# #WhyESGMatters

## Biomimicry: Learning from nature

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# Biomimicry: Learning from nature

Biomimicry is a field that emulates designs and processes in nature to create new technologies and a greener future. Examples include adhesives inspired by gecko feet, metal detectors influenced by sharks, and night vision goggles drawn from snakes that can detect warm-blooded prey in complete darkness. As a fast-growing field with research and patents increasing rapidly, and supported by policy, this is nature investing with a twist.

## Did you know?

- A Zimbabwe shopping centre uses termite mound-inspired ventilation to lower its reliance on air conditioning by **90%**
- Engineers increased electricity generation by **10%** after incorporating designs similar to bumps found on humpback whales into wind turbine blades
- **3%** of biomimetics publications in 2016 related to sustainability, but rose to **7%** by 2020, indicating an increasing focus on sustainability in the field
- Research articles and conference papers focused on biomimicry research increased by **60x** from 1995 to 2020
- 28% of biomimicry sustainability research publications from 2004 to 2021 were focused on **resource efficiency**, the largest by category
- 20% of ‘biometric sustainable design’ publications from 2004 to 2021 were published in **China**, the largest by country

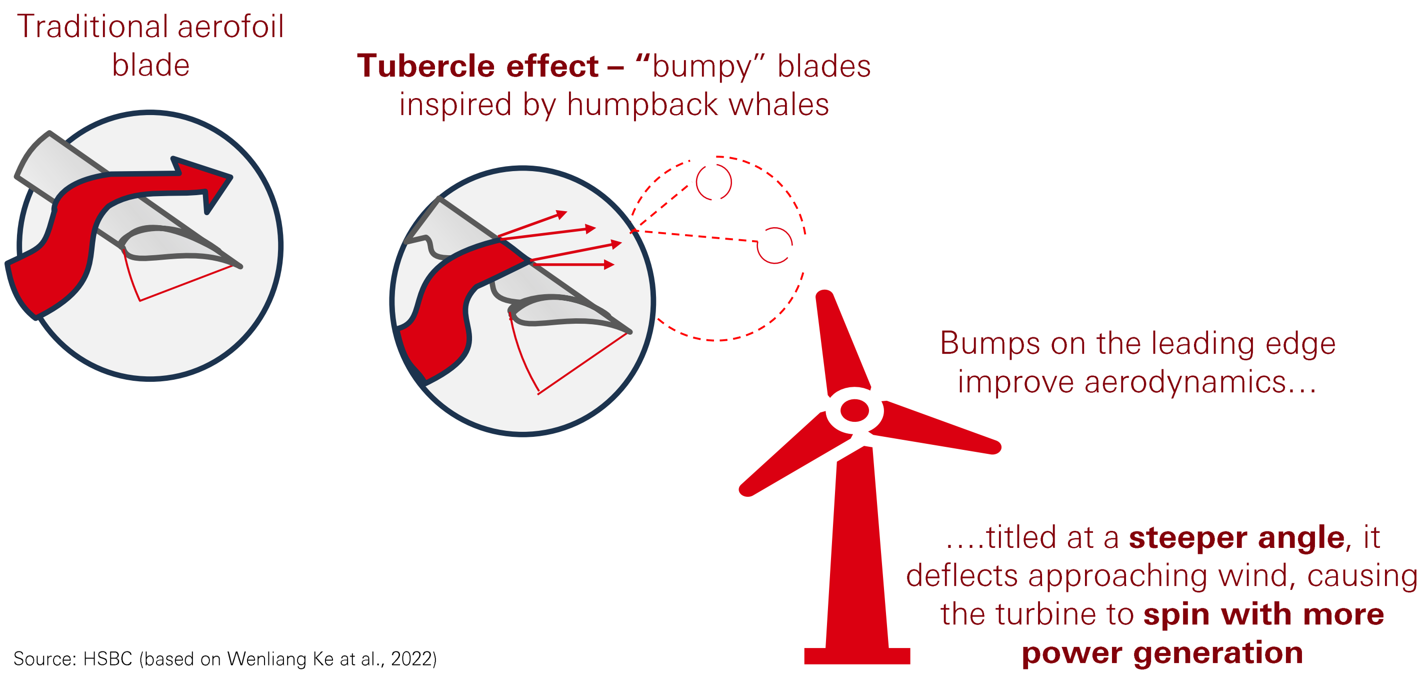
# Inspired by nature

Biomimicry observes how things work in nature by studying the **forms** (shapes & structures), **processes** (behaviours & methods) and **systems** (interdependence & ecosystems) of plants, animals and ecosystems, translating them into innovative and sustainable solutions. The field seeks to improve human-derived processes in areas including **energy efficiency**, **sustainable materials** and **strength and durability**.

### Mimicking nature's forms – more efficient turbines with tubercles

By incorporating into wind turbine blades, a design similar to tubercles (bumps the size of golf balls) found on humpback whales, engineers can reduce drag as it allows the blades to spin faster with less resistance, generating 10% more electricity.[1, 2]

### Whale-fin inspired wind turbine blades



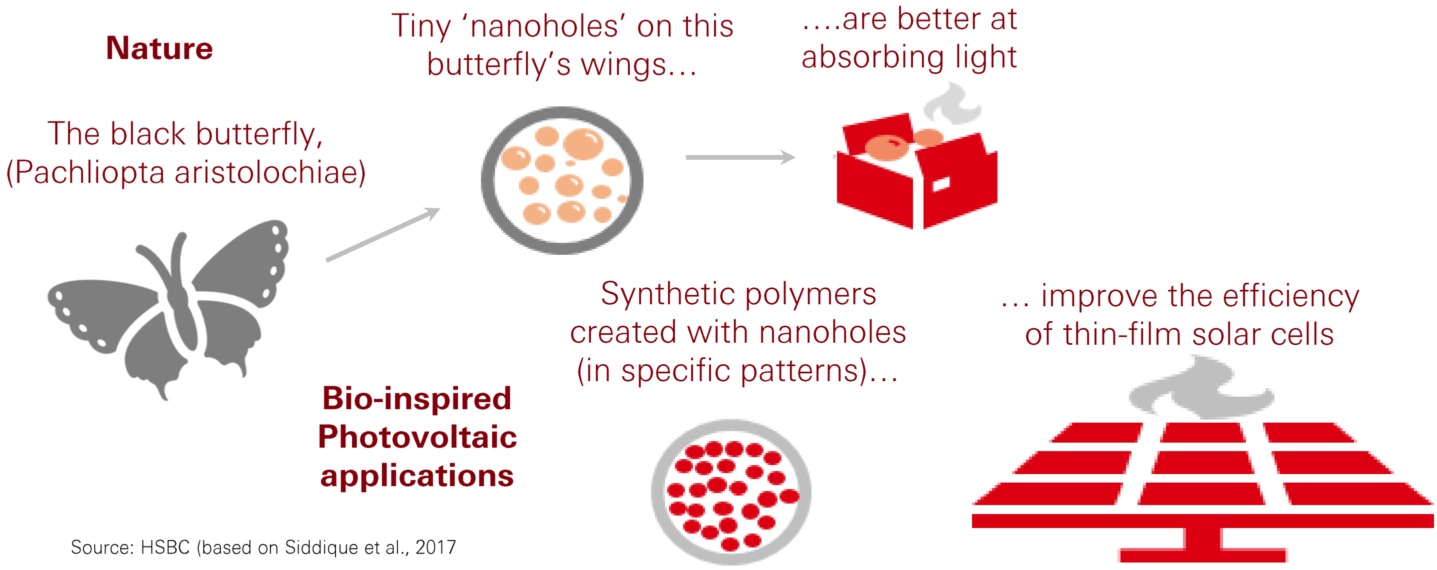

Source: HSBC (based on Wenliang Ke at al., 2022)

1. Power Technology, Biomimicry: powering the world with lessons from nature, 18 August 2020
2. Influence of leading-edge tubercles on the aerodynamic performance of a horizontal-axis wind turbine: A numerical study; Wenliang Ke et al., Energy, 15 January 2022

### Mimicking nature's processes – butterfly wings inspire more efficient solar cells

Researchers studied the light-absorbing black wings of a certain butterfly, finding tiny, random holes that scatter sunlight for better absorption. By mimicking this design, researchers created thin silicon solar cells with similar holes which can absorb light regardless of the angle.[3]

**Butterfly wings inspired solar cells**

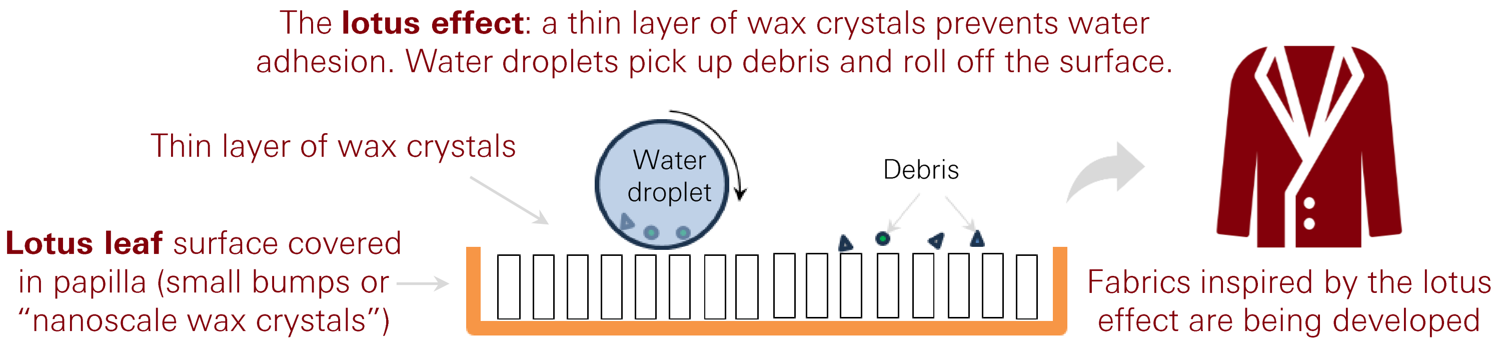



Source: HSBC (based on Siddique et al., 2017

### Mimicking nature's systems – lotus-leaf inspired clothes

Scientists are developing fabrics that mimic the lotus leaf's self-cleaning properties, which helps to reduce water usage for washing, and ultimately reduces the fabric's footprint.[4]

**Lotus leaf inspired fabrics**




Source: HSBC (based on Becky Poole, 2007)

3. The Verge, Butterfly wings inspire a better way to absorb light in solar panels, 19 October 2017
4. Fibre2Fashion, Exploring Biomimicry in Fashion, June 2023

# A rapid evolution

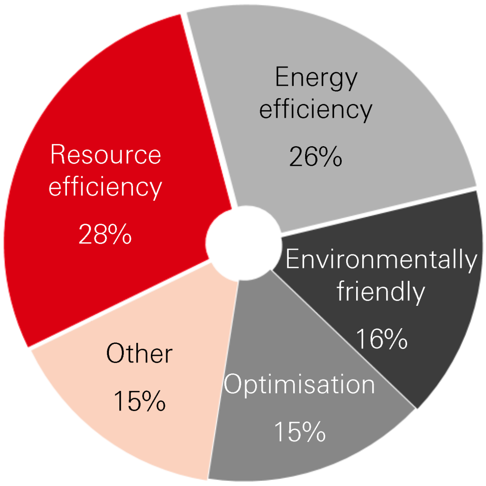
Biomimicry research has seen a surge in interest over the past three decades, as evidenced by a 60x increase (1995-2020) in research publications across a wide range of scientific disciplines such as materials science, chemicals and engineering. This shows the power of bio-inspiration, and the applicability of biomimicry in helping to advance science and technology.[5]

### Proactively fitting in with sustainability

However, not all biomimicry research is considered as sustainable. A 2023 study[6] by Jatsch et al. finds "an urgent need to ramp up sustainable design within biomimetic research". The study found that only 3% of biomimetics publications in 2016 related to sustainability, but this portion rose to 7% by 2020, indicating an increasing focus on sustainability in the field.

Of the research papers that do explicitly contribute to sustainability, many different areas are being explored with efficiency a key focus. Jatsch et al. also note that the largest contributors to carbon emissions globally (China, US, India, Europe) are also the lead contributors to biomimetics research that actively includes sustainability.

**Classification of research publications (2004-21) into different sustainability aspects**




Source: Jatsch et al., 2023

### The race to be inspired

There has also been a substantial increase in **biomimicry patents** since 2000.[7] A 2023 study by Haejin Bae finds that "biomimicry technology is in a growth phase that is expected to continue in the future and that South Korea and the United States are leading the development of this technology".

5. ISunil Sharma and Prabir Sarkar, Research into Design for a Connected World: Biomimicry: Exploring Research, Challenges, Gaps, and Tools, January 2019
6. Biomimetics for Sustainable Developments—A Literature Overview of Trends, Jatsch et al., Biomimetics, 11 July 2023
7. Nature-inspired innovation policy: Biomimicry as a pathway to leverage biodiversity for economic development; A Lebdioui, Ecological Economics, 9 September 2022

# Bright future

### Artificial Intelligence

AI could accelerate progress in biomimicry and enable more accurate and complex analysis through data processing, simulation, modelling and pattern recognition.[8] For instance, researchers at Arizona State University are turning their attention to social insects like ants and bees.[8] By studying their behaviour – how these insects communicate, solve problems and adapt to their environment – researchers are designing robots that can work together in factories and other situations such as aiding in disaster areas.

### Policy landscape

The future for biomimicry appears positive as more policies are aimed at fostering innovation and sustainable development. More governments are now recognising the potential for biomimicry and are implementing national-level policy initiatives to support research and development in biomimicry.[9]

### Working with nature

We think policy support for biomimicry will grow as biodiversity continues to rise up the global agenda. For example, some emerging economies are exploring how to leverage their local biodiversity for innovation, to create supportive ecosystems for biomimicry R&D, and to facilitate international research collaboration.

One important angle is the integration of benefit-sharing frameworks that ensure the economic benefits derived from biomimicry are aligned with biodiversity conservation. This involves creating legal frameworks that protect biodiversity hotspots, ensuring that biomimicry practices don’t harm natural ecosystems.

# Conclusion

As we continue to discover the vast potential of biomimicry, its impact will undoubtedly continue to grow, pushing advancements across diverse sectors and technologies. The Biomimicry Institute has a Ray of Hope Prize Accelerator[10] offering support for “high-impact nature-inspired startups”. Companies and investors that embrace these technologies can become frontrunners in shaping a more sustainable future.

With consumers increasingly looking for more sustainable solutions, biomimicry presents a natural investment opportunity. By investing in bio-inspired technologies, investors and corporates can not only achieve potential financial gains but also become catalysts for positive change as they help to drive the transition towards a greener economy and a healthier planet.

8. Lars Langenstuek, The Merging of AI and Biomimicry in Design, 20 September 2023
9. Nature-inspired innovation policy: Biomimicry as a pathway to leverage biodiversity for economic development; A Lebdioui, Ecological Economics, 9 September 2022
10. biomimicry.org/rayofhopeprize/

**Disclosure appendix**

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