

Written evidence from National Biofilms Innovation Centre (ENB0033)

Q1 What are the UK's key strengths in the area of engineering biology?

- **Are there any notable research institutes or groups or key projects? Are there innovative companies, start-ups, or spin-outs that you think are of particular promise or significance using engineering biology in the UK today?**
- **What is the current economic impact of engineering biology on the UK and what might its potential economic impact be?**

The National Biofilms Innovation Centre (NBIC [1]) was created in 2017 as a joint BBSRC and Innovate UK investment to harness the UK's academic and industrial strengths in biofilms research to tackle global challenges. Biofilms are communities of living micro-organisms, such as bacteria or fungi, evolving and growing as a collective. Biofilms are highly complex, but with the potential to address global challenges in agriculture/food production, energy, chemical processing, water security and bioremediation. They also play a key role in the global carbon cycle and represent the second largest biomass on the planet, and thus have a role to play in climate change mitigation and adaptation. The research in NBIC is organised into four interventional themes: Prevent, Detect, Manage and Engineer. The Engineer theme aligns directly with the growing recent interest in Engineering Biology and seeks to apply biofilm (microbial community) engineering approaches to industrial and biotechnological challenges. The theme aims to Engineer wholly new biofilm communities that exert beneficial functions, through a combination of rational design and physical control.

Microbial biofilms pose significant challenges and opportunities in various sectors, impacting health, food safety, industrial processes, and the economy globally. Biofilms exert a significant economic impact globally estimated at US\$5 trillion annually [2], affecting sectors like consumer products (US\$91 billion), foods (US\$91 billion), and water and wastewater treatment (US\$117 billion). Effectively controlling and engineering environmental and industrial biofilms is crucial for addressing these challenges. Rational biofilm engineering through Engineering Biology approaches offers the opportunity to mitigate the industrial impacts of deleterious biofilms, while also opening new markets for beneficial biofilm communities [e.g. 3] across multiple sectors.

¹ <https://biofilms.ac.uk/>

² Economic significance of biofilms: a multidisciplinary and cross-sectoral challenge *npj Biofilms Microbiomes* **8**, 42 (2022). <https://doi.org/10.1038/s41522-022-00306-y>

³ Creating pathways for collaboration between Argentina and the UK to utilise microbial biofilms in sustainable agriculture. *CABI Agric Biosci* **5**, 23 (2024). <https://doi.org/10.1186/s43170-024-00227-0>

6. How should engineering biology be regulated?

- **Who regulates engineering biology in the UK and internationally?**

NBIC has very recently formed the Biofilms Alliance, a collaborative network which will bring together academia and industry experts, regulatory bodies, and standardisation agencies to further our understanding of UK-specific barriers and benefits related to biofilm innovation and regulatory decision-making, and to determine which industry sectors stand to gain the most and experience the fastest benefits from advancements in regulatory science related to biofilm engineering and control. Outdated guidelines, limited dialogue between academic researchers, industry and regulators, and the absence of standardised methodologies create the pressing need for a systematic approach. The network aims to evaluate existing methodologies, recommend models, and establish a structured framework for interpreting biofilm data, ultimately creating a collection of recommended regulatory tools [4].

7. What are the possible barriers and limitations to good and effective use of engineering biology?

- **What more can the Government do to foster public understanding of engineering biology? Is public acceptability of these technologies a barrier to deployment in the UK?**

The scale of the challenges e.g. in food and water security and climate change mitigation require rapid deployment of new bio-based technologies. Public dialogue is critical before Engineering Biology approaches can be introduced on a national scale. Public acceptability, a lack of trust and an increase in misinformation are all barriers to deployment. Embedding of publicly visible and transparent responsible innovation practices in academia and industry is required, as is additional investment into public engagement/dialogue and outreach activities across disparate communities and demographic groups. Increased collaboration between academia, industry, the charity sector and “trusted players” in the environmental space is essential.

At the coalface of Engineering Biology research, enhanced training through Collaborative Training Partnerships and Flexible Talent Mobility Accounts offer opportunities for researchers to transfer typically between academia and industry. Such opportunities could be expanded to enhance interdisciplinarity and transfer to and from the government and the third sector.

⁴ The Need for Funding in Biofilm Standardisation <https://biofilms.ac.uk/funding-in-biofilm-standardisation/>

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