Overview of the proposed National Engineering Biology Programme

The vision is to harness the potential of Engineering Biology to deliver a greener, healthier, resilient future – we will build back better with biology.

Synthetic Biology is the design, engineering and re-engineering of biologically based parts, devices and systems. As an emerging technology it has the potential to transform many sectors and help address major global grand challenges including; decarbonisation, health and wellbeing, energy, food security and environmental management. From enabling new vaccines for medicine, new materials for defence and transport, plastic-free packaging, improved fibres for sports clothing, and opportunities for bioremediation and agricultural production, engineering biology has application across many sectors, and can make a significant contribution to delivering government strategies including the Clean Growth Strategy, the UK Life Sciences Strategy, the UK's Industrial Strategy, 'Growing the Bioeconomy' and Defra's 25 Year Environment Plan.

Previous investment has built the UK's capability in Synthetic Biology, so we are amongst the world's leaders in this emerging technology. Engineering Biology encompasses the wider capabilities/ecosystem that supports the exploitation of synthetic biology knowledge for economic and public benefit. UKRI partners and Dstl are working on a proposal to establish a **National Engineering Biology Programme** that will build on the UK's capabilities and accelerate them to the next level through a coordinated and integrated programme, encompassing both fundamental and advanced research in synthetic biology through to the delivery of commercially viable solutions, boosting British business and tackling the societal challenges we face.

National Engineering Biology Programme Objectives

UKRI partners and Dstl are working on a proposal to establish a **National Engineering Biology Programme,** that will:

- Deliver a step change in discovery and application-inspired engineering biology transformational research and innovation
- Harness the transformative potential of engineering biology by supporting knowledge exchange and translation for economic and public benefit
- Promote collaboration across disciplines and sectors
- Leverage and enhance the UK's national capabilities
- Address skills needs and develop talent

Based on the outputs from community stakeholders' engagement exercises, in 2020, the following thematic foci have been identified and an overview of the programme is provided in **Annex 1.** Opportunities within this programme will focus on application-inspired themes including Biomedicine, Clean Growth, Food Systems, and Environmental Solutions, and discovery-inspired advanced, cutting-edge research on Bioinspired Design, Bioengineered Cells & Systems and Novel Materials.

Recognised as core to enabling both application- and discovery-inspired research and innovation, this programme will also support transformative underpinning technologies, including sensor technologies, manufacturing and scale-up, automation, artificial intelligence/machine learning, and predictable design.

Essential to creating a dynamic, entrepreneurial environment, conducive to realising the potential of engineering biology this programme will also support enabling themes

encompassing training, knowledge exchange, commercialisation, industry engagement, infrastructure, standards and international collaboration.

THEMATIC AREAS

While the thematic areas have been identified as application- and discovery-inspired, the National Engineering Biology Programme will support the development of both the early stage fundamental research and innovation, as well as the translation and commercialisation of technologies, services and products, throughout all themes.

The following themes are not exhaustive, as disciplines outside of these areas would have opportunity for support through the National Programme, and likewise, within each theme, the description below is not exhaustive, but rather representative of the types of disciplines and challenges that are anticipated to be explored within each theme.

Application-inspired

The **Food Systems** theme aims to develop research and technology applications to deliver productive, resilient and sustainable food and farming. In this theme we anticipate that engineering biology will be used to address breeding and traits in crops and animals, soil microbiomes, disease control, securing the supply of food, and alternative agriculture and farming solutions.

The **Biomedicine** theme aims to drive innovative means to improve health, including for prevention, diagnosis and treatment of diseases. We anticipate that engineering biology would enable development of novel technologies and solutions, such as; engineered cells/tissues/networks and biomaterials for regenerative medicine, precision drug targeting, novel diagnostics and vaccine development and advanced therapies manufacture.

The **Clean Growth** theme aims to deliver solutions to support domestic commitments towards a greener and more sustainable future. In this theme we anticipate that engineering biology will present bio-manufacturing solutions, create sustainable and renewable supply chains, and develop efficient and smart power generation and storage solutions.

The **Environmental Solutions** theme aims to develop research and technologiy solutions towards delivering a healthy, productive and resilient environment. In this theme we anticipate that engineering biology technologies can be developed and applied to address challenges including bioremediation, waste management, biomining, and resilient agri-environmental systems and ecosystems.

Discovery-Inspired

The **Bioinspired Design** theme aims to build on the fundamental potential of biology. In this theme we anticipate that engineering biology is used to utilise and enhance the properties of nature for biotechnological solutions, such as; the sensitivity of receptors in a dog's nose and broader sentinel organisms, navigation due to magnetoreception in a bird's brain, or the data storage and computing capability of nucleic acids and cells.

The **Novel Materials** theme aims to develop new materials, products and production processes. It is anticipated that engineering biology can be used to: create more sustainable production processes, or alternative production solutions, and develop new materials, non-natural materials, integrated materials, and smart/functional materials.

The **Bioengineered Cells and Systems** theme aims to develop novel approaches and technologies that allow us to construct *de novo* or modify existing cell and biological systems efficiently and effectively. We anticipate that engineering biology will be applied to innovation

in precision genome engineering technologies, meet challenges at different biological scales (e.g. synthetic organelles, functionally-modified cells, hybrid networks such as brain-computer interface), and further the development and control of minimal / protocells, synthetic microbial communities, and artificial life.

Annex 1: Overview of the themes within the National Engineering Biology Programme