs down into his mouth, has a good drink, goes off and hides for the rest of the day. And the ingenuity, if you could call it that, goes even further.

Because if you look closely at the beetle's shell, there are lots of little bumps on that shell. And those bumps are hydrophilic; they attract water. Between them there's a waxy finish which repels water. And the effect of this is that as the droplets start to form on the bumps, they stay in tight, spherical beads, which means they're much more mobile than they would be if it was just a film of water over the whole beetle's shell. So even when there's only a small amount of moisture in the air, it's able to harvest that very effectively and channel it down to its mouth. So amazing example of an adaptation to a very resource-constrained environment -- and in that sense, very relevant to the kind of challenges we're going to be facing over the next few years, next few decades.

Find out more

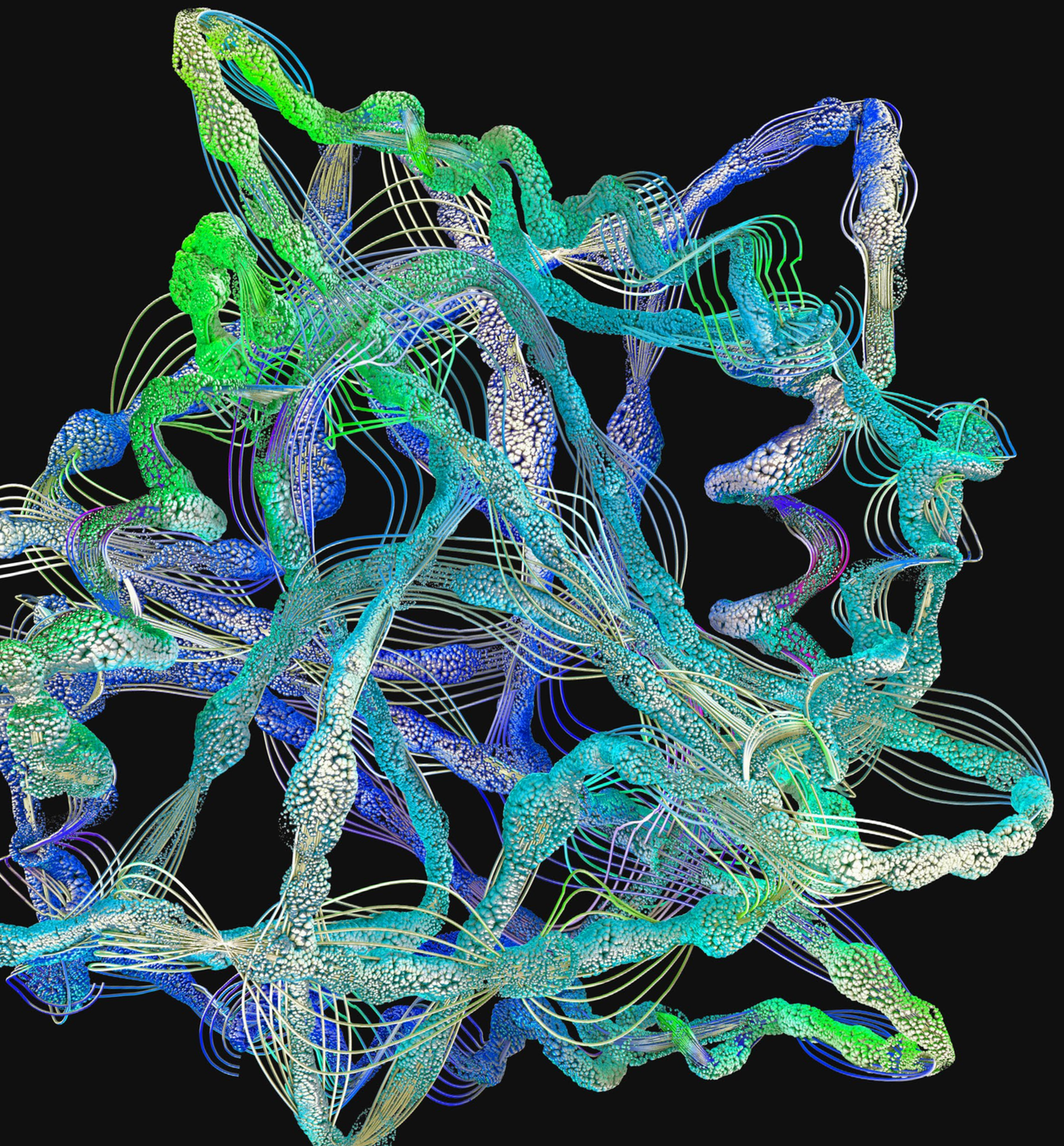
Materials

How might we transition our inefficient and wasteful material flows to cyclic ones by learning from biological systems?

Materials are the fundamental medium of human utility. It is also the most direct way we consume natural resources. The various properties of materials such as structures, sources, and processing influence its functions and have tremendous environmental implications. Over the past centuries, we've been extracting materials from nature and generating waste on an enormous scale. How might we transition our inefficient and wasteful material flows to cyclic ones by learning from biological systems?

Sustainable Development Goals

CASE STUDY — CLICK HERE TO READ



Zentraxa

Amount of fundraised: N/A
Nature Inspired Strategies: Through millions of years of evolution, nature has found solutions to the most difficult problems. Inspired by the diversity of nature, we precision engineer bespoke biomaterials to meet the toughest challenges across a range of industries. Our process is scalable & sustainable by design, and our tailor-made solutions offer performance & stability without sacrifice.

At the core of our platform is scalability, ensuring the ingredients we create are commercially viable and can easily be integrated with existing systems. Zentide is particularly effective at producing difficult-to-make materials which can be the key performance-enhancing ingredients in everyday products. Combined with our extensive technical know-how, Zentide allows us to push boundaries to develop sustainable products with improved performance. Nature has found solutions to some of the most difficult problems. With Zentide, we can circumvent the limits of conventional biopolymer synthesis to access the full diversity within natural systems.

Find out more

Close

Energy

CASE STUDY — CLICK HERE TO READ

How might we learn from nature to create a more efficient and low-carbon energy system?

Energy is the currency of human social functioning. It powers everything from our metabolism to electricity, from transport to manufacturing. As our population and people's living standard continue to grow at accelerating rates, it is vital to develop a more efficient energy system to balance our rising energy consumption within our planet's capacity. In nature, evolution has developed optimised energy storage and transition systems functioning well under uncertainty and limitations. So how might we learn from nature to create a more efficient and low-carbon energy system?

Sustainable Development Goals

Close

Arborea

Amount of fundraised: $6.1m
Nature Inspired Strategies:
Arborea's breakthrough cultivation technology mimics the functioning mechanisms of a real leaf to self-maintain the ideal growth conditions homogeneously at different scales and with the smallest energy inputs. Furthermore, it uniquely sequesters CO2 from most exhaust gasses, even with very low CO2 concentration and at atmospheric pressure.

Our food ingredients and proteins are wholly vegan, NO-GMO, hormone-free and mostly carbon neutral. The unique functioning mechanisms of the BioSolar Leaf impedes contamination to produce the safest and purest ingredients.

Find out more

Optics & Photonics

How might we learn from nature to harness light in a better way that improves our manufacturing process, energy generation and operation efficiency?

Optics and photonics concern the physical properties of light and the generation, detection and manipulation of light. They are closely related to our life; in terms of lighting, optical data transmission, electronics, energy and pigmentation. While sunlight is also essential to biological processes, there is a portfolio of photonic strategies such as light absorption, reflection and guiding in nature for inspiration. How might we learn from nature to harness light in a better way that improves our manufacturing process, energy generation and operation efficiency?

Sustainable Development Goals

CASE STUDY — CLICK HERE TO READ

Close

Impossible Materials

Amount of fundraised: N/A
Nature Inspired Strategies:
Everyone is familiar with the colour white, the most widely used artificial colour. White pigments can be found in numerous products such as toothpaste, wall paint, printing inks, car coatings and even food. However, to create the light scattering properties that enable a white colour, highly refractive particles are needed (usually titanium dioxide or zinc oxide), which have recent studies suggesting potential harmful effects to human health and safety in the form of nanomaterials.

The Bio-inspired Photonics group from University of Cambridge has developed a cellulose-based white pigment, taking the inspiration from the structure of the white Cyphochilus beetle scales. Here, a coating and a slurry made from this renewable and biocompatible material source are shown. These cellulose white pigments are currently scaled and commercialized as a sustainable alternative for titanium dioxide(TiO2). This research output has evolved into a biotech startup called Impossible Material, a Cambridge University spinout company enabling cellulose-based pigment solutions.

Find out more

Thermoregulation

How might we learn from nature to create low-carbon innovations for thermal control processes from anatomical, physiological, to behavioural bio-mechanisms?

Thermoregulation is the ability of organisms to keep temperature homeostasis within their body. The diversity of natural habitats have shaped many efficient strategies in different species to cope with the fluctuations and extremities in environmental temperatures. How might we learn from nature to create low-carbon innovations for thermal control processes from anatomical, physiological, to behavioural bio-mechanisms?

Sustainable Development Goals

Close

Inotektextile

Amount of fundraised: N/A
Nature Inspired Strategies: The study of moisture induced shape change in botanical structures such as the pine cone inspired the design of INOTEK™ textiles so that their air permeability adapts in response to humidity changes in the micro-climate of the clothing system. Conventional fibres swell as they absorb moisture. This causes the yarn to swell which in turn reduces the air permeability of the textile structure. INOTEK™ textiles function in the opposite manner. When they absorb moisture INOTEK™ textiles become more permeable to air.

INOTEK™ fibres close causing the yarn to tighten. This creates microscopic pockets of air in the textile structure. In dry conditions INOTEK™ fibres open up like a pine cone, reducing permeability to air and increasing their insulation properties.

Smart Fabrics and Interactive Textiles (SFITs) are defined as having an in-built ability to respond to external stimuli, including electrical, mechanical, thermal, chemical or magnetic.

INOTEK™ textiles use humidity as a trigger to react to changes in the micro-climate in order to keep the wearer dryer for longer and get dry quicker.

Find out more

Fluid Dynamics

CASE STUDY — CLICK HERE TO READ

INDUSTRY

How might we learn from nature to reduce energy loss in transporting with and within fluid systems?

Fluid dynamics studies the flow of liquids and gases. It has been applied in optimising mobility by reducing energy loss, such as vehicle design, petroleum transportation and weather pattern prediction. In nature, lifeforms residing in fluid systems have evolved highly energy-efficient structures to facilitate motions, such as vortex flows and fractal structures. How might we learn from nature to reduce energy loss in transporting with and within fluid systems?

Close

Animal Dynamics

Amount of fundraised: $9.8m
Nature Inspired Strategies:
At Animal Dynamics, we deliver bio-inspired solutions that positively impact and protect both nature and humanity. What motivates us is our drive to create original and worthwhile solutions to real problems. Our mission is to bring to market innovative systems that radically improve the way cargo is delivered.

We believe that more efficient systems will disrupt existing markets in a good way, by building machines that can do more with less energy. Finding alternative sources of fuel is essential for our future; equally important are alternative systems of movement that use fuel more efficiently. Analysing natural systems brings us closer to an understanding of nature, and an appreciation of the extraordinary precision and elegance of animal movement.

A small-scale drone with flapping propulsion designed to have lower power consumption for an increased range and to tolerate wind and environmental conditions.

Find out more

Data & Computing

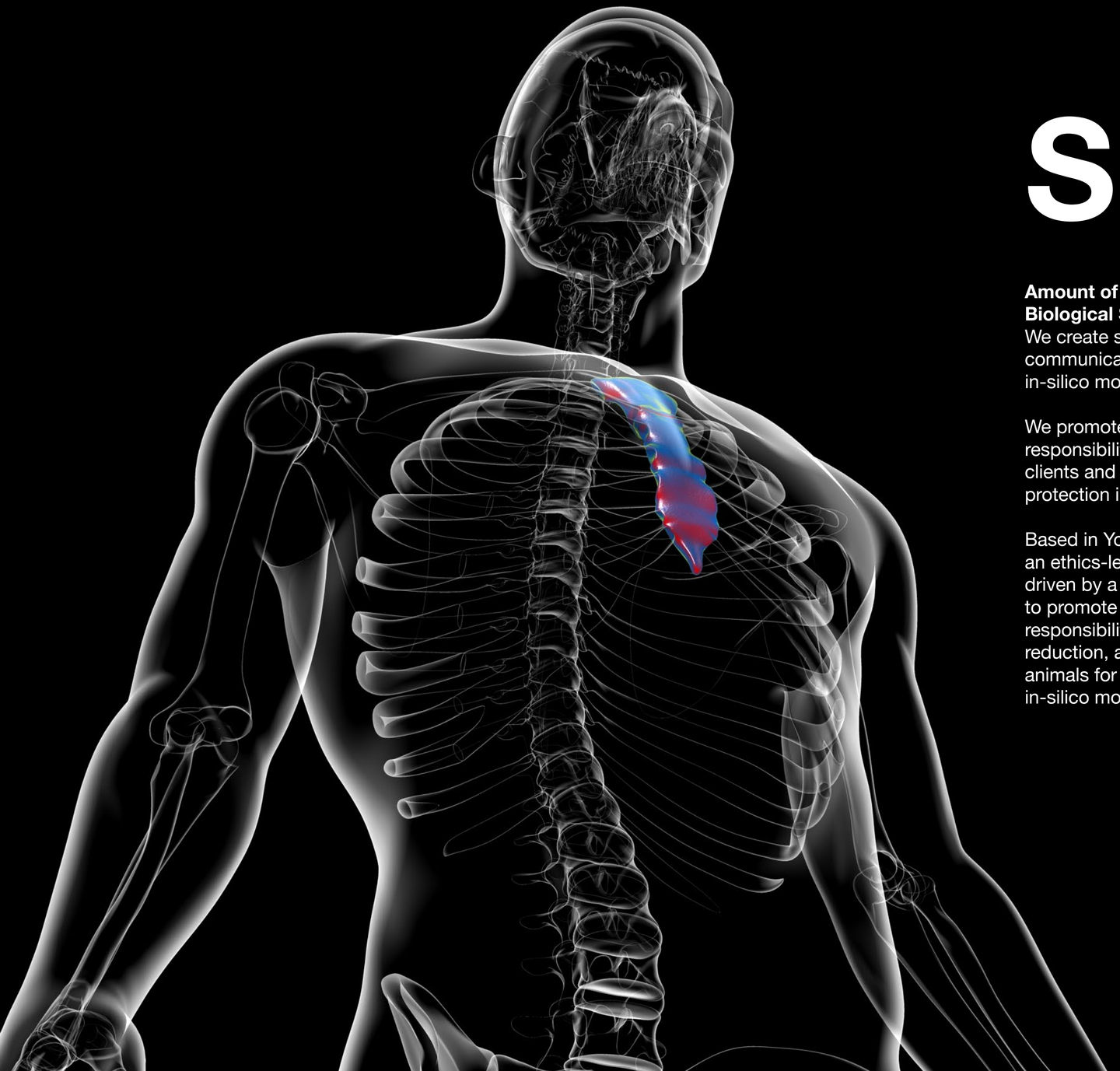
How might we harness natural intelligence by digitally replicating mechanisms and living processes in our computational world?

Through advances in computation technologies, we can emulate biological processes in digital format at a level of complexity like never before. This significantly broadened the application areas of natural mechanisms, such as using ant colony models to solve routing problems, simulating living organisms to test out new drug experiments and novel biomimetic sensors, software. So how might we harness natural intelligence by digitally replicating mechanisms and living processes in our computational world?

Sustainable Development Goals

CASE STUDY — CLICK HERE TO READ

Close



Simomics

Amount of fundraised: N/A
Biological Strategies:
We create software solutions to explore, communicate and maximise the value of in-silico models.

We promote corporate environmental responsibility and support our global clients and partners in key environmental protection initiatives.

Based in York since 2014, Simomics is an ethics-led software technology SME, driven by a strong mission and purpose to promote corporate environmental responsibility, and the replacement, reduction, and refinement of the use of animals for scientific purposes through in-silico modelling.

We develop technologies to explore, communicate and maximise the value from computer based (in-silico) models to accelerate and de-risk R&D and support key environmental protection initiatives.

Combining world leading expertise in life science, software engineering and data science, we work with global clients and partners in the pharmaceutical, agrochemical, personal care and environmental industries.

Find out more

Systems

How might we learn from systems, both biological and ecological, to create resilient, symbiotic and self-organising urban systems?

An ecosystem is a sum of all the organisms and their environment with energy, material, and mass flows that connect and circulate as a functional collective. The structures and relations enable an interdependent, cyclic and robust organisation that functions in dynamic balance despite limitations of resources and fluctuations. So how might we learn from nature to design our agriculture, industrial and urban systems as organic systems that thrive in equilibrium within the planetary boundaries?

Sustainable Development Goals

CASE STUDY — CLICK HERE TO READ

Close

Space Syntax

Amount of fundraised: N/A

Biological Strategies:
Space syntax research has led to a fundamental understanding of the relationship between spatial design and the use of space as well as longer term social outcomes.

The UCL Space Syntax Laboratory is the international centre of the theory and methodology known as ‘space syntax’. It studies the effects of spatial design on aspects of social, organisational and economic performance of buildings and urban areas.

Their main aims are to;

- develop theories and to test these by studying the effects of spatial design on aspects of social, organisational and economic performance of buildings and urban areas
- integrate computational approaches at the heart of the design process, including structural, societal and environmental analysis
- and to develop the generation of design solutions that combine machine learning, optimisation and technological innovation.

Find out more

Barriers to innovation

Innovation is defined as a new or changed entity realising or redistributing value*. Despite being an exciting journey developing a nature-inspired innovation, there are many roadblocks ahead at different stages, from ideas to reality.

> **Despite opportunities with investors, most actors in the space are unable to transition from validated technology to system completion. This is due to barriers related to funding, time and skills.**
>
> An interviewee

Innovation is difficult for any industry, with a 90% failure rate amongst startups. As a result, multinational companies would instead merge with competitors or buy smaller companies to stay ahead of the competition.

While the challenges in the development process vary in different contexts, our research has identified some commonalities during our survey with relevant industry practitioners. For example, many interviewees expressed difficulties forming good partnerships with academics and sourcing funding between TRL stages.

90%

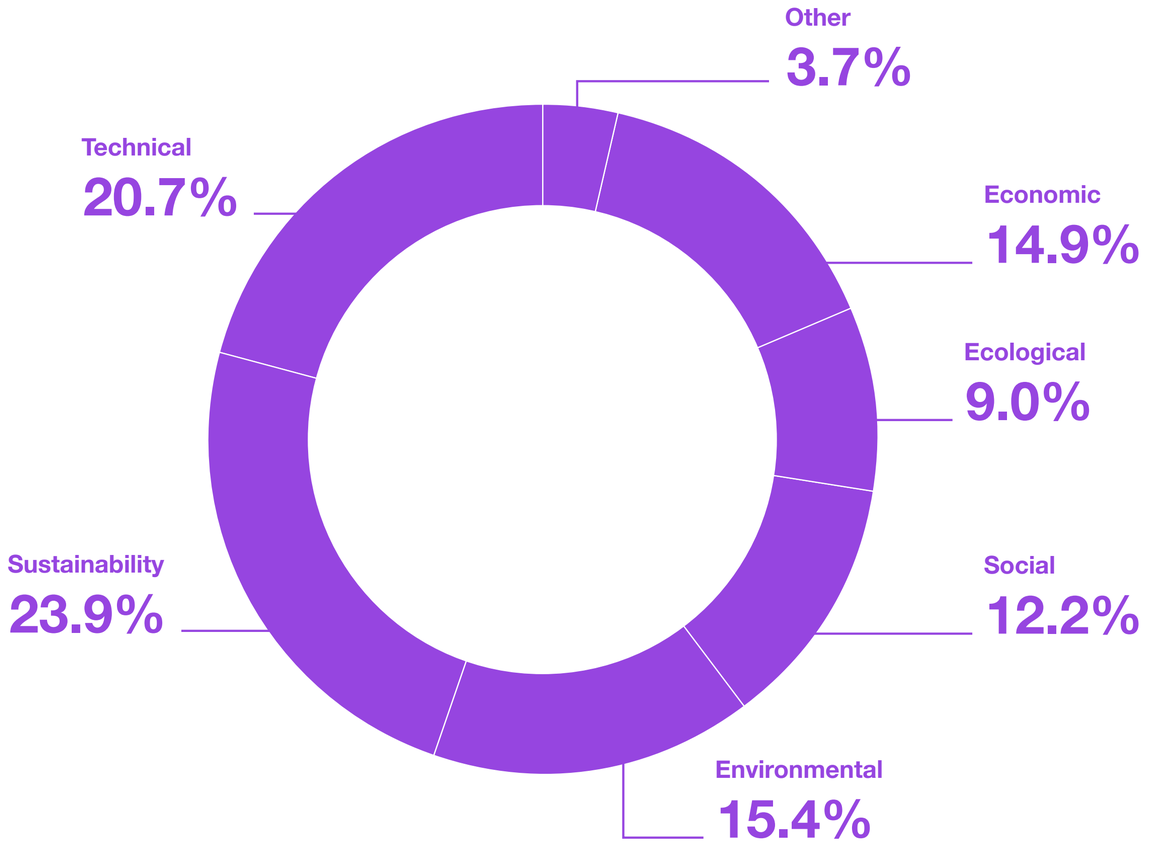
fail rate amongst startups in an industry where innovation is difficult for many.

Sources: ISO TC 279 Innovation Management.

Innovation focus

We collected data from 143 respondents from various sectors to identify common challenges and opportunities in their development process.

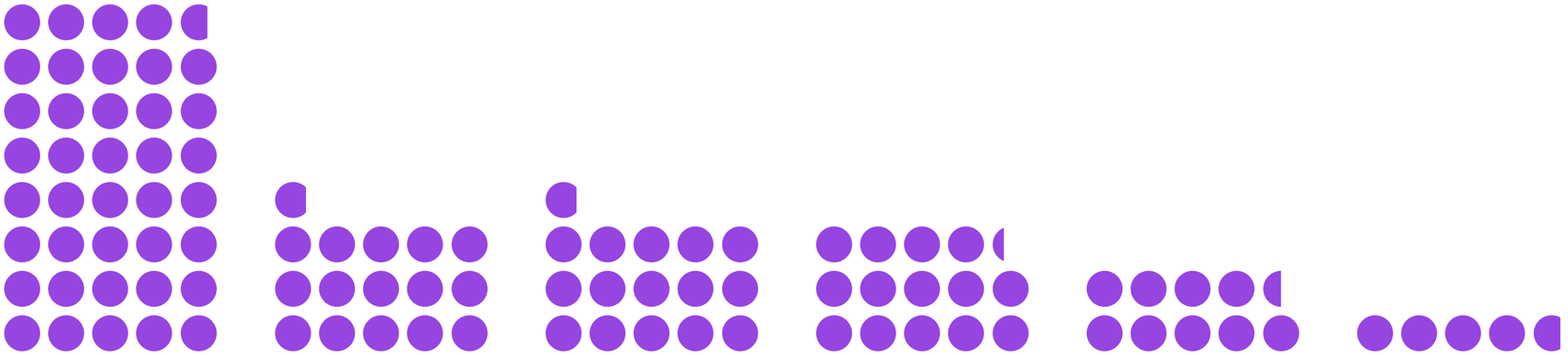
As discussed in the previous chapter, diversity in the application is the main character in nature-inspired innovation. This is also shown in the wide range of answers from the survey with a bigger group on sustainability-oriented innovation.



Barriers to innovation

Download figures and diagrams from the report tool kit here

Despite finance being the most common challenges across various industries, external market, market needs, a lack of specialised skill sets and time are also major factors that affect the development process.



Financial	External market	Skills	Time	Other	Internal risk
39.7%	15.9%	15.9%	14.3%	9.5%	4.8%

Collaboration

Differences in mindset and workflow in academia and industry are the main contributors to the collaboration challenges happening in the developmental phases.

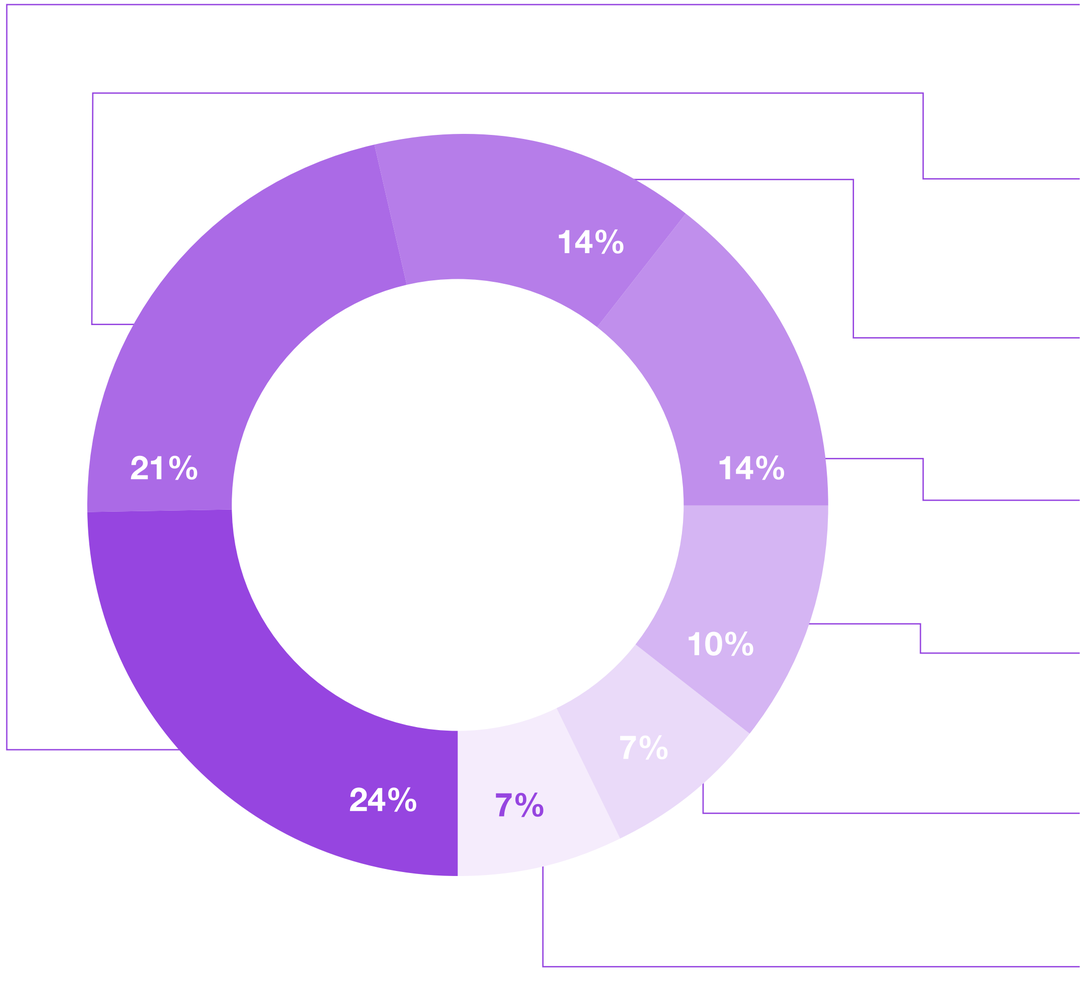
In addition, we focused on challenges faced by participants with active partnerships with academia.

Differences in mindset and workflow in academia and industry are the main contributors to the collaboration challenges in the developmental phases.

One-third of these partnerships do not lead to commercially viable solutions. The funding barrier emerges at TRL 4 when validated technology in the lab does not appeal to investors.

Academics working on nature-inspired technology feel they need more time to build on lab-validated technology. Their prototypes require additional time to be validated in relevant industry environments.

Industry actors demonstrate their frustration towards academia in not fully understanding the needs for real-world solutions and being geared towards academic publications and research rather than business-oriented and revenue-building solutions and processes.



24% Research/innovation was at a very early stage (TRL 1-3)

21% Cost and time to complete R&D to develop a commercially viable product were too high

14% Difficulty in getting alignment amongst researcher, University and company on commercial terms for sharing intellectual property/patents

14% Lack of internal people/skills to direct the R&D towards commercial viability

10% Other

7% Role of the Research and/or University in the future direction of the research/innovation

7% Commercial application & viability of innovation was unclear

Download figures and diagrams from the report tool kit here

Moving forwards

One of the questions emerging in this research analysis is making academia-industry partnerships on nature-inspired innovations - more commercially viable.

> **The main struggle is transforming academics into businessmen or bridging both of them. It really depends on the academic environment.**
>
> An interviewee

Our research identified in the keyword analysis the need for development and learning for doctoral researchers that go beyond the scope of their research subject.

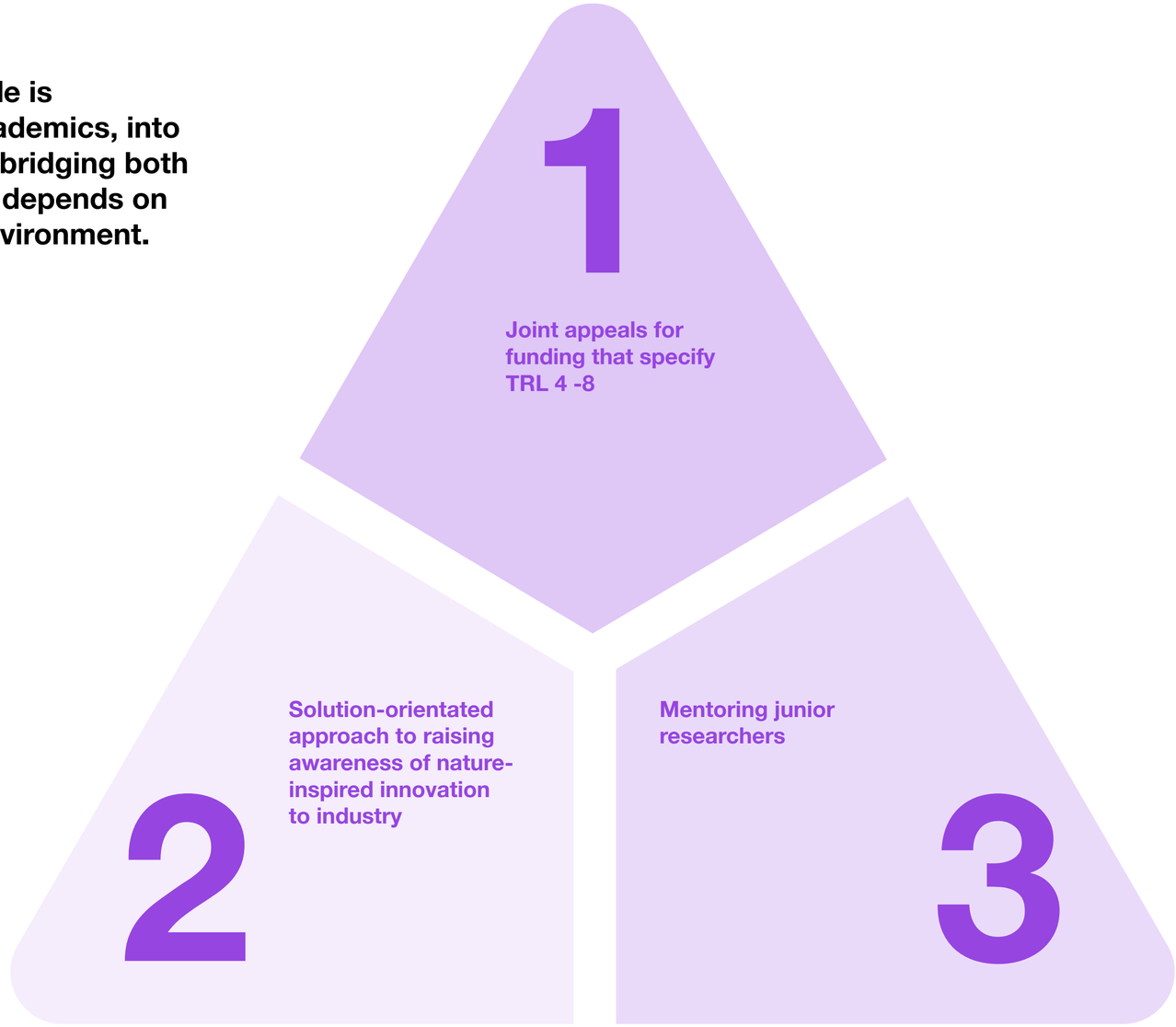
There is no dearth of partnerships between academia and industry actors. However, several factors should be institutionalised to make them sustainable, commercially viable, and successful.

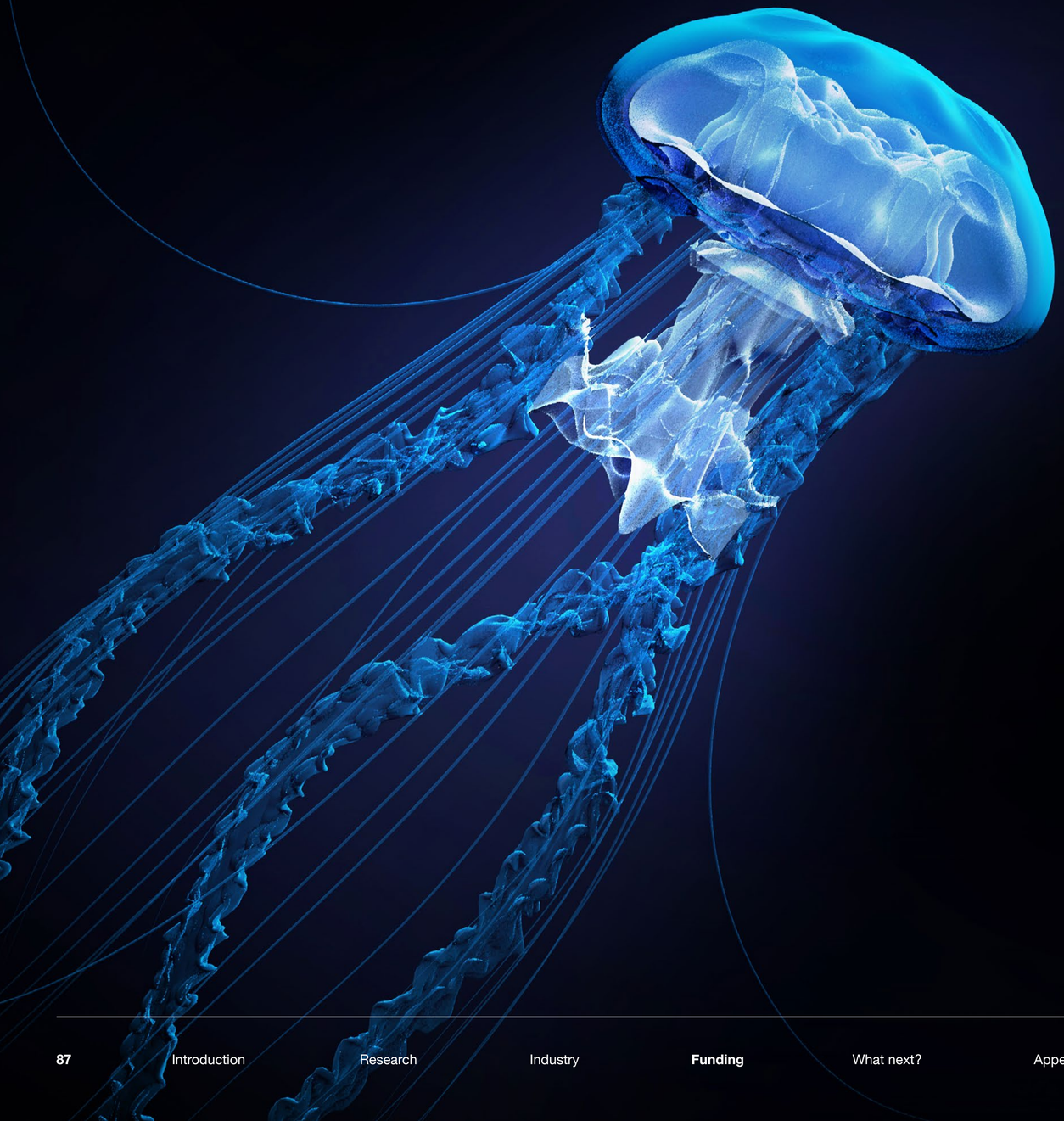
First, these partnerships should start either at TRL 1, when stakeholders start to ideate and formulate their nature-inspired innovations OR at TRL 4, when technology has been validated in a lab setting. However, there is not enough funding to validate it in other environments or develop it further for “market readiness.” Second, when a partnership has been commercially viable, the following success factors are mentioned: financial resources, technological capability, societal impact, level commitment among the people involved, a potent combination of academic and industry expertise and, finally, enough time and resources, to overcome challenges.

Third, an often overlooked factor in strengthening such partnerships and keeping them sustainable is mentoring young scholars within a framework that applies to real-world situations and industry concerns.

The main struggle is transforming academics, into businessmen or bridging both of them. It really depends on the academic environment.

Anonymous





Funding

Our desktop research of the researchers working in nature-inspired innovation identified 350+ funding streams and commercialisation types ranging from research councils, foundations/charities, and philanthropy (e.g. The Wellcome Trust) to industrial partnerships for later research and development.

Overview

It is clear that the majority of funding, 47%, comes from research councils (the UK and globally) and via industry-specific links. The remainder is made up of the charity sector and philanthropy-based organisations that are connected to endowments or specific for-profit organisations.

Download figures and diagrams from the report tool kit here

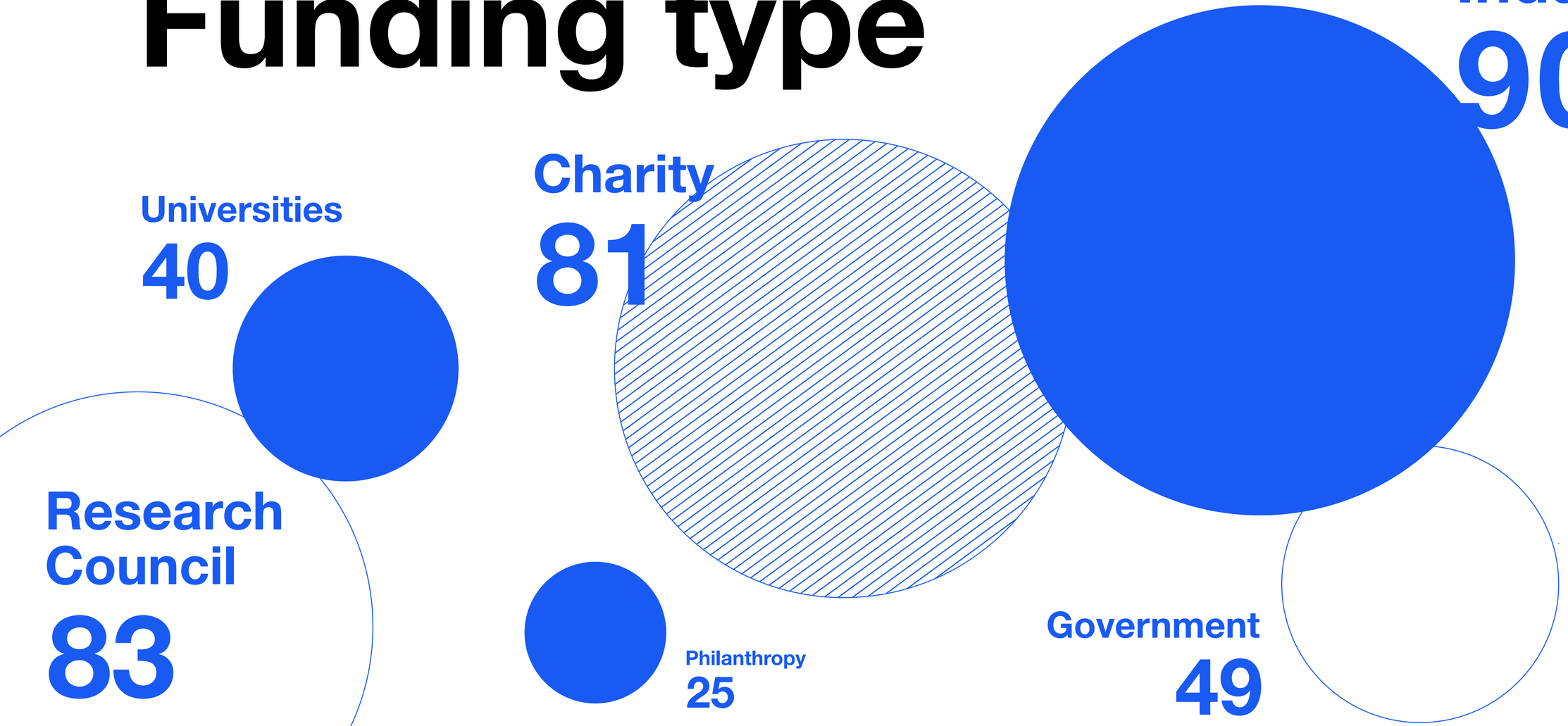
University-funded Research is led by the institutions and comes from various sources to be awarded to researchers in that particular institution. Government-level research sits outside the different national research councils to address specific calls for innovation.

We aim to identify the most relevant grants for researchers and startups to further their R&D processes without diluting their stake in the companies.

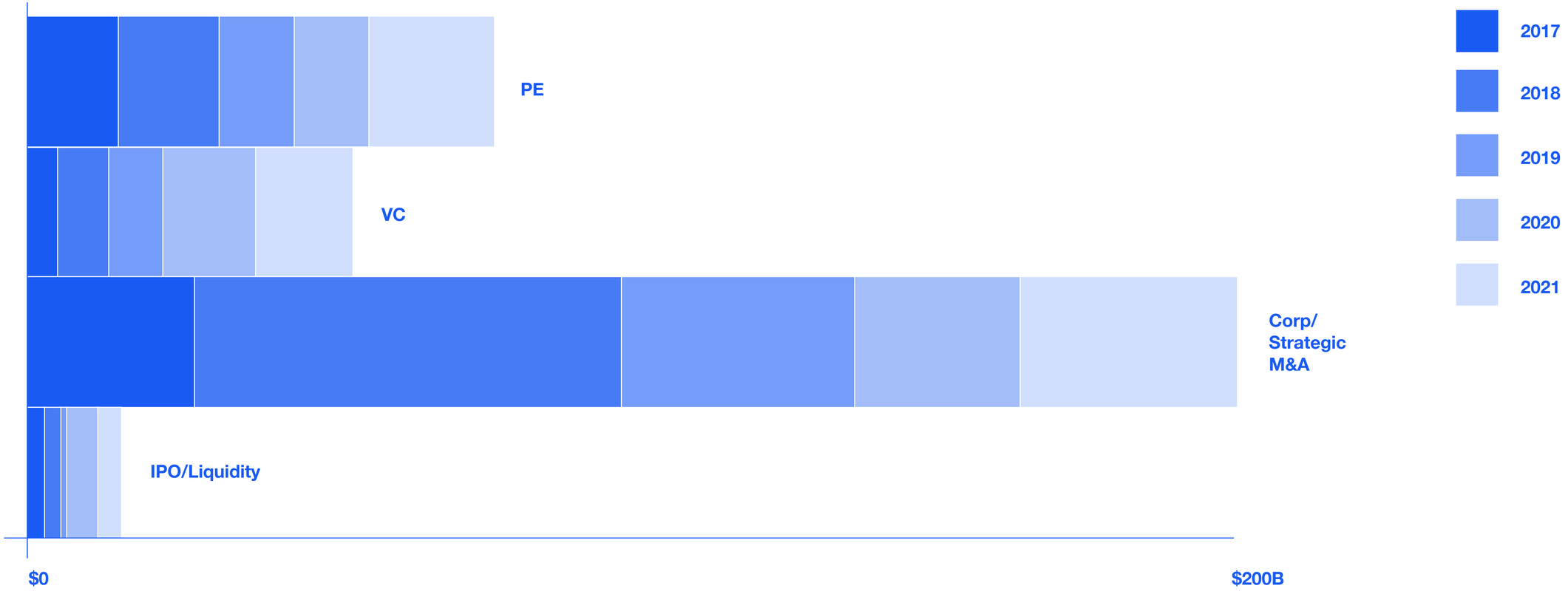
47%

of major funding comes from research councils

Funding type



Cleanteach Investments



Overview

Visit the Pitchbook site here

According to Pitchbook data, since 2017, there has been an increase in capital raised by cleantech investments, with total global deals averaging $120 billion. 2018 was the outlier year as investment in Tesla pushed the capital raised to close to $200 billion.

The top investors relevant to the UK were Innovate UK, Horizon 2020 and EIT Climate KIC. The top acquirers were in the clean energy and waste management sectors by Encavis, Chorus Clean Energy and Waste Management. Electric vehicles and clean energy lead both the public and private companies in the cleantech technology sector. 70% of the clean technology deals since 2019 in the UK are in the clean energy sector. Construction, commercial products, automotive, and environmental services make up the remaining 30%.

According to Crunchbase News, several funds are available and actively scaling up their investments this year. Their focus is on clean manufacturing, energy efficiency, renewables, sustainable packaging, amongst others. The three significant funds in this area are Lowercarbon Capital Fund, New Climate Tech Fund IV, and Ecosystem Integrity Fund.

$120bn increase in cleantech investments since 2017

An investment in Tesla in 2018 pushed the capital raised close to

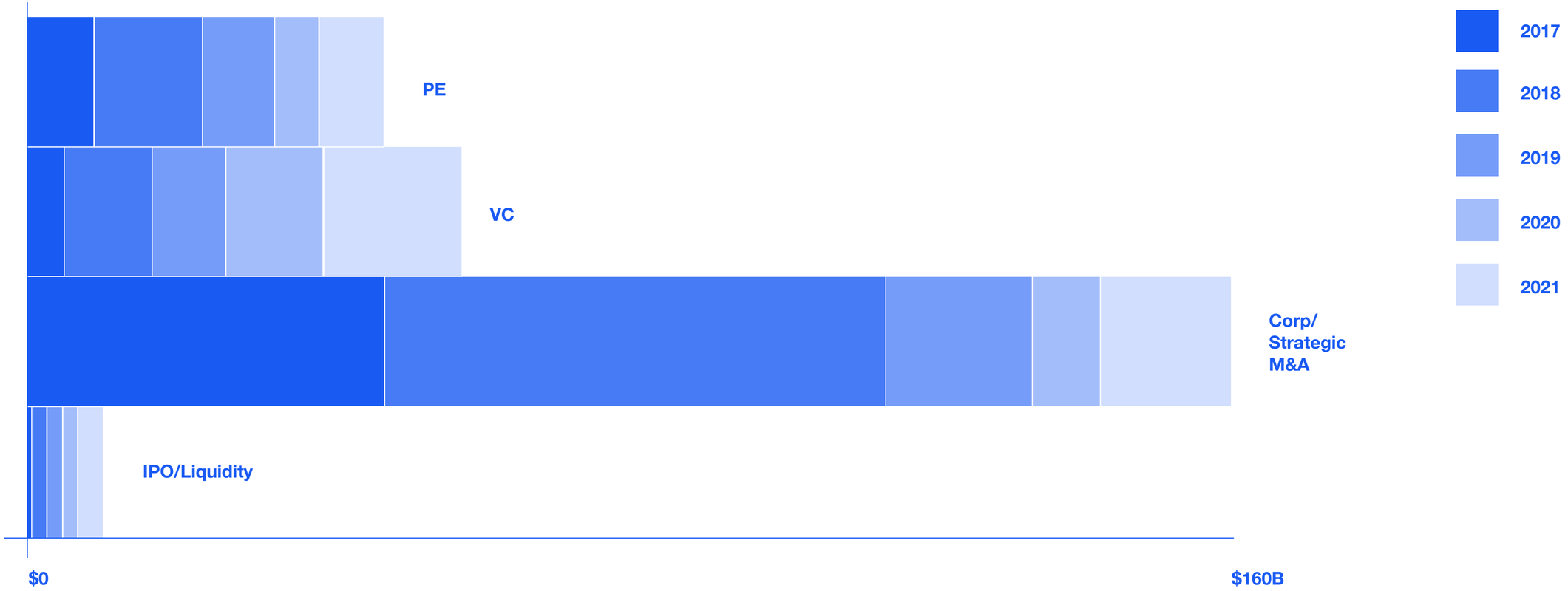
$200bn

Top investors including...

Horizon 2020, Innovate UK and EIT Climate KIC

LOHAS Investments

Investments in Lifestyles of Health and Sustainability.



Overview

According to Pitchbook data, since 2017, there has been a consistent level of capital raised by lifestyle, wellbeing, and sustainability investments, with total global deals averaging $60 billion. 2018 was the outlier year as investment in Tesla pushed the capital raised to close to $160 billion.

The top investors relevant to the UK were Innovate UK, Horizon 2020 and SOSV. The top acquirers were in the energy sectors by Chorus Clean Energy and Encavis with Canopy Growth focusing on medical-grade cannabis production. Electric vehicles and Healthcare lead public and private companies in lifestyle, wellbeing, and sustainability investments.

35% of the lifestyle, wellbeing, and sustainability deals since 2019 in the UK are in the food and agriculture sectors. This is followed by 20% in pharmaceuticals and drug discovery, 20% in electrical equipment, with the remainder in environmental services, construction and leisure facilities.

$60bn

total gobal deals value by lifestyle, wellbeing and sustainability investments

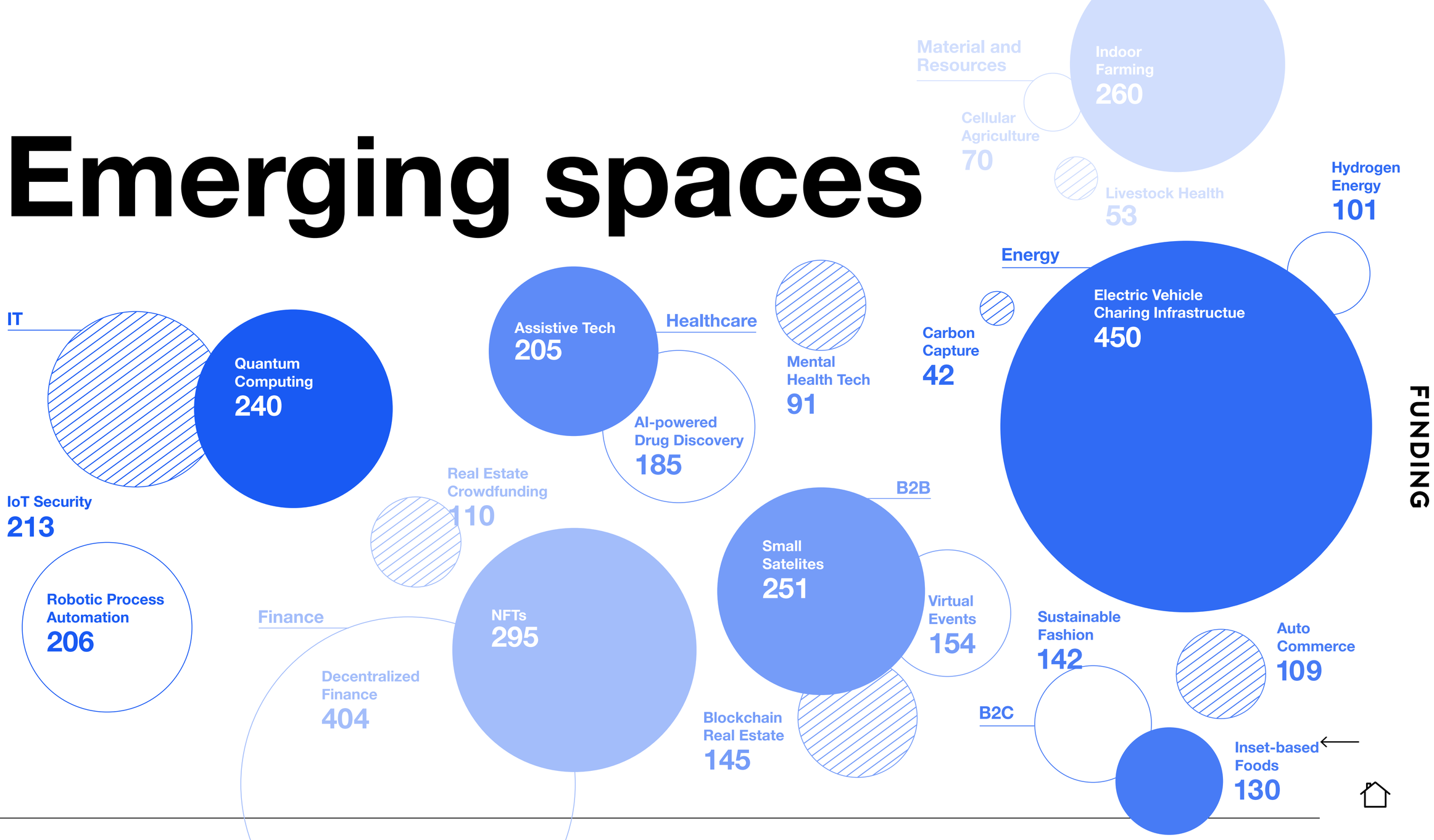
An investment in Tesla in 2018 pushed the capital raised close to

$160bn

Top investors included...

Horizon 2020, Innovate UK and SOSV

Emerging spaces



FUNDING

Overview

Visit the Pitchbook site here

Pitchbook focuses on seven emerging spaces that have the highest potential for growth according to their data, which is collected by identifying the quantity of emerging companies active in different sectors. These are Business-to-Business (B2B); Business-to-Consumer (B2C); Energy; Finance; Healthcare; IT; and Materials and Resources.

The UK Business Angel Market 2020 report by the British Business Bank and the UK Business Angels Association, the top three areas that DeepTech invests in are: healthcare, software as a service, financial technology. The follows the global trend data from Pitchbook focusing on the UK only.

The most relevant in each sector to nature-inspired innovation:

IT
Quantum Computing, Digital Twins, Robotic Process Automation

Business-to-Consumer (B2B)
Sustainable Fashion, Insect-based Foods, Auto Commerce

Business-to-Business (B2C)
Small Satellites, Sustainable Packaging, SportsTech

Finance
Decentralised Finance, NFT's, Real Estate Crowdfunding

Healthcare
Assistive Tech, AI-powered Drug Discovery, Mental Health Tech

Energy
Electric Vehicle Charging, Hydrogen Energy, Carbon Capture

Materials and Resources
Indoor Farming, Cellular Agriculture, Desalination Tech

Close

Ziylo

Ziylo has developed an innovative technology platform, which could be a key component to enable the next generation of insulin, able to react and adapt to glucose levels in the blood, therefore eliminating the risk of hypoglycaemia - dangerously low blood sugar levels - and leading to better metabolic control for people living with the disease.

Amount of fundraised: $800million deal purchased by Novo Nordisk
Nature-inspired Strategies: Ziylo has developed Biomimetic Glucose Binding Molecules (GBM) for Continuous Glucose Monitors (CGM) & Glucose Responsive Insulins (GRI)

It's a real success story for researchers in the Davis Research Group in the School of Chemistry who had been working on the problem for many years before Ziylo was established as a start-up company in 2014. It's likely their lab-based work will now be turned into a real-world application to improves the lives of people around the world.

Ziylo's glucose binding molecules are synthetic molecules that were designed by Professor Anthony Davis, who has been at the forefront of research into synthetic sugar receptors for the last 20 years.

Challenges

One of the key questions asked during our survey to researchers was the desire to commercialise. 69.8% of respondents expressed interest in commercialising their research.

Out of 210 survey responses, the majority, 91.4%, of those wishing to commercialise would prefer to partner with entrepreneurs or licence their innovation than leave academia and be a full-time entrepreneur. Further, the figure increases 31.3% among masters, doctoral researchers and post-doctoral researchers.

Crunchbase raises the point that many start-ups aren't focusing on solving the significant planetary issues instead of fintech and online retail, with few having a climate focus. Raising capital for new ideas is still mostly found in traditional sectors instead of in areas of climate change and planetary health.

According to Sifted, the critical challenge for many start-ups is finding new hires. However, it is less about finding people who have the skills but forming a team with fundamentally aligned sustainable values and visions

> **We asked for flying cars.**
> **Instead we got 140 characters!**
>
> Peter Thiel

Download figures and diagrams from the report tool kit here

36%

Partner with entrepreneurs to create start-ups, and split your time between academia and start-up to help get your innovation to market

28%

License the innovation to industry and continue focusing on academic work

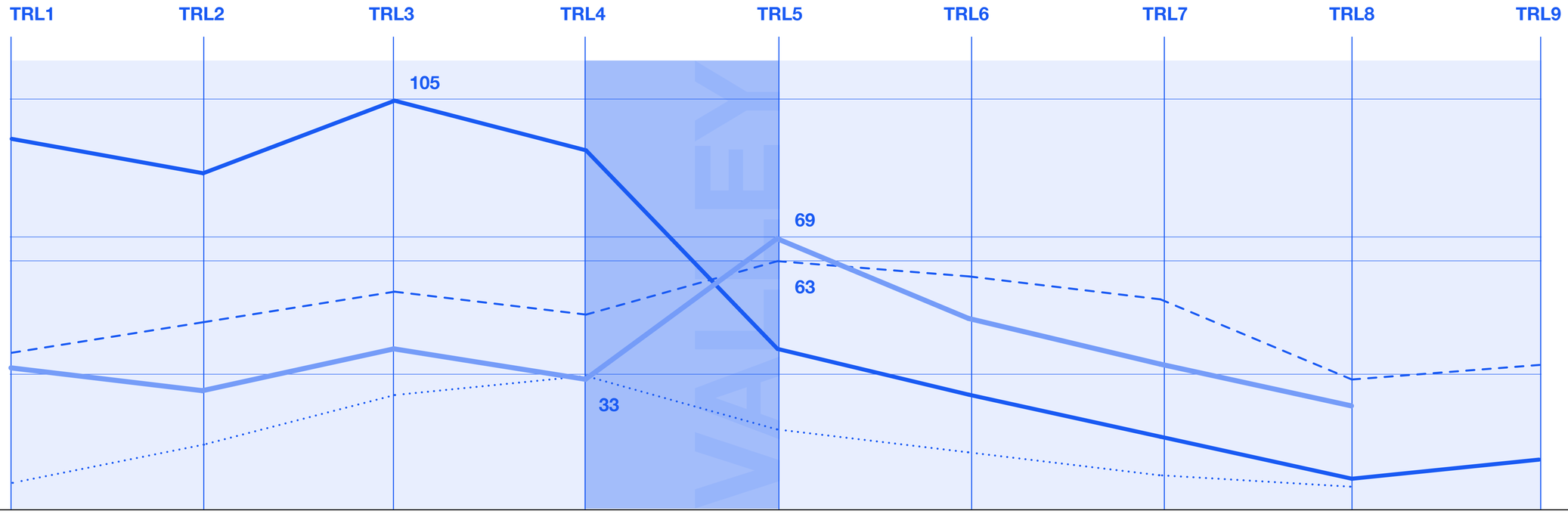
06%

Be an entrepreneur and start your own company to focus on getting the innovation to market

Valley of death

Our survey responses have highlighted a valley of death between Technology Readiness Level 4 and Technology Readiness Level 5 in developing nature-inspired innovations.

- At what level of TRL does your main research fall under?
- At what TRLs do you face the biggest funding challenges?
- At what TRL have investors approached you?
- Where are your main challenges within nature-inspired solutions?



Valley of death

For our research, we asked several questions around the Technology Readiness Levels using the Horizon 2020 definitions. Our data from the researchers' questions highlights the clear valley of death between TRL4 - validating in the lab and TRL5 - technology validated in the appropriate environment.

Different Success Criteria

Investors will rarely approach researchers until the innovation has been validated in either lab or industry conditions. There is the standpoint that researchers and the market have different success metrics. Validating and protecting the Intellectual Property(IP) do not necessarily lead to commercial viability. Biofabricate defines TRL4 as the 'ugly prototype'. It is just one further step to a solution, not the solution itself.

The big leap from 4 to 5

The primary funding challenges in the context of nature-inspired solutions are how to get to TRL5 and validate in industrially relevant environments. Unfortunately, many researchers will stop before this stage due to both developmental and capital challenges that could completely pivot the focus of the prototype solution. These challenges are time-consuming such as sourcing equipements outside university labs to scale up the testing.

Valley of death

The report by Sifted titled Scale Up Europe: How to build Global Tech Leaders in Europe highlights the challenges of companies scaling and attracting talents.

The solutions mentioned in the report relevant to our context are selected as following:

- Foster entrepreneurship within universities by adapting curriculum to encourage connections between disciplines and integrating entrepreneurs/VCs into university bodies
- Elaborate a charter of reporting and best practices on collaboration (open innovation, procurement) and takeovers
- Key themes - industry (business) into science, and science into industry (business), to allow cross-overs
- Develop the pool of talent within the deep tech investor ecosystem.

The report by Sifted, Respond, and the BMW Foundation - Herbert Quandt, titled Protect. Power. Transform. Tech Innovations Changing the World, highlights information about how we can develop the suite of net-zero technologies.

> **We don’t yet have the full suite of technologies to get to net zero economies by 2050. The 2020’s will be a key area of investment in Climate Tech.**
>
> Celine Herweijer - Global Climate Change Leader, PwC

Valley of death

Despite challenges in funding gaps faced by R&D, there has been a strong academic momentum in the UK generating huge potentials for tech transfer. The UK is leading Europe's tech for a good ecosystem with two hundred and twenty Tech for Good projects. The three leading sectors within this are digital democracy, health and care, and skills and learning. Even though the UK left the European Union, we still have access to new European Union Horizon innovation programmes that are currently tackling cancer, climate change, healthy oceans, climate-neutral cities, and healthy soil. Therefore the UK is very much well-positioned within this area.

Strong academic ecosystem

Europe is often decried for lagging the US and China in tech. However, it boasts some of the world's leading universities, whose research is fuelling progress in technical and frontier domains, from materials science to quantum computing and Deeptech. According to a Reuters ranking, Germany, the UK, and France lead the way for the most universities ranked in the top 100 for innovation.

The UK's Cambridge University is contributing to everything from Edtech to Smart Cities. London's Imperial College has formed innovation labs and a hackathon spirit with focuses on highly relevant challenges such as Covid protective equipment, regenerative medicine and energy materials The continent's academic ecosystem is a great source of intellectual pioneers, entrepreneurs and spinout companies entering the deeptech sector.

Time and capital

Innovation takes time and capital to develop. Through dissecting the time and capital needed for each stage of the development process in nature inspired innovation, we aim to provide a more accurate and practical guide for investors and funders.

Our research has highlighted that, on average, researchers need 10.6 years and £5.96 million to reach TRL8. Six years of this is research to get to TRL4, with a moderate capital needed of £2.84 million. Given that many doctoral researchers are funded for three years, to complete in foure, there is a funding and time gap that needs to be oevercome. To commercialise the project, reaching TRL 8 - system complete and qualified can take up to another six years and £4.2 million.

Focusing on specific fields, our research found that Environment related projects require the highest capital at £7.9 million (33% above average). In contrast, Design requires £4.7 million (21% less than average). Chemistry requires 10.6 years (15% higher than average) compared to Design in terms of time needed. Again, that requires 6.9 years (34% less than average). On average, Medicine and Chemistry need increased time to reach commercialisation.

£5.96m

needed on average along with 10.6 years including 6 years of research to get to TRL4

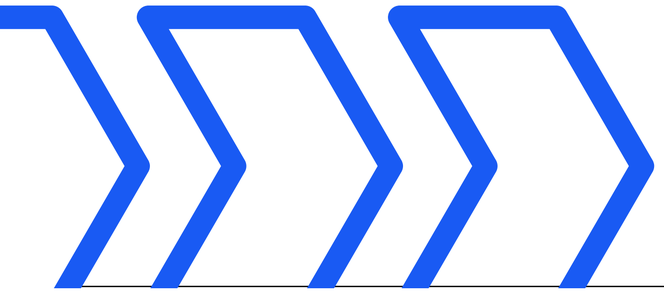
Time and capital

£3.9m

average capital needed for XXXXXXX with an average of

73 months

Moving forwards



Read the Nature-inspired Solutions Network Report here

What next?

The report is the first step in understanding the needs of the research community to enable greater collaboration with industry, and focus on commercialisation of ideas within the nature-inspired innovation space. Our research has identified a wide variety of research topics at different stages of maturity across the breadth and depth within the United Kingdom ecosystem. What is apparent is the need to appeal to a wider range of funding sources, and identify the potential industrial applications for many of these proposed technologies.

> **Innovation by itself confers only limited competitive advantage. The pioneering innovators in a new business arena almost never (less than 10% of the time) become big winners...we found no systematic correlation between achieving highest levels of corporate performance and being first into the game**
>
> Jim Collins, Author - Beyond Entrepreneurship 2.0

1

Stronger links between academia and industry

Fostering a closer partnership between researchers and industry is crucial in order to achieve success in market-focused research. Bringing in stakeholders at an early stage of research can help better align the research focus and the industry need as well as cultivate common languages. At the same time, they can also create roadmaps tailored to the development process of different types of research.

2

More effective funding policies

One of the significant challenges is the difficulty of getting funding for a project that sits across research council borders. In contrast, most of the funding bodies have relatively narrow interests. We advocate a more effectively-designed funding policy that recognises and supports the value of interdisciplinary research. Furthermore, we advise funding bodies to tailor their funding size according to the typical amount of capital needed for nature-inspired research to move across each TRL level to maximise the efficacy of a funding round as well as avoid gaps, especially the valley of death.

3

Entrepreneurial training for academics

The entrepreneurial training of academics is vital to ensure they can assemble a team that effectively translates their knowledge into applications. For example, it is essential to communicate research output in ways that appeal to different stakeholders, collaborate with people from various backgrounds and network with potential collaborators and investors.

4

Alignment with UK Government's Innovation Strategy

The UK government has been strengthening their innovation strategies, focusing on areas such as computation, energy and low carbon technologies. Coupling with the UK's ambitious environmental goals, there is an up-and-coming niche attracting many stakeholders and resources for tech innovations that thrive within and protect the equilibrium of natural systems. Strategic alignments with these trends can be a crucial solution to overcome funding challenges at different stages of development.

5

A better connected network

The critical insight from our research is that there is enormous potential for translating the rich repository of academic discoveries into real-world innovations if we can connect the right resources to the right people. We aim to facilitate the creation of interest networks, access to expertise across sectors and application-oriented activities via building a specialised platform for effective connections. We will connect researchers, industry and finance.

6

Learning from successful models

According to the data from Pitchbook from 2016 - 2020, the US has the most significant number of activities of billion-dollar startups followed by Asia and the EU, with nearly tenfold as the UK numbers at peak values. On the other hand, the UK has seen a rapid rise in venture investment since 2018. Coupled with substantial academic and talent resources, how might we harness the potential in the UK by learning from successful models from other major startup hubs in terms of improving the innovation pipeline, and increasing accessibility to early-stage opportunities.

Contact us

Visit the Biomimicry Innovation Lab website here

To contact us for further information, please reach out to us via our website or drop us an email.

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Appendixes

Mi-Solar Ltd

The concept itself relates to a non tracking solar concentrator based on a design seen in nature and its function that has proved itself over the millenia. By copying nature, it is intended that a solar concentrator can be built, tested and become a commercial alternative to existing CSP that will operate without the need for a tracking system and on a smaller land footprint.

Glossary

Bioengineering

Application of engineering knowledge to the fields of medicine or biology.

Biological system

Coherent group of observable elements originating from the living world spanning from nanoscale to macroscale.

Bioinspiration

Creative approach based on the observation of biological systems.

Nature-inspired engineering

Draws lessons from nature to engineer innovative solutions. Rather than imitating nature out of context or succumbing to superficial analogies, this scientific approach uncovers fundamental mechanisms underlying desirable traits, and apply these mechanisms to design and synthesise artificial systems that hereby borrow the traits of the natural model.

Biodesign (Bio Design)

The incorporation of living organisms or ecosystems as essential components, enhancing the function of the finished work.

Biomimetics

iInterdisciplinary cooperation of biology and technology or other fields of innovation with the goal of solving practical problems through the function analysis of **biological systems**, their **abstraction** into **models**, and the transfer into and application of these models to the solution.

Biomimicry (biomimetism)

Philosophy and interdisciplinary design approaches taking nature as a model to meet the challenges of sustainable development (social, environmental, and economic).

Ecomimicry

Ecomimicry is the practice of designing socially responsive and environmental. responsible technologies for a particular locale based upon the characteristics of. animals, plants and ecosystems of that locale.

Bionics

Technical discipline that seeks to replicate, increase, or replace biological functions by their electronic and/or mechanical equivalents.

References

Further reading

dogeatcog

Find out more about dogeatcog and the work they do here

A small and enthusiastic team striving to work with ethical clients to Create Good Trouble through design, illustration and animation.

Working as partners to local, national and global organisations, often within the education and conservation sectors, dogeatcog are specialists in illustration, editorial design and animation. With a social conscience, dogeatcog set up Drawsome! festival in 2015, with the aim to create an accessible and inclusive arts festival in York, placing up and coming creatives next to more established artists/ musicians and raising money and awareness for Bowel Cancer UK.

View the showreel here
dogeatcog.co.uk
@dogeatcog

Drawsome!

We set up Drawsome! festival in 2015, with the aim to create a fully accessible and inclusive grassroots arts and music festival in York, placing up and coming creatives next to more established artists and musicians, with the aim of raising money and awareness for Bowel Cancer UK.

@drawsome_york

York Design Week

We co-founded York Design Week in 2019 with Kaizen Arts Agency and United by Design. Last year's festival focuses on five themes, all with a central goal to create a 'city of activists', who we inspire to take responsibility for their locality, through the sub themes of Play, Make Space, Trust, Share and Re-Wild. The festival was a space for learning, exploring and doing – an invitation for citizens to roll up their sleeves, to build resilient, creative, healthy communities through art and design.

yorkdesignweek.com
@yorkdesignweek

York Creatives

We are part of a wider network of creatives within the city, and have helped to spark regular informal networking events for anyone and everyone who would consider themselves as working within the creative industries. We offer an open door to all, and are delighted to welcome anyone thinking of a career change into the creative sector to find out more.

yorkcreatives.com
@yorkcreatives