SynbiCITE Overview 2024

Foreword by Profs Kitney and Freemont

SynbiCITE is the UK's national centre for the commercialisation of Engineering Biology/Synthetic Biology[1]. The prime objective of SynbiCITE is to accelerate and promote the commercial exploitation of Engineering Biology research and technology. SynbiCITE's role as nucleating point for this rapidly emerging industry is designed, to deliver sustained and substantial benefits to the UK economy and particularly the BioEconomy and sustainability.

SynbiCITE is a unique collaboration of the UK's leading academic institutions and industrial partners, ranging from start-ups to large multinational companies, and supporting organisations, including Regional Governments.

SynbiCITE was founded in 2013 with a Research Council Grant of £9m and other commitments over 5 years comprising of grants from Engineering and Physical Sciences Research Council (EPSRC), Biotechnology and Biological Sciences Research Council (BBSRC), Innovate UK and its industrial and academic partners.

SynbiCITE and our partners, across the UK and globally, are committed to developing this technology through responsible innovation, which encompasses ethical, societal and environmental considerations.

Professor Richard I Kitney

Professor Paul S Freemont

Background

[1] Internationally, the terms Synthetic Biology and Engineering Biology are often used interchangeably. For the purpose of simplicity, the term Engineering Biology will be used throughout this brochure, except where either term is used by a particular source.

The UK has been seen internationally as world leading in terms of the implementation of The Royal Academy of Engineering Report (2009) and "A Synthetic Biology Roadmap for the UK" (2012). Both reports recommended the construction of a UK-wide infrastructure for Synthetic Biology. A key component was the creation of a number of research and development centres for Synthetic Biology located within leading universities with internationally competitive research in Engineering, Physical Science and Biology. As a result, starting in 2013, six new Synthetic Biology Research Centres, or SBRCs, were created in the universities of Bristol, Cambridge/John Innes, Edinburgh, Manchester, Nottingham and Warwick – together with the existing major research centre at Imperial College. In addition, SynbiCITE, the U.K.'s National Industrial Translation Centre for Synthetic Biology was created at Imperial College to work with all the SBRCs and other centres and to support the growth of the U.K.'s Synthetic Biology industry. This represented an investment of over £300 million of public money.

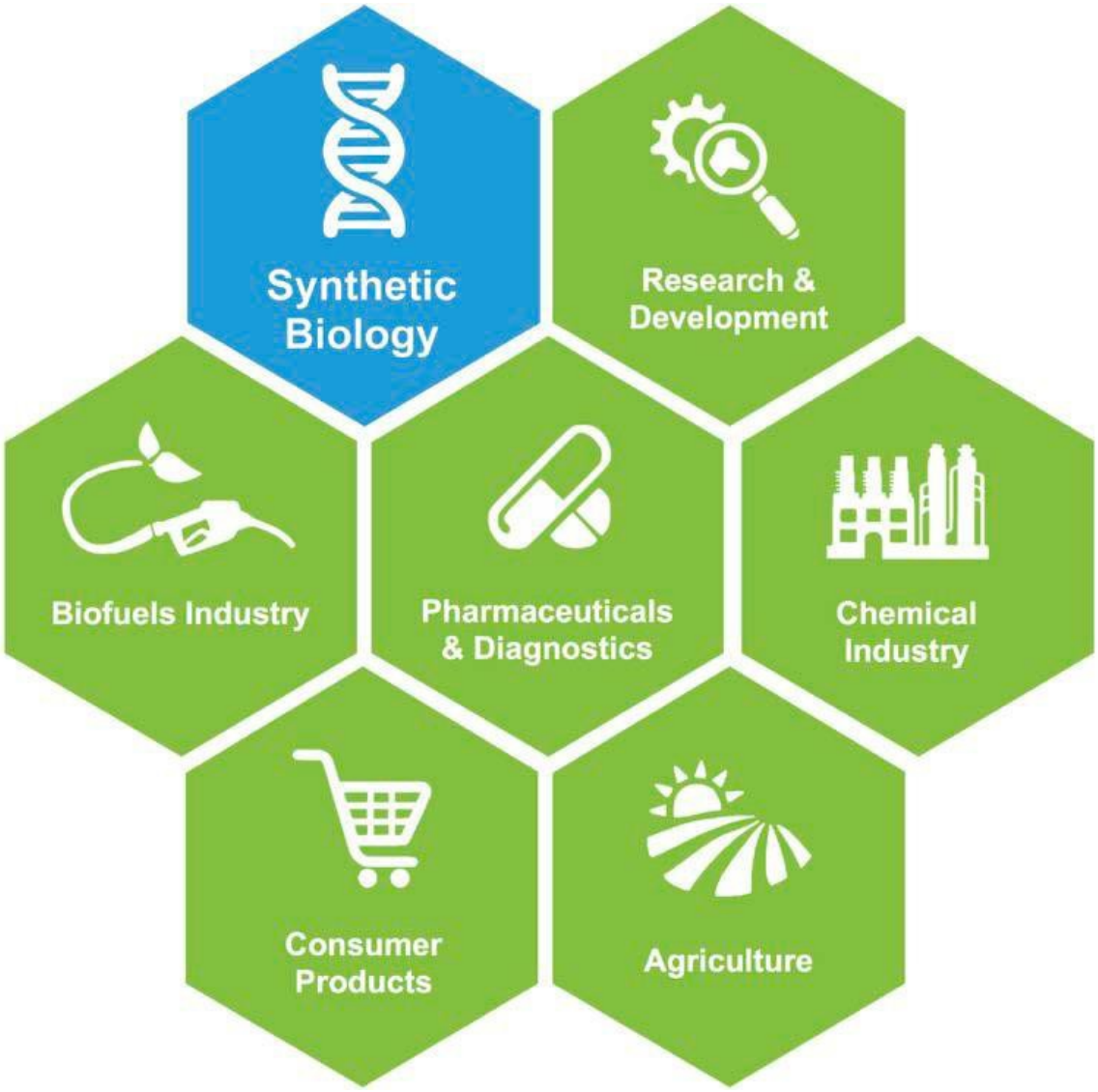
In the UK, there are currently around 180 start-ups and SMEs engaged in Engineering Biology. SynbiCITE supports around 80 of these companies through scientific and technical support, business courses and the use of its Biofoundry. Since 2013, the Infrastructure has supported the establishment and growth of around 100 new companies (principally through SynbiCITE) and has attracted around £1.4 billion of investment from the international Private Sector (2013- 2019). (What is important to note is that it is clear from talking to investors that continued and increasing private investment in the field is reliant upon continued public investment of the existing infrastructure.) This has resulted in the creation of many high-quality jobs in the sector, but it is essential that this effort continue to ensure that the UK is well positioned with skills, training and technologies to capitalise on previous investment and enable it to develop the BioEconomy.

The UK is internationally recognised for the quality and effectiveness of its engineering biology infrastructure. What is key is continuing public investment and support for the existing infrastructure of the research centres, SynbiCITE and the Biofoundries - i.e. building on excellence, not reinventing the wheel. This will, in turn, attract increasing amounts of inward private investment.

Engineering biology is seen internationally as an important driver of the growth of the BioEconomy. In the UK, the BioEconomy is estimated to grow from £220 billion in 2016 to £440 billion by 2030[2]. Such a development will require significant additional public funding to facilitate the expansion of the existing infrastructure and the creation of additional facilities. An important factor in the growth of the importance of Engineering Biology, as platform technology, is the increasing use of automation. This phenomenon started with the use of Individual liquid handling robots. It has now developed into sophisticated installations that use of high levels of automation (e.g. as realised in Biofoundries). These developments are coupled to the rapidly increasing application of AI, machine learning, information systems and techniques based in systems theory, and signal and image processing. There is, therefore, in the context of the BioEconomy, increasing reliance on Engineering and Physical Science - this is reflected in a number of start-ups and the highly specialist staff they require. One example is Evonetix, a DNA synthesis company that uses technology based on silicon arrays, manufactured with semiconductor microfabrication techniques. Despite being a 'biology' company, a large percentage of the company's employees are physical scientists, engineers, AI specialists and chemists. Another example is LabGenius a company that uses AI,

[2] Growing the BioEconomy: a national strategy to 2030
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1037343/181205_BEIS_Growing_the_Bioeconomy__Web_SP_.pdf

robotic automation and engineering biology to discover novel protein therapeutics. In short, Engineering and Physical Science, manifested in Engineering Biology, and developing biological products, is the 'Engine Room' that will drive the Bioeconomy. Engineering Biology is highly disruptive technology and one the UK needs to remain at the forefront of to achieve its ambition of growing the BioEconomy.



Nucleating, Incubating and Accelerating a New Industry in the UK

Within the U.K.'s Engineering Biology ecosystem there are examples of start-ups outside SynbiCITE; however, SynbiCITE is the vehicle that provides major support for company growth within the UK. To recapitulate, our mission is to promote the adoption and use of synthetic biology by industry. The primary objective is to: accelerate and promote the commercial exploitation of engineering biology research from universities and other institutions throughout the UK; to provide major support for Start-ups and Small and Medium-Sized Enterprises (SMEs); and to interact on projects with major industry that may or may not be currently in the sector. In this regard, SynbiCITE acts as a nucleating point for Engineering Biology companies and, particularly, start-ups and SMEs.

Private Sector Investment in UK
Synthetic Biology Companies

	£m
2013	121
2014	202
2015	222
2016	230
2017	262
2018	500
2019	295
2020	359
2021	776
2022	724

Source: Beauhurst

Total £3.70 bn
(An approximate 9x Multiplier on Public Investment)

Various estimates place the British Government's investment in Engineering Biology prior to 2020 were around £400million, primarily in 2013/2014 to establish the new SBRCs, the Biofoundries and SynbiCITE. As part of its work SynbiCITE has a continuing review of private sector investment into companies working in the UK in Engineering Biology. From 2013 to 2018 there was a total investment of £1.5 billion into the sector, showing a steady increase in investment year-on- year (as shown in the table above). This represents a 4.4x multiplier on the public sector investment. Many analysts in the field believe that there is a need for a different type of funding model for small companies. In many large companies and, indeed, in the traditional VC investment community, Engineering Biology is still viewed as "high risk". In the United States, for example, this problem has been recognised in several fields over the last 30 or 40 years. One solution, which has been highly effective, is to provide "long-tail" of public funding over many years (e.g. the DARPA program) to "de-risk" the field to the point where the private sector feels comfortable about investing large amounts of money.

In terms of nucleating, incubating and accelerating a new industry in the UK, as will be described, SynbiCITE comprises three hubs: the BioDesign and Applications Hub, the Business and Outreach Hub, and the Facilities Hub. The three hubs comprise our activities in relation to growing the U.K.'s Engineering Biology industry and, in turn, the country's BioEconomy.

These activities can be thought of as comprising different levels of interaction with UK companies. This interaction can, in turn, be thought of in terms of a core and two outer concentric annuli. In the UK there are currently around 180 Start-ups and SMEs. Of these, almost all have interacted with SynbiCITE in some way. For example, through attendance and participation in our SynbiTECH conferences – these companies sit in the outer annulus. Next, there are around 80 companies (sitting in the inner annulus). These are companies that have typically been given business support. For example, by attending SynbiCITE's business courses; obtaining investment through SynbiCITE acting as a broker; and some scientific and technical support.

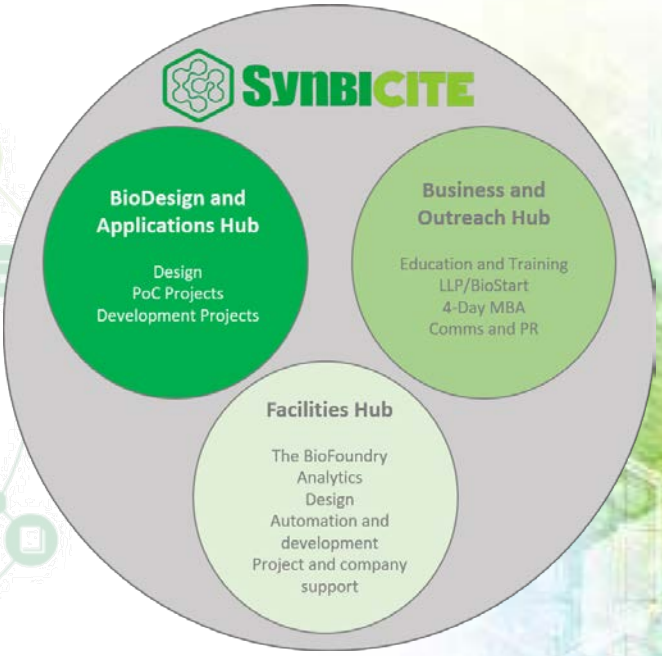
The inner core of activity comprises major interaction with around 30 companies. This interaction often covers many aspects of the activities in all three of SynbiCITE's hubs (in many cases supporting these companies from formation since 2013). A recent survey identified the total market cap of these companies to be around £790 million. (This is on the basis of a public investment of around £12 million in SynbiCITE; representing a public sector of multiplier of around 66.)

New UK Government Investment in Engineering Biology

As part of his opening address to SynbiTECH 2023 in December last year, Andrew Griffith MP, Minister of State for Science, Research and Innovation described the government's strategy of making UK the most innovative economy in the world. At the centre of this mission, Minister Griffith explained, are five critical technologies: engineering biology, quantum technologies, AI, semiconductors and future telecommunications. Andrew Griffith announced that to realise the vision for the development of the U.K.'s engineering biology industry, the government is committing £2 billion over 10 years to the field - " the shared endeavour [with the engineering biology community] will give us innovative new products, or resilience and secure supply chains and more sustainable manufacturing – all while growing the economy and creating well-paid, highly skilled jobs in the UK".

SynbiCITE's Structure and Activities

The next sections describe SynbiCITE's three hubs of activity in detail



Overview

SynbiCITE is located on the Imperial White City Campus on Level 1 of the I-HUB building. The centre comprises the co-location of two foci of activity: (i) SynbiCITE technical facilities, including the Biofoundry, admin and teaching facilities; (ii) the co-location of companies. The facility therefore represents a cluster of activities based around the three hubs of activity (described in more detail below), together with the co-location of companies. This configuration is being used to enhance the growth of the U.K.'s engineering biology industry.

Companies are provided with a series of support activities that are provided within the three Hubs of SynbiCITE.

A The BioDesign and Applications Hub

(1) BioDesign

The BioDesign and Applications Hub supports the work of companies in all areas of the Engineering Biology design cycle; but, particularly, In the areas of testing, measurement and technical standards. The main areas of support that the BioDesign and Applications Hub provides are shown in the table below. Within SynbiCITE theses areas are closely linked to the work undertaken within the Facilities Hub. This, in turn, is supported by the bioscience and engineering base within the member universities and institutions of SynbiCITE (including the UK's seven major Engineering Biology research centres, and the collaboration with Imperial College). The support provided to companies by the Facilities Hub comprises the BioFoundry, the Bio analytics Facility (eg the mass spec facility) and their associated staff scientist and bioengineers.

<table>
<tr><td>BioDesign</td><td>Build</td><td>Test</td><td>Produce</td></tr>
<tr><td rowspan="2">Computational Modelling</td><td>DNA Assembly</td><td>Characterisation</td><td>Prototype/PoC</td></tr>
<tr><td>Gene Assembly</td><td rowspan="3">Testing and Measurement</td><td>Pilot/Demo</td></tr>
<tr><td rowspan="2">Structure-based Modelling</td><td rowspan="2">Genome Assembly</td><td>Scale-up</td></tr>
<tr><td>Production Model</td></tr>
<tr><td>DNA Assembly</td><td>Assembly</td><td>Reporters and Reference</td><td rowspan="3">Commercialisation and Production</td></tr>
<tr><td>Design</td><td rowspan="2">Verification and Validation</td><td>Materials</td></tr>
<tr><td>Machine Learning</td><td>Bioassays</td></tr>
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B The Business and Outreach Hub

(1) Education and Training

This theme comprises two main activities – the Business Basics and Lean LaunchPad/BioStart Courses. The approach focuses, principally, on the task of providing a supportive business environment for start-ups and growing SMEs. This area of activity focuses on the continued development and deployment of the SynbiCITE training courses, which are designed to accelerate and enhance the commercialisation process by training the next generation of Engineering biology entrepreneurs.

a) Business Basics Course

The course is designed to provide a rapid introduction to the key elements of business practice that are needed to establish and grow a new company. An important aspect of the course is that no prior knowledge is assumed as experience shows that many of the scientists and engineers attending the course have little or no business experience or knowledge. Consequently, the course is divided into three days that are taught and supervised by teachers with expert knowledge of developing small companies.

Day 1. Setting the Scene and Getting Started – Setting up a company – Raising funds Getting Up and Running – Funding Strategy – Early stage considerations – Business planning and business plans	Day 3. Facing the Investor Challenge – Case studies and Critique
Day 2. Execution and Preparing for Commercial Success – Communications strategy – Business development and licensing – Leadership development	

b) Lean Launchpad/BioStart

Lean LaunchPad was originally developed within SynbiCITE to provide a customer facing course for start-ups and SMEs in Engineering Biology. The course runs for 12 weeks and usually involves teams of three comprising, for example, team members who are scientifically and technically oriented, and a member who is business oriented. The aim of the course is that through extensive mentoring by appropriate business experts, the teams develop an effective product/business strategy that can be funded by external investment/grants at the end of the course. The original Lean LaunchPad course has now been developed into BioStart.

Communications and PR

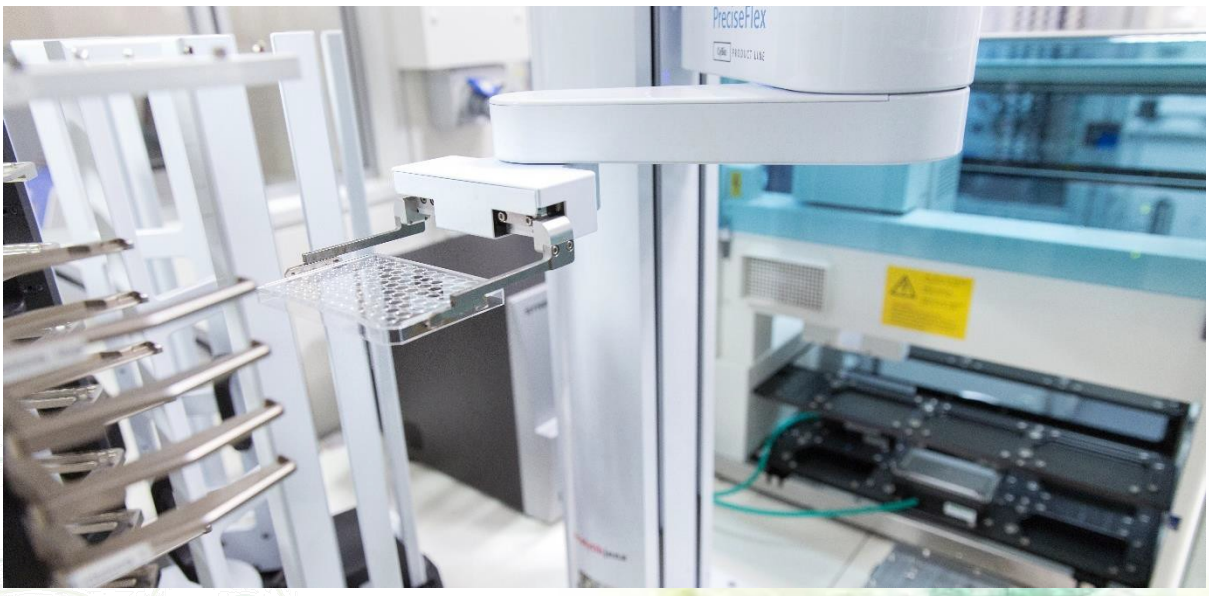
Communications and PR are key activities within SynbiCITE– www.synbicite.com. The SynbiCITE website to acts as a UK repository for Engineering Biology research and commercialisation activities, as well as policy, governance, and stakeholder engagement. Since 2019, SynbiCITE organises and runs, a major conference (SynbiTECH) which acts to nucleate the global engineering biology industry. These events highlight recent advances and challenges, and what they could mean for the future of UK engineering biology industry and the wider bio-economy.

C. The Facilities Hub

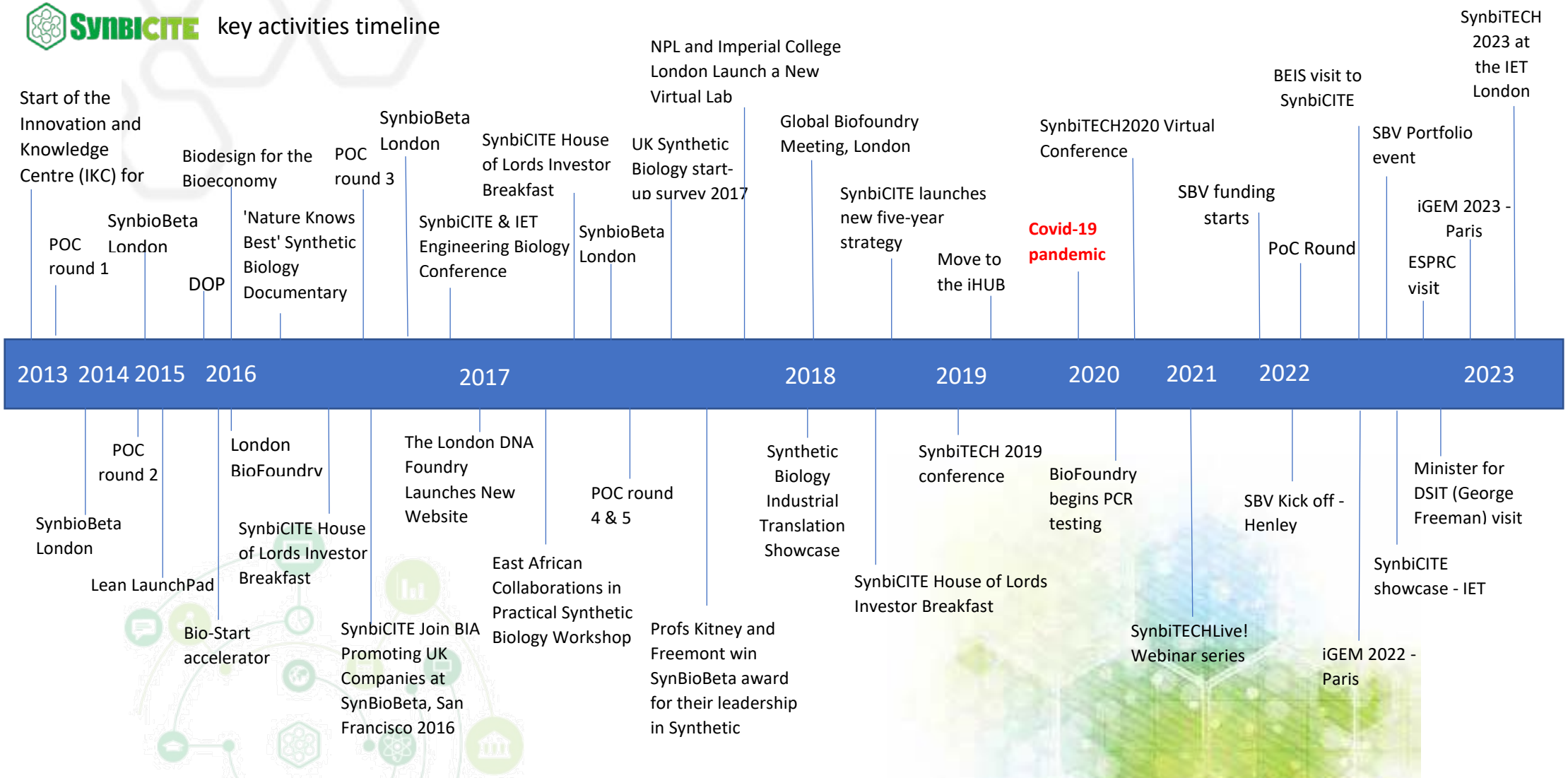
The activities within the Facilities Hub comprise three main areas: (i) the DNA foundry, (ii) the application of metrology and standards, and (iii) the bio analytics facility. Advances in the reading and writing of DNA have culminated in the development of DNA Foundries. The Foundry concept allows the compression and acceleration of the design-build-test-cycle of biological systems that can be designed and engineered to achieve commercial and industrial impact. The key to achieving commercial and industrial impact is opening up the Foundry and biological design and manufacturing processes to new researchers/innovators/companies and novel approaches. This allows information to be shared and a BioDesign ethos to be established – founded on predictability, reliability, scalability, and reproducibility. The base technology areas upon which new metrology is built in Engineering Biology are: robotics and automation (e.g. Microfluidics, liquid handling robots); data and Information; DNA and genome construction; Cellular measurements (e.g. Mass spectrometry; FACS); Fermentation and bioprocessing technology.

The Biofoundry

Foundry activity primarily comprises further expansion and development of the automation infrastructure at the core of the SynbiCITE Facilities Hub. This provides a suite of 'state-of-the-art' robotic equipment supplying automated end-to-end BioDesign, construction and validation of large genetic constructs. The Foundry is specifically designed to support the commercialisation and industrial translation of Engineering Biology – allowing SynbiCITE's partners to prototype, for example, new biologically based production platforms for chemicals, drugs and materials. Specific Foundry services will include: Data Analytics and Machine Learning; BioDesign; Automation and Protocol developments



SynBICITE key activities timeline



SynBioBeta International Leadership Award

SynBioBeta is, arguably, the world's leading business and commercial conference in Engineering Biology. The annual meeting is typically held in the greater San Francisco Bay Area, with over 1000 attendees from business, industry and academia. One annual theme of the conference is the industrial translation of research from universities and other research laboratories into industry. An important aspect of the theme is the formation and support of start-ups and SMEs (small and medium-sized companies). As part of the SynBioBeta outstanding contribution towards, the Codirectors of SynbiCITE were awarded SynBioBeta's International Leadership Award for the Industrial Translation of Synthetic Biology. This was in recognition of SynbiCITE's "important contribution to the development and support of the U.K.'s engineering biology industry".

Engineering Biology Research Consortium (EBRC)

EBRC is a not-for-profit, public-private US partnership dedicated to bringing together an inclusive community committed to advancing engineering biology/synthetic biology to address national and global needs. Membership of the EBRC comprises leading universities in the US (as well as some international universities) working in the field, together with a wide range of companies – principally from the United States. The EBRC showcase cutting-edge research in engineering biology/synthetic biology, identify pressing challenges and opportunities in research and applications. The partnership facilitates and supports compelling research roadmaps and programs to address important research and applications, as well as providing this timely access to other key developments in engineering biology. Both Professors Kitney and Freemont are on International Advisory Board (Freemont Chairs the Board), and Kitney is a member of the EBRC's Executive Committee.

Case Studies

Puraffinity

They are a green technology company incorporated in 2015 focussed on designing smart materials for environmental applications.

SynbiCITE Support

BioStart Accelerator - Winner BioFoundry
Proof of Concept Funding
Lean Launchpad training
4 day MBA More Business Acumen

Their belief is that deep science holds the answers to a myriad of environmental challenges that pose a threat to our planet and wellbeing. Cutting-edge material design coupled with creative engineering can provide a new horizon for addressing the global market PFAS treatment requirements.

Puraffinity combines chemistry and material engineering expertise to architect molecular structures that exhibit a high affinity towards target compounds and can bind them effectively. The result is a new class of targeted adsorbent media that selectively captures emerging contaminants such as PFAS. The technology we develop can be used for PFAS treatment in different applications and water matrices which cover a variety of markets such as Point of Use, municipal potable water, groundwater remediation, industrial manufacturing, airport/military bases, oil and gas. By harnessing multidisciplinary approaches and scientific principles, their mission is to create sustainable environmental solutions for tackling some of the world's most pressing challenges.

Market Pull: Grand Challenges and Societal Benefits: Global freshwater reserves are increasingly polluted due to the accumulation of persistent hazardous chemicals that remain in wastewater after current treatment methods. This leads to increasing water stress, predicted to affect 47% of the world's population by 2030.

https://www.puraffinity.com/

Case Studies

LabGenius

LabGenius develops next-generation protein therapeutics using a machine learning-driven evolution engine (EVA).

They use robotic automation, Engineering Biology and advanced machine learning to explore protein fitness landscapes and improve multiple drug properties simultaneously.

They are a privately-owned company, backed by top-tier venture capital funds, currently based in London.

SynbiCITE Support

BioFoundry
Proof of Concept Funding
Lean Launchpad training
4 day MBA More Business Acumen
Biostart Accelerator - participant

The discovery of protein therapeutics has thus far been highly artisanal, relying heavily on humans for both experimental design and execution.

Which is why we've seen diminishing returns for decades, as we're just not cognitively capable of fully grasping the complexities of biological systems.

But that's where EVA comes in: our smart robotic platform is capable of designing, conducting and — critically — learning from its own experiments.

They are initially deploying EVA to develop novel therapeutics with distinct advantages over traditional methods.

In the first instance, they're going after Inflammatory Bowel Disease (IBD). Today, protein- based IBD treatments generate billions in annual revenue, yet they are far from perfect.

They're working on a new class of protein-based IBD treatments that have the potential to be more convenient, more effective, and safer than existing options.

https://labgeni.us/

Case Studies

Prokarium

Pioneering the Field of Microbial Immunotherapy

SynbiCITE Support

Development of Prototype funding

Biofoundry

Prokarium develops vaccines against a variety of infectious diseases, basing the immunotherapy on Engineering Biology.

Using engineered strains of attenuated bacteria offers a cost-effective solution for the production of oral vaccines and bypasses the need for expensive protein purification steps. Since Prokarium's Salmonella platform has already been proven safe, the biotech is now expanding into broader indications, ranging from vaccines against infections with clostridium difficile or chlamydia to candidates targeting the Zika virus or the bacterium Yersinia pestis, which causes plague.

Prokarium is pioneering the field of microbial immunotherapy. Our pipeline is designed to unlock the next level of immuno-oncology by building on the most recent advances in cancer immunology. Prokarium's lead program is focused on transforming the treatment paradigm in bladder cancer by orchestrating immune-driven, long-lasting antitumor effects.

this adaption of our platform technology, we leverage proprietary genetic engineering interventions to build on the natural ability of our bacterial strains to seek out and colonise solid tumours. We have developed attenuated strains capable of targeting tumours without causing pathology in normal tissues. These strains are also capable of delivering specific immunostimulatory cargo aimed at activating the patient's immune system to destroy tumours.

SynbiCITE was also able to support Prokarium in obtaining funding to perform preclinical studies on its lead Chlamydia vaccine. In 2015 Prokarium applied and received funding from SynbiCITE's Development of Prototype (DoP) Fund to co-fund its critical pre-clinical studies on its lead candidate. SynbiCITE contributed £377K to Prokarium and academic collaborator Prof Robin Shattock of Imperial College to complete the pre-clinical development of its innovative Chlamydia vaccine. In addition, SynbiCITE has been able to offer its central London business facilities to Prokarium for business and board meetings.

Prokarium recently announced a $30 Million Financing to Deliver Lead Program into Clinic and Build Novel Therapeutic Platform. This follows Prokarium's announcement of partnering with Ginkgo Bioworks to leverage its world-class Foundry and extensive Codebase to develop a bactofection platform technology. Prokarium's lead program has the potential to transform the treatment paradigm in bladder cancer, one of the costliest cancers to treat, in its efforts to become the new standard-of-care in a market that has seen little innovation in over 30 years and to offer advanced therapies an alternative to Bacillus Calmette-Guérin (BCG). Prokarium's pipeline leverages evolutionary advantages of a proprietary strain of Salmonella and combines them with bespoke synthetic circuits to deliver diverse therapeutic cargo for difficult-to-treat cancers.

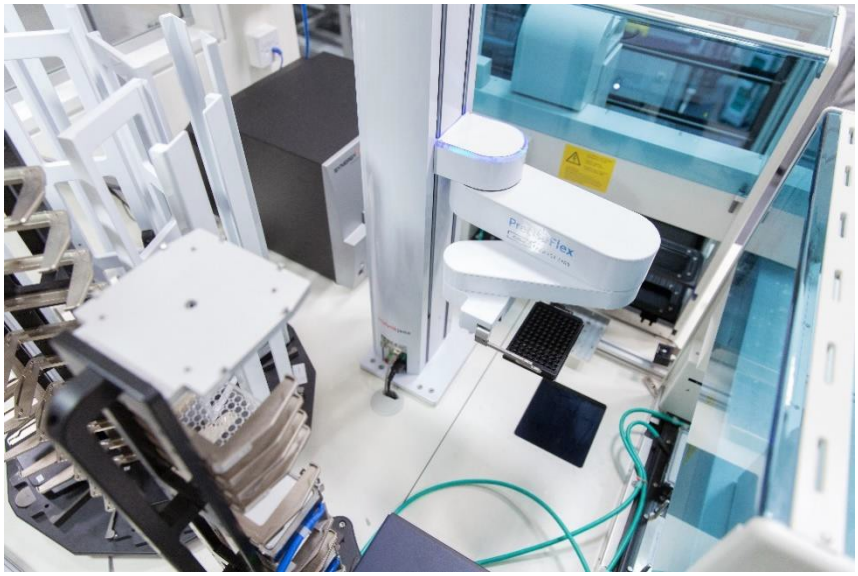
https://www.prokarium.com/

Innovation - The Facilities Hub

The London Biofoundry

Synbicite London Biofoundry rapid response projects during Covid-19 pandemic

When the extent of the threat of the SARS-CoV-2 became obvious in early February 2020 the Biofoundry team pivoted some of its activities from Engineering Biology R&D and industrial projects to a number projects designed to help with the response to what a short time later became a full blown national emergency. Start of April 2020, with case numbers rising across the country the total UK capacity for testing samples for SARS-CoV-2 was limited to 10k per day, falling seriously short of requirements for the operation of the test and trace programme. One of the main reasons have been overstretched supply lines for specialised, closed testing platforms in diagnostic labs. A Biofoundry team therefore designed reagent agnostic, open and automated testing workflows and validated a range of reagents for RNA extraction and RT-qPCR detection to provide a flexible resilient testing solution. The rapid development of this platform has been enabled by strong foundational work for diagnostic standards around virus-like particles (VLPs) as a positive control required for developing the novel workflows and provide process controls during deployment. With the automation equipment and know-how available at the Biofoundry, the team established the novel testing workflow within a few weeks and installed it at 2 testing sites (MDU, St Marys and Diagnostic Unit at Charing Cross Hospital). The novel process has been included in UKAS accreditation and contributes now 8000 samples/day testing capacity at three testing sites (Charing Cross Hospital, Imperial Lighthouse, Biofoundry). Along the gold-standard RT-qPCR tests, the team also validated next generation diagnostic test based on CRISPR and LAMP detection. This pioneering work has been described in a Nature Communications publication (Crone et al.) to support further roll-out across the communities.



In a second project stream the team focused on sequencing the genomes of the novel Coronovirus from positive samples. We and others argued that surveying the sequences and mutations of the virus variants is absolutely required to understand the spreading mechanisms and dynamics as well as keeping track of mutations that occur over time and might enable the virus to escape RT-qPCR detection and in extreme scenarios even efforts. In an early work in April we supported a team at the Dementia Research Institute in studying viral prevalence and transmission in a number of UK nursing homes addressing the crisis engulfing the care-home sector at the time. The Biofoundry team implemented a novel sample preparation pipeline for SARS-CoV-2 next generation sequencing and the resulting sequencing data allowed us to analyse infection clusters in great detail and derive spreading patterns (Graham et al.).

While working on this project, the Biofoundry team realised how cumbersome and detrimental to high throughput workflows current sequencing library methods are and decided to work with Nimagen to create a novel simplified sequencing library method, resulting in RC-PCR, one of the most efficient methods for deriving sequencing ready libraries from positive RNA samples. This new method has already been used to track the outbreak analysis at a hospital in the Netherlands (Wolters et al.) and we see this as a new foundational element for diagnostic labs in the fight against the SARS-CoV-2 pandemic.

In an ongoing collaboration with colleagues at the Charing Cross NHS Trust, the Biofoundry team established new sample pooling workflows that hold the promise to multiply existing testing capacity and automated ELISA testing workflows required for the vaccine trials ongoing at Imperial.

References:

1. A role for Biofoundries in rapid development and validation of automated SARS-CoV-2 clinical diagnostics. Nat Commun 11, 4464 (2020). Crone, M.A., Priestman, M., Ciechonska, M. et al. https://doi.org/10.1038/s41467-020-18130-3

2. SARS-CoV-2 infection, clinical features and outcome of COVID-19 in United Kingdom nursing homes. Journal of Infection, Volume 81, Issue 3, 411 – 419, Graham, N., Junghans, C., Downes, R., https://doi.org/10.1016/j.jinf.2020.05.073

3. Novel SARS-CoV-2 Whole-genome sequencing technique using Reverse Complement PCR enables easy, fast and accurate outbreak analysis in hospital and community settings. bioRxiv 2020.10.29.360578. Wolters, F., Coolen J., Tostmann, A., https://doi.org/10.1101/2020.10.29.360578

Analytics

Studies for established industrial partners continue using the analytical platform technologies, including EnzBond, Pureaffinity and FabricNano. Discussions with other start- ups and SMEs regarding future studies are progressing, including contacts re-established following SynbiTech. Academic collaborations continue, with a shift towards resource requirements being included on future grants. Using college computing infrastructure, remote set-up and monitoring on analytical instrumentation is enabled, included access to iHub equipment by connecting such systems to Imperial VPN, thus facilitating the execution of parallel projects.

Fit-for-purpose analytical measurements are an essential resource for companies of all sizes and at all stages of translation, be at it PoC, DoP or scaled production. Metrological studies are carried out to verify the identity, amount and purity of entities produced by Engineering Biology processes, either directly with collaborators undertaking the molecular biology or as part of the design-build-test-learn packages provided by the Biofoundry.

If you are interested in working with our team please send an enquiry email to info@synbicite.com

Meet some of the Team

Dr David Bell - Head of Analytics and Metrology

Following a PhD and post-doctoral research at the University of Manchester, David was recruited to establish an analytical laboratory at the biosciences research centre in a precursor to GSK. Gaining responsibility for spectroscopic facilities across multiple R&D sites, David applied his expertise to discovery research and chemical development, with an emphasis on biochemical analysis.

After a move to a small biotech, as Head of Mass Spectrometry, David transformed the workflows used, thus making a major contribution to the ongoing success of Oxford Biotherapeutics in internal candidate discovery and progression, in addition to ensuring repeat external studies with academia and pharma.

Experience at the UK chemistry National Measurement Institute, LGC, was followed by a move the centre at Imperial College London in July 2014 to establish the analytics core facility.

Using his in-depth knowledge and experience of pharma and biotech, David is responsible for analytics and metrology within SynbiCITE, providing support and advice to academics, students and partners. In addition to providing the range of analytical resources, he manages the metrology for multiple projects at different stages, from discovery to validation.

Dr Marko Storch - Head of SynBio and Automation

Marko received his PhD in Biophysics studying proteins responsible for cell division on the single molecule level at the Max Planck Institute for Cell Biology and Genetics in Dresden.

After leading an iGEM team he decided to pursue research in Engineering Biology and joined Imperial College London to build foundational tools for automated DNA assembly and next generation directed evolution systems. He won a Marie Curie Fellowship and multiple grants to support his work in automated Engineering Biology and technology transfer projects.

He then joined the London Biofoundry to lead projects in Engineering Biology and the implementation of automated workflows in collaboration with partners in academia and industry.

Laura McKay – Centre Administrator

Laura joined the Centre in 2016, having previously worked for Imperial College in a number of roles. Laura is the first point of contact for the centre. She oversees all administrative duties.

Collaborations – The Business and Outreach Hub

Standards and Metrology in Engineering Biology

The importance of engineering biology and its potential to impact a wide range of applications is well recognised in scientific, government and technology development sectors. Engineering biology is a burgeoning sector and cuts across different concepts and capabilities within life sciences as a whole, including applications such as biomedicine, bioremediation, bioenergy and innovative material and chemicals. There are many variables to factor in when looking to scale-up the production of a Engineering Biology product, and the availability of reference standards is key to enabling the full exploitation and development of Engineering Biology technologies. Yet, the inherent complexity of biological systems and molecules poses measurement challenges that are distinct from those of chemical and physical metrology; these can't be met by a single stand-alone technique or approach. As such, we find that the establishment of a unique set of standards and measurement techniques is one the most important objectives for contemporary Engineering Biology.

Standards provide certainty in the consistency of the product performance, and confidence in the ability to measure and evaluate key performance parameters. These are the main attributes in deciding which products are validated, adopted, and ultimately commercialised by industry. The growing demand for scaling up such technologies raises the issue of what is needed to make them work at an industrial scale. Establishing industry-led measurements and standards will safe-guard the quality and safety of products and allow companies to maintain competitiveness and enhance innovation.

As such, the then Department for Business, Energy and Industrial Strategy (BEIS) helped fund a partly-virtual Centre of Excellence in Engineering Biology, Metrology and Standards in 2018. As the core project partners, SynbiCITE and NPL are collaborating through this virtual centre. A higher order cell-free platform for intracellular measurements is being developed that will generate candidate reference materials and synthesis protocols in the form of a ‘toolbox’.

Industry confidence in the higher order biological reference materials that are developed will be ensured through their validation and certification by NPL, and regular engagement with the spectrum of Engineering Biology companies will help ultimately transform high-value manufacturing into high-value products. SynbiCITE is well connected with many spin-outs and start-ups, who we have seen to be the major channel for industrial translation.

A community is being developed that is committed to addressing the measurement and standards constraints that this sector faces, and which cuts across the breadth of Engineering Biology. We aim to identify key technical, regulatory and societal challenges for the development and adoption of standards, and to identify the barriers to adoption with the relevant stakeholders. If you’d like to get involved in this necessary agenda, would like more information or discuss this approach, please get in touch by emailing info@synbicite.com

Related Initiatives

Global Biofoundries Alliance (GBA)

The 'Metrology, Reproducibility and Data Quality working group' aims to address standardisation when applied to the context-dependent and emergent behaviour of living systems through the Biofoundries' infrastructure. The Working Group is currently canvasing the current metrology infrastructure in the GBA's Biofoundries and identifying open-source metrology projects that could form the basis of a collaboration that will help develop measurement protocols, reference materials and inter-operability between Biofoundries and uniformity within the early translational stages of Engineering Biology. Prof Paul Freemont is the chair of this Working Group.

Industry Club

It is now clear that Engineering Biology applications have, for example, the potential to bring about profound changes in the production of food, materials and chemicals - and help to address pressing global challenges, such as chronic disease, climate change and food security.

As a result of the pandemic, we have been living through unprecedented times. But the response to COVID-19 was a breakthrough moment for Engineering Biology, in terms of its successful application to mRNA vaccine design. The pandemic also opened doors to new Engineering Biology approaches and accelerated trends already in motion.

We're making future plans, rebuilding and re-aligning with current bio-economic development strategies. This is why we think it is now timely to relaunch our the SynbiCITE Industry Club – addressing sustainable business strategies to encompass all stakeholders, including new and emerging organisations. SynbiCITE is the UK's national translation and commercialisation hub for 80+ companies ranging from SMEs to multinational corporations.

The Industry Club will form an exclusive close-knit community of Engineering Biology professionals, both in the UK and internationally - as it continues to evolve. It will provide a forum through which innovative SMEs, spinouts and start-ups connect with the Engineering Biology community. The club will continue to enhance existing relationships between SynbiCITE and numerous companies in the field, as well as help facilitate relationships with new partners.

We can act as a broker to help companies identify suitable partners capable of providing Engineering Biology solutions to their problems - as well as help uncover innovative solutions that are unique to the field.

We can also reduce the barrier to entry into Engineering Biology by offering the resources and facilities to explore your new technology. We can offer access to SynbiCITE's London Biofoundry at the Imperial College Translation and Innovation Hub. Our evolving infrastructure provides the computational and biological capabilities to rapidly design, prototype and test living systems for specific applications.

SynbiCITE is also playing a pivotal role in a community that is committed to addressing the standards and metrology constraints and challenges that are unique to Engineering Biology – for example, through direct collaboration with the UK's National Measurement Institute, NPL.

We're committed to engaging with our industry partners to understand their challenges in relation to scale-up and commercialisation strategies.

General membership of the SynbiCITE Industry Hub is free- and we'd like to understand how we can best support you.

Contact l.mckay@imperial.ac.uk for further information.

SBRC Overview

BrisSynBio

Led by: Professor Imre Berger and Professor Dek Woolfson, University of Bristol

BrisSynBio aims to develop new techniques, technologies and reagents that will allow biologically-based products to be made easily, quickly and cheaply, and in sufficient quantities to make them useful. Researchers hope to develop new antibiotics; assemble virus-like particles to present new routes to vaccines; build simple cells from scratch; use red blood cells to deliver complex molecules like anti-cancer drugs directly to tumours; and reprogram bacteria to perform useful tasks like sensing environmental pollutants

http://www.bristol.ac.uk/brissynbio/

SBRC Nottingham

Led by: Professor Nigel Minton, The University of Nottingham

SBRC Nottingham will provide sustainable routes to important chemicals that modern society needs. They aim to use Engineering Biology to engineer bacteria to convert gasses that are all around us (such as carbon monoxide (CO), carbon dioxide (CO2) and methane (CH4)) into more desirable and useful molecules, reducing our reliance on petrochemicals

https://www.sbrc-nottingham.ac.uk/

Open Plant

Led by: Dr Jim Haseloff, University of Cambridge
Professor Anne Osbourn, John Innes Centre

The OpenPlant initiative will establish internationally-linked DNA registries for sharing information about plant specific parts and simple testbeds. The development and exchange of new foundational tools and parts will directly contribute to the engineering of new traits in plants. OpenPlant will also provide a forum for technical exchange and wider discussion of the potential impact of plant Engineering Biology on conservation and sustainability

https://www.openplant.org/

UK Centre for Mammalian Synthetic Biology

Led by: Professor Susan Rosser, The University of Edinburgh

This Centre will build in-house expertise in synthetic biology in mammalian systems for use in areas such as the pharmaceutical and drug testing industries, biosensing cell lines for diagnostics, novel therapeutics, production of protein based drugs e.g. antibodies and also programming stem cell development for regenerative medicine applications

https://www.ed.ac.uk/biology/mammalian-synbio

SYNBIOCHEM

Led by: Professor Nigel Scrutton, The University of Manchester

SYNBIOCHEM will bring scientists together to design and engineer biological parts, devices and systems for sustainable fine and speciality chemicals production, including new products and intermediates for drug development, agricultural chemicals and new materials for sustainable manufacturing

https://synbiochem.co.uk/

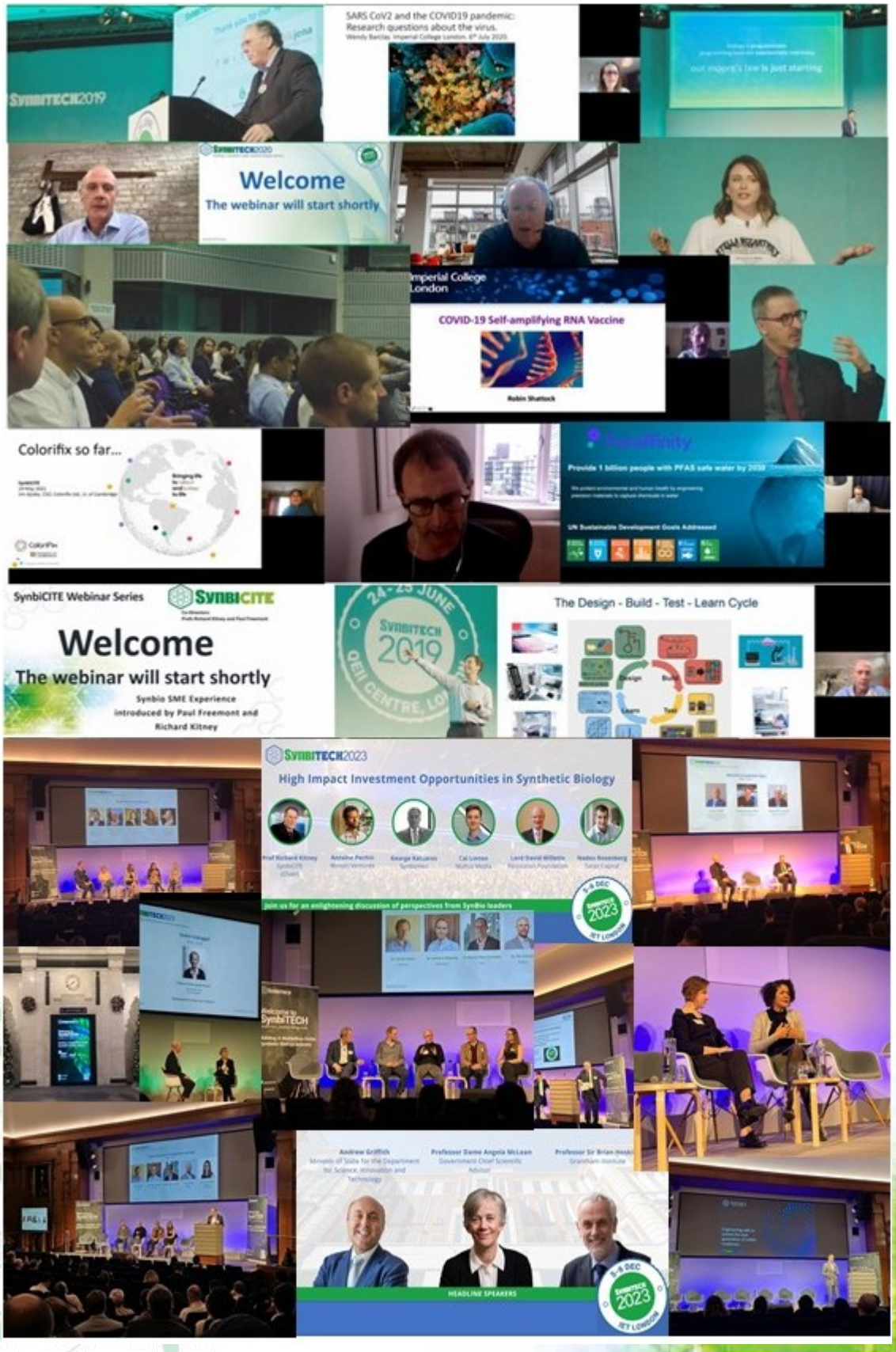
Warwick Integrative Synthetic Biology Centre

Led by: Dr Declan Bates, Dr Orkun Soyer and Professor John McCarthy, The University of Warwick

WISB will utilise state-of-the-art principles of biosystems design and engineering to develop next-generation Engineering Biology tools, biosynthetic pathways that generate valuable bioactives, synthetic communities of microbes that could help improve the environment as well as skin and gut health, and plants with enhanced resistance to stress and pathogens

https://www.wisb-uow.co.uk/

SynbiTECH conferences at a glance



SynbiTECH

SynbiTECH is SynbiCITE's annual international conference on synthetic biology/engineering biology. The conference focuses on growing the synthetic biology/engineering biology industry internationally. It typically comprises around 300 attendees drawn from industry, investment this, policy-making and research. The conference focuses on the greatest opportunities and challenges for building a multibillion-dollar industry that will contribute to the fast-growing Bioeconomy and sustainability. The conference programme comprises keynote lectures by leading speakers in the field, presentations by a wide range of companies, and panel discussions - as well as "fireside" discussions with leading experts in the field from industry, government and finance. SynbiTECH is held at the IET Conference Centre in central London.

SynbiTECH 2023

2 days

51 speakers

350 attendees

SynbiTECH Attendee testimonies

Grant Aarons, Fabric Nano

"Pretty much everyone we were looking to connect with in the synthetic biology and industrial biotechnology community was there - we got weeks of customer development done in two days! An excellent opportunity to present our multi-enzyme immobilisation and biocatalysis enhancement system to such an informed and prestigious audience"

Tom Ellis, Imperial College London

"SynbiTECH was one of the best conferences I've attended in years. Diverse and stimulating at its heart. A real showcase of biodesign and synthetic biology and the incredible future potential of these areas"

Chueh Loo Poh, AdvanSyn

"I find that the conference is very well run, and I enjoyed the talks".