

# Accelerating the commercialisation of synthetic biology



SynbiCITE is a pioneering Innovation and Knowledge Centre (IKC) dedicated to promoting the adoption and use of synthetic biology by industry.

SynbiCITE is the UK's national centre for the commercialisation of synthetic biology. The prime objective of SynbiCITE is to accelerate and promote the commercial exploitation of synthetic biology research and technology. SynbiCITE's role as nucleating point for this rapidly emerging industry is designed in time to deliver sustained and substantial benefits to the UK economy.

SynbiCITE is a unique collaboration of over 70 of the UK's leading academic institutions and industrial partners, ranging from start-ups to large multinational companies, and supporting organisations including the Northern Ireland, Scottish and Welsh Regional Governments and the Greater London Authority.

SynbiCITE was set up in 2013 with a £28 million commitment 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.

## Our goal

The vision for SynbiCITE is to create a globally renowned national resource of interacting partners from academia, industry and business which accelerates the commercialisation of world-class science and the emerging technologies encompassed by synthetic biology.

## What we offer

We support innovation and provide our partners with access to a broad array of resources designed to help translate university-based research and pre-seed concepts into commercial products, tools, processes and products.

## Education and training

SynbiCITE runs a number of innovation educational programmes throughout the year. These programmes (Lean LaunchPad for Synthetic Biology and the 4-day MBA) have been specifically designed for would-be entrepreneurs looking to start their own companies in synthetic biology.

## Funding opportunities

SynbiCITE has funding available to accelerate and enhance innovation in synthetic biology that meet clear selection criteria and can demonstrate significant commercial potential. Support for innovation at different stages of translation is provided through Proof of Concept (PoC) and Development of Prototype (DoP) awards.

## Laboratory facilities

Currently located at the Imperial College Incubator, the state of the art facilities at SynbiCITE houses all the equipment to explore the commercial potential of synthetic biology. These labs allow researchers and companies to rapidly evaluate new ideas and designs, collecting robust data to advance the technology, removing much of the risk and uncertainty in the process. SynbiCITE is staffed with a team of highly experienced scientists to help our partners manage their research projects from concepts to commercialisation.

## The Foundry

SynbiCITE is home to the DNA Synthesis and Construction Foundry.

Funded by the RCUK, the Foundry is at the core of SynbiCITE's facilities hub, providing a suite of state-of-the-art robotic equipment supplying automated end-to-end design, construction and validation of large gene constructs. The Foundry is specifically designed to support the commercialisation of synthetic biology allowing SynbiCITE's partners to prototype new biologically based chemicals, drugs and materials.

SynbiCITE is principally supported by

**EPSRC**

Engineering and Physical Sciences  
Research Council

 **BBSRC**  
bioscience for the future

**Innovate UK**  
Technology Strategy Board





## How we support our partners to commercialise synthetic biology

Prokarium uses synthetic biology to create a novel vaccination solutions.

Their innovative vaccine delivery platform, Vaxonella®, allows the production of oral vaccines using the body's own immune cells with little or no side effects and at lower costs than injectable vaccines.

Prokarium was successful in its application for DoP collaborative funding from SynbiCITE to support its pre-clinical trials for the Vaxonella® *Chlamydia* vaccine. SynbiCITE is providing £377,000 of the £498,000 project, while Prokarium provided the remaining £121,000. Under the project, Prokarium, along with its collaborator professor Robin Shattock of Imperial College London, will complete the pre-clinical development of a novel vaccine for this most commonly reported sexually transmitted disease.

[www.prokarium.com](http://www.prokarium.com)



LabGenius is creating enabling products and technologies that are driving the rapid development of synthetic biology.

Advances in enabling technologies such as low cost next-generation DNA sequencing, microfluidic DNA synthesis and CRISPR/cas9 genomic engineering are driving the dynamic growth in synthetic biology.

LabGenius is developing a portfolio of enabling and core products, the picks and shovels, of this burgeoning industry. The enabling and core products sector is predicted to exhibit the fastest growth rate with a CAGR 48% (2014-2020).

LabGenius utilise the facilities in the Foundry and are graduates of several of our education and training programmes. They have also received PoC funding from SynbiCITE which has directly contributed to their ability to develop their products and business and they have recently launched their first product - Lab Gene600™.

[www.labgeni.us](http://www.labgeni.us)



CHAIN Biotechnology is developing cutting edge microbial technology to bring renewable fine chemical products to market.

They are developing advanced fermentation technology for the production of high value chemicals and in particular chiral chemical intermediates used in a variety of applications such as nutraceuticals, pharmaceuticals and fragrances.

CHAIN are located at SynbiCITE and are able to access the full suite of facilities and equipment we offer, including the Foundry. The company has also participated in many of SynbiCITE's innovation programmes including the 3 Day MBA and Lean LaunchPad for synthetic biology. Business support with project management and funding for PoC available from SynbiCITE has been critical to the progress that CHAIN has achieved.

[www.chainbiotech.com](http://www.chainbiotech.com)



## Our team

SynbiCITE has brought people together with different backgrounds, skills and experience to create an environment that drives the adoption of new technology and business models. SynbiCITE is able to provide our partners business expertise in market and business analysis, marketing, PR and IP management.

### Principal directors

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#### Prof Richard Kitney – *Co-Director*

Richard has been working at the forefront of synthetic biology since 2003 and has been pivotal in shaping its development both strategically and in terms of UK investment. He was Chair of The Royal Academy of Engineering Inquiry into Synthetic Biology and is a member of the Ministerial Synthetic Biology Leadership Council. Richard co-directs the Imperial College Synthetic Hub, one of the world's leading R&D centres, with Professor Paul Freemont.



#### Prof Paul Freemont – *Co-Director*

Paul is co-founder and co-director of the Centre for Synthetic Biology and Innovation and National UK Innovation and Knowledge Centre SynbiCITE at Imperial College London, which form part of the Imperial College Synthetic Hub. A leading figure in synthetic biology, he has played a key role in the development of synthetic biology internationally including nominated expert in the UN Convention on Biological Diversity, a steering group member of the US NIST synthetic biology standards consortium and a Fellow of the Royal Society of Biology.

### Key managerial staff

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#### Dr Stephen Chambers – *CEO*

Stephen is CEO of SynbiCITE. Previously, he co-founded Abpro, a company using synthetic biology to generate antibodies and proteins, serving as Vice President of Technology. Prior to that, Stephen was a founding scientist at Vertex Pharmaceuticals, establishing and directing the protein production division for structure-based drug design and development of novel therapeutic agents resulting in the successful approval of HIV and HCV protease inhibitors.



#### Dr John Collins – *Commercial Director*

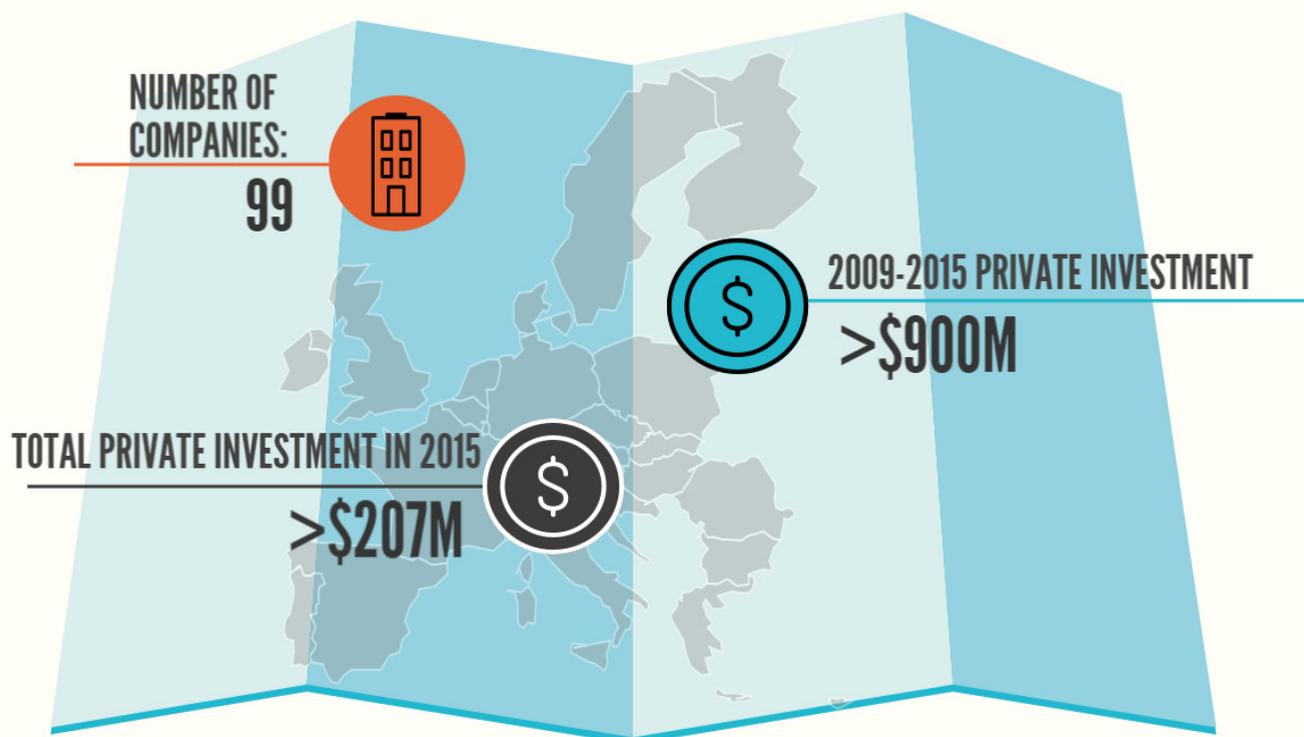
Prior to working for SynbiCITE, John had his own innovation management consultancy, running international business development for a manufacturing technologies trade association. He also worked for the Technology Strategy Board (now Innovate UK). John works with all of our partners to collaborate and run projects that will accelerate the commercialisation of synthetic biology, growing an industry based on synthetic biology to make the UK and the world a richer place.

### Get in touch

SynbiCITE, Imperial College Incubator, Level 1 Bessemer Building  
Imperial College London, London, SW7 2AZ  
✉ [info@synbicite.com](mailto:info@synbicite.com)   [@synbicite](https://twitter.com/synbicite)   [www.synbicite.com](http://www.synbicite.com)



# 5 MIN GUIDE: SYNTHETIC BIOLOGY STARTUP LANDSCAPE IN EUROPE



Global Companies: 290

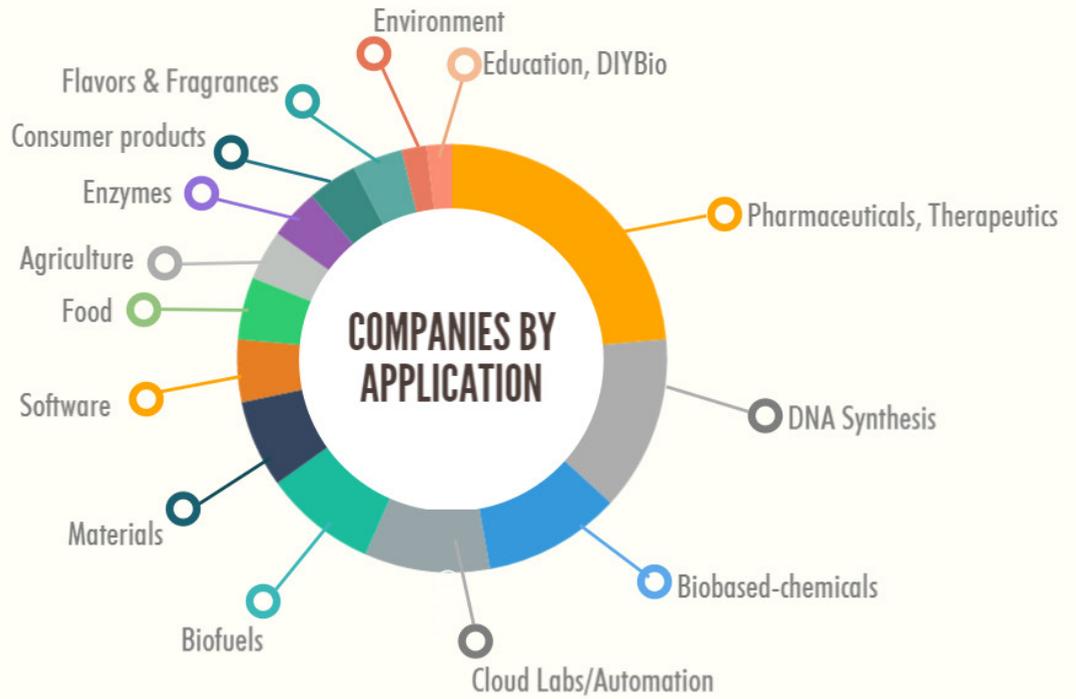
Global Private Investment 2009-2015: \$3.2B



The startup scene is buzzing at the moment; new companies are being founded by the day, investor money is piling into the field in the hopes of catching the next unicorn, wild-eyed founders roam the streets with brilliant plans to change the world – at least once they can get that first round of seed funding. You are probably reading this with visions of San Francisco or Boston, but it would be foolish to pass over the major changes happening across the Atlantic, in the innovative hubs of Europe. Still confused? Better read through our handy 5-minute guide to the European synthetic biology startup landscape then.

The first requirement on everyone's lips: show us the money! European countries are the base for almost a third of the world's synthetic biology startups, with slightly less than one hundred found in our last survey. Investment scales matched this, with European companies pulling in over \$900 million USD in private investment over the 2009-2015 period (this includes over \$207 million USD last year alone) – this is slightly less than a third of the global investment during that period (~\$3.2 billion USD).

# APPLICATIONS



# SUCCESS STORIES



**OXITEC**  
GM mosquitoes to control dengue fever



**EVOLVA**  
High-value ingredients by yeast fermentation



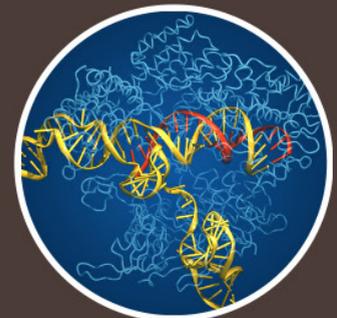
**SYNTHACE**  
High-level programming language for biology



**INGENZA**  
Bioprocesses to manufacture chemicals, pharmaceuticals and biofuels



**ELIGO BIOSCIENCE**  
Microbiome precision engineering



**CRISPR Therapeutics**  
Gene editing technology for medical therapies

As you'd expect in biotech, every company has a new and inventive way to achieve their fame and fortune. However the majority of companies (almost half, in fact) fall into the fields of pharmaceuticals/therapeutics, DNA synthesis, and bio-based chemical production. The largest share aim to produce novel pharmaceuticals, understandably given that the biotech revolution has been driving vast profits in the area ever since Genentech managed to produce recombinant insulin. Surprisingly, however, DNA synthesis is a clear second place –the ability to quickly and cheaply synthesise DNA is rapidly coming to support much of modern biotechnology, and firms are springing up to capitalise on this need.

## EU INVESTORS INCLUDE:



**OLIVER SEXTON**  
Rainbow Seed Fund



**ANDY SMITH**  
Mann Bioinvest



**JOŠKO BOBANOVIĆ**  
Sofinnova Partners



**BILL LIAO**  
SOSV



**ALEXANDRA LINDSAY**  
Calculus Capital



**DAVID MOTT**  
Oxford Capital

The need for copious amounts of synthetic DNA (and the corresponding drop in synthesis prices) were just two of the major opportunities we found in our surveys. There was a significant increase in funding supply as well, both from venture capital and government grants. This funding is sorely needed, the road from clever laboratory idea to a solid business is a difficult one with a number of expensive toll-booths on the way. In this manner synthetic biology shares many attributes with pharmaceutical development and tech companies, with immense potential rewards linked to high cash burn rates (a process which can last a very long time, if we take Amazon as an example).

Potential entrepreneurs should not worry, however (well, no more than usual) – the European market is steadily gaining a number of venture funds and incubators with an eye to setting up the success stories of tomorrow. A number of these incubators are currently based in the UK and Ireland, with well-known names such as IndieBio, Imperial Innovations, and SynbiCITE setting the pace. They are matched by a similar number of venture capital firms such as Oxford Capital, Rainbow Seed Fund and the accelerator's accelerator, SOSV.

Funding can't solve everything of course, and despite the proliferation of VC funds there remain several problems which affect the European synthetic biology scene. Some of these are universal – the difficulties of scaling processes up from the lab bench to the commercial production floor, or the sheer complexity of working with biological systems. Others are more apparent in Europe, such as the complexity of EU regulatory systems – this is particularly noticeable when dealing with genetically modified organisms. Tying into this are strong biosafety/biosecurity fears, which in turn may limit the spread of synthetic biology techniques across the continent.

## CHALLENGES

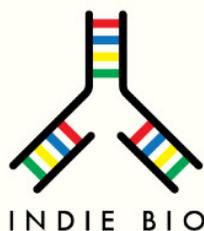
SCALE-UP TO MAKE THE LEAP FROM LAB TO MARKET

COMPLEXITY TO DESIGN BIOLOGICAL SYSTEMS

INCREASED USE OF MORE COMPLEX SYSTEMS COULD OVERWHELM REGULATORS

FEARS ABOUT BIOSAFETY AND BIOSECURITY

## ACCELERATORS/INCUBATORS INCLUDE:



# TRENDS TO WATCH FOR

Companies are using an efficient and reliable method to rapidly and precisely engineer genomes for different applications

## CRISPR GENE EDITING TECHNOLOGY

Scientists and entrepreneurs are sharing laboratory space and equipment to do biological experiments in community labs.

## DIYBio

## REPRODUCIBILITY

Powerful tools are needed to help researchers design, analyze and collaborate on experiments, to reduce error and accelerate innovation.

## VIRTUAL BIOLOGY LABS

Companies are outsourcing scientific experiments to other organizations that have the facilities and equipment. As a result, the company has access to high-quality research at lower costs.

## BIG DATA AND MACHINE LEARNING

Because of the high complexity of biological systems, better methods are needed to sort, store, analyze and learn from the data from scientific experiments.

Despite this, there are a number of major success stories coming from the European synthetic biology market. This include the ones everyone should have heard of (CRISPR Therapeutics springs to mind, as do the bright minds at Oxitec) as well as less-known successes such as Eligo Bioscience and Synthace. These companies are leading the wave of new synthetic biology firms which are targeting fields as diverse as virtual biology labs through to bio-hacker support groups.

Interested in learning a bit more than a quick five-minute overview can provide? SynBioBeta has a number of articles covering the latest news coming out of the synthetic biology scene – whether it be steady incumbents or zippy newcomers, we're the place to find out what's going on.

FOR MORE INFO, VISIT:

<http://www.synbiobeta.com/>

A PROJECT BY:

 **synbiobeta**  
The Activity Hub for the Synthetic Biology Industry

# BIODESIGN FOR THE BIOECONOMY

UK Synthetic Biology  
Strategic Plan 2016

Download the Vimeo at

<https://vimeo.com/157133305>



# THE FOUNDRY @IMPERIAL COLLEGE

You design  
...  
We execute

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Imperial College London  
London SW7 2AZ

Access our DNA synthesis & construction  
foundry from your desktop.

Letting you focus on the design & the  
Foundry on assembly & characterisation.

### *For more information:*

☎ +44 (0)20 7594 5910

✉ [stephen.chambers@synbicate.com](mailto:stephen.chambers@synbicate.com)

🌐 [www.synbicate.com](http://www.synbicate.com)



***A Maker Space for Synthetic Biology***



# the Revolution in Synthetic Biology

How are **ADVANCES** in **SYNTHETIC BIOLOGY** paving the way for **NOVEL PRODUCTS** and **NEW INDUSTRIES**?

**IMPERIAL COLLEGE LONDON**

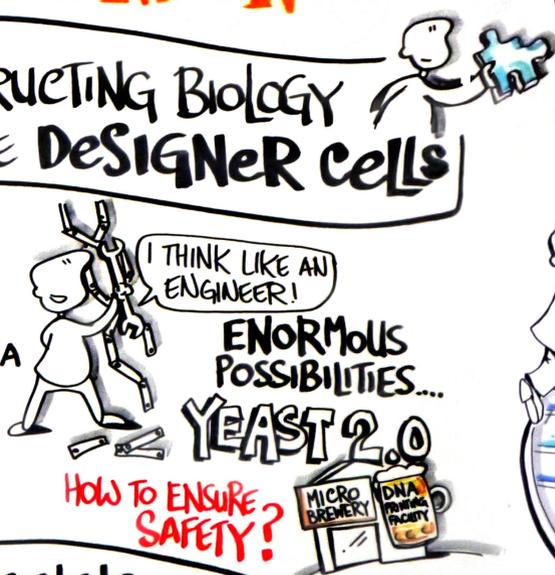
**帝国理工学院**

**RECONSTRUCTING BIOLOGY to CREATE DESIGNER CELLS**

**YEAST**

TODAY WE CAN COMBINE ITS DNA IN NEW WAYS

WE WILL BE ABLE TO DO IT IN SPACE!



I THINK LIKE AN ENGINEER!

ENORMOUS POSSIBILITIES...

**YEAST 2.0**

HOW TO ENSURE SAFETY?



**SCALING SYNTHETIC BIOLOGY from LAB to MARKET**

**HIGH VOLUME CHALLENGES**

SCALE UP to DELIVER

SPEED IS KEY!



BIOSENSOR



YOU CAN SEE THAT I AM HAPPY!

BIOSENSOR

**DEVELOPING WAYS TO ELIMINATE TRIAL & ERROR PROCESS**

CELLS CHANGE BECAUSE THE ENVIRONMENT CHANGES...

LISTEN FOR SIGNS

**CONTROL**

**OPEN SOURCE**

**RISK of BIOTERRORISM**

DIFFERENT VIEWS IN DIFFERENT COUNTRIES



LOOK AT DIFFERENT BUSINESS MODELS

**CLOUD LABS**

**CROWDSOURCE FUNDING?**

STARTING A COMPANY IS CHEAP TODAY...

**IS IP PROTECTION NECESSARY?**

BUT HOW TO BRING THE PRODUCT OUT?

PRODUCING CHEMICAL

HOW THAT HANGS LOW!

**THIS IS A TOOL**

WE CAN'T EVEN IMAGINE WHERE THEY WILL GO!

**HACKING EXOTIC ORGANISMS and PUTTING THEM to WORK**



SEEING **POTENTIAL**, AND REALISING IT

**COMMERCIAL OPPORTUNITIES AHEAD!**

I CAN LIVE ON SUSTAINABLE SOURCES, TOO!



**CHANGE**

YEAST to NOT COLLIDE WITH FOOD INDUSTRY

**HARNESS MY POTENTIAL!**

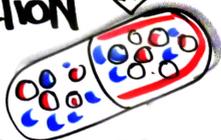
**PROGRAMMING and CONTROLLING LIFE**



**FEEDBACK**

SENSING + PRODUCTION

A PILL FULL OF CELLS READY TO PRODUCE WHAT WE NEED, WHEN WE NEED IT!



**MATHEMATICS** → **PREDICTABILITY**

CONTROLLING CELLS from our LAPTOP



I AM CONTROLLING MY HERD OF CELLS

**Carefully and Responsibly**

where will this **Tool** ?  
**Lead us ?**  
biology as a new technology