COUNCIL FOR SCIENCE AND TECHNOLOGY

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Prime Minister
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'Sent by email only'

31 March 2023

Dear Prime Minister

ENGINEERING BIOLOGY: OPPORTUNITIES FOR THE UK ECONOMY AND NATIONAL GOALS

From the discovery of the structure of DNA to the development of a world-leading COVID-19 vaccine, the UK has a long history in life sciences innovation. Yet with recent technological developments in the ability to edit, manipulate, and synthetically recreate genetic material, we are again at the point of transformational change within this sector. This step change in capability is fundamental to engineering biology, which describes the application of rigorous engineering principles to biology. This multidisciplinary field will be transformative across many sectors including in health, transport, farming, food, environment, defence, manufacturing, construction, and energy.

Engineering biology has the potential to enable breakthroughs across several pressing global challenges, and significantly contribute to achieving national goals including net zero and Levelling Up. The McKinsey Global Institute has recently assessed several end-use applications of engineering biology that could plausibly be commercialised in the next 10–20 years and has estimated that they could contribute a combined global economic impact of up to $4 trillion[1]. More than half of this is expected to be outside of the human health sector, in areas such as agriculture, food, materials and energy production. Further, estimates show that as much as 60% of physical inputs to the global economy could be derived from biological systems and living factories, and even small progress towards this figure could be transformational for economies and societies[1].

[1] Mckinsey & Company. The Bio Revolution: Innovations transforming economies, societies, and our lives. 2020. https://www.mckinsey.com/industries/life-sciences/our-insights/the-bio-revolution-innovations-transforming-economies-societies-and-our-lives

The UK's overall aim should be to create a long-term, sustainable environment which supports research, innovation, and commercialisation in engineering biology. This should capitalise on and bring together the UK's well-established strengths in the life sciences and digital technologies, including in artificial intelligence and machine learning. Achieving this goal would directly contribute to national and regional economic growth by building an in-demand technically skilled workforce, a network of local and end-use-specific infrastructures, and a boost to the UK's manufacturing capability. A targeted approach encouraging commercial development of biological replacements for fossil fuels would enable the UK to take a step closer towards net zero.

What needs to change

There is a window of opportunity for the UK to accelerate the commercialisation of engineering biology. To capitalise on the investment the UK has already made in engineering biology and establish technological leadership, government will need to act now to translate current research capabilities into significant economic and social impact or risk losing momentum to international competitors. To achieve this we offer recommendations in the following three areas:

a. Act now to build on and extend the UK's existing strengths in foundational capabilities;

Recommendation one: The government should work with industry and public sector funders to establish centres for programming biology, forming a national institute working across disciplines to advance research within the field and accelerate its scaled up application. These centres should nucleate into a national hub with the following functions:

a. a UK-based capacity for rapid and cost-effective DNA synthesis;
b. scalable technologies for rapidly building DNA genomes across microbial factories, plants, and animals; and
c. knowledge and AI based solutions for predicting and discovering which DNA sequences make organisms with the desired properties.

Recommendation two: The government should seek to become a world leader in measuring complex biological systems. The Department for Science, Innovation and Technology (DSIT) should convene the relevant national standards bodies to establish a bio-sector measurement standards and metrology board.

b. Demonstrate leadership, define ambitions to signal direction and focus effort, and take strategic action;

Recommendation three: DSIT should lead development of a cross-government engineering biology strategy to communicate government's vision and long-term ambitions for maintaining and extending UK capabilities, and harness engineering biology for solutions to the UK's national goals and challenges.

c. Lay the groundwork to support the scale up of engineering biology-based solutions and businesses;

Recommendation four: The government should work with industry and UKRI to establish multidisciplinary Biomanufacturing Innovation Centres, for testing, scale up, and commercialisation of non-health engineering biology applications, including materials and fuels. These integrated scale up hubs should be in locations with a relevant industry base, and link to universities with strong engineering biology capability and technical skills infrastructure.

Recommendation five: DSIT should work with policy teams across government and the engineering biology community to review the critical uncertainties around future demand for engineering biology, explore scenarios for future changes to UK supply chains, and identify policy and regulatory implications.

Recommendation six: DSIT and the Office for Science and Technology Strategy (OSTS) should work with the Regulatory Horizons Council to establish a 'Regulatory Observatory', bringing together insights on engineering biology applications for regulators across sectors, and advising on improvements to support the sector and provide consumer engagement and reassurance.

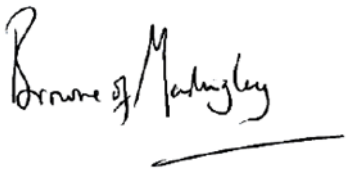
The attached report provides background and detailed recommendations for action in these areas.

We are grateful to Council members for developing this advice, in particular, Professor Paul Newman (Director of the Oxford Robotics Institute and BP Professor of Information Engineering, University of Oxford), Paul Stein (Chairman, Rolls-Royce Small Modular Reactors), Suranga Chandratillake (General Partner, Balderton Capital), Christopher Bishop (Chief Research Scientist at Microsoft Research Cambridge), Professor Philip Bond (Professor of Creativity and Innovation, University of Manchester), Professor Dame Ottoline Leyser (Chief Executive Officer of UK Research and Innovation), with support from Professor Michael Hopkins (Professor of Innovation Management, University of Sussex Business School), Professor Paul Freemont (Co-director of the National UK Innovation and Knowledge Centre for Synthetic Biology at Imperial College London), Professor Jason Chin (Programme Leader at the Medical Research Council Laboratory of Molecular Biology) and Professor Ian Shott (Executive Chairman of Shott Trinova). We also thank policy teams across government and stakeholders across industry and academia who helped to inform our work.

This letter is copied to the Chancellor of the Exchequer; the Secretary of State for Science, Innovation and Technology; the Secretary of State for Environment, Food and Rural Affairs; the Minister of State for Science, Research and Innovation, the Minister of State for Decarbonisation and Technology, the Cabinet Secretary and the Permanent Secretaries of HM Treasury, the Department for Science, Innovation and

Technology, the Department for Environment, Food and Rural Affairs, and the Department for Transport.

Yours sincerely,



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