

# Chemical engineering careers in the bioeconomy

A selection of career profiles



# Foreword

In December 2018, IChemE published the final report of its BioFutures Programme.<sup>1</sup> The report recognised the need for chemical engineers to have a greater diversity of knowledge and skills and to be able to apply these to the grand challenges facing society, as recognised by the UN Sustainable Development Goals<sup>2</sup> and the NAE Grand Challenges for Engineering.<sup>3</sup> These include the rapid development of the bioeconomy, pressure to reduce greenhouse gas emissions, and an increased emphasis on responsible and sustainable production. One of the recommendations from the BioFutures report prioritised by IChemE's Board of Trustees was for IChemE to produce and promote new career profiles to showcase the roles of chemical engineers in the bioeconomy, in order to raise awareness of their contribution.

It gives me great pleasure to present this collection of careers profiles submitted by members of the chemical engineering community. Each one of these career profiles demonstrates the impact made by chemical engineers across the breadth of the bioeconomy, including water, energy, food, manufacturing, and health and wellbeing.

In 2006, the Organisation for Economic Co-operation and Development (OECD) defined the bioeconomy as "the aggregate set of economic operations in a society that uses the latent value incumbent in biological products and processes to capture new growth and welfare benefits for citizens and nations".<sup>4</sup> This definition includes the use of biological feedstocks and/or processes which involve biotechnology to generate economic outputs. The output in terms of products and services may be in the form of chemicals, food, pharmaceuticals, materials or energy. The growth of the bioeconomy is viewed to be central to achieving many of the UN Sustainable Development Goals, transitioning towards sustainable consumption and tackling climate change by reducing dependence on non-renewable feedstocks. This growth demands innovation and realisation of new technologies, underpinned by essential knowledge and skills.

As chemical engineers we must continue to support, be encouraged and evolve our knowledge to encompass new advances in engineering biology, synthetic biology and industrial biotechnology. I hope that this booklet provides inspiration to students who decide to study chemical engineering; to the professionals who work in engineering; to the companies operating in the biosector interested in the skills a chemical engineer can bring to their operation; and to the public, to help develop their understanding of the role that chemical engineering plays in society.

As demonstrated by the career profiles presented here, a career in chemical engineering is a journey, and there are many different doors to open and many different roads to exciting new opportunities. For some people this journey may start with a chemical engineering degree, but others may enter through other degree subjects or as apprentices or technicians. All have an important role to play. I wish all reading this all the very best in their own journey!



**Dr James Winterburn AMIChemE**

Chair, IChemE Biochemical Engineering Special Interest Group



























<sup>1</sup> <https://www.icheme.org/media/8634/biofutures-final-report-v5.pdf>

<sup>2</sup> <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>

<sup>3</sup> <http://www.engineeringchallenges.org/>

<sup>4</sup> <http://www.oecd.org/sti/emerging-tech/34823102.pdf>

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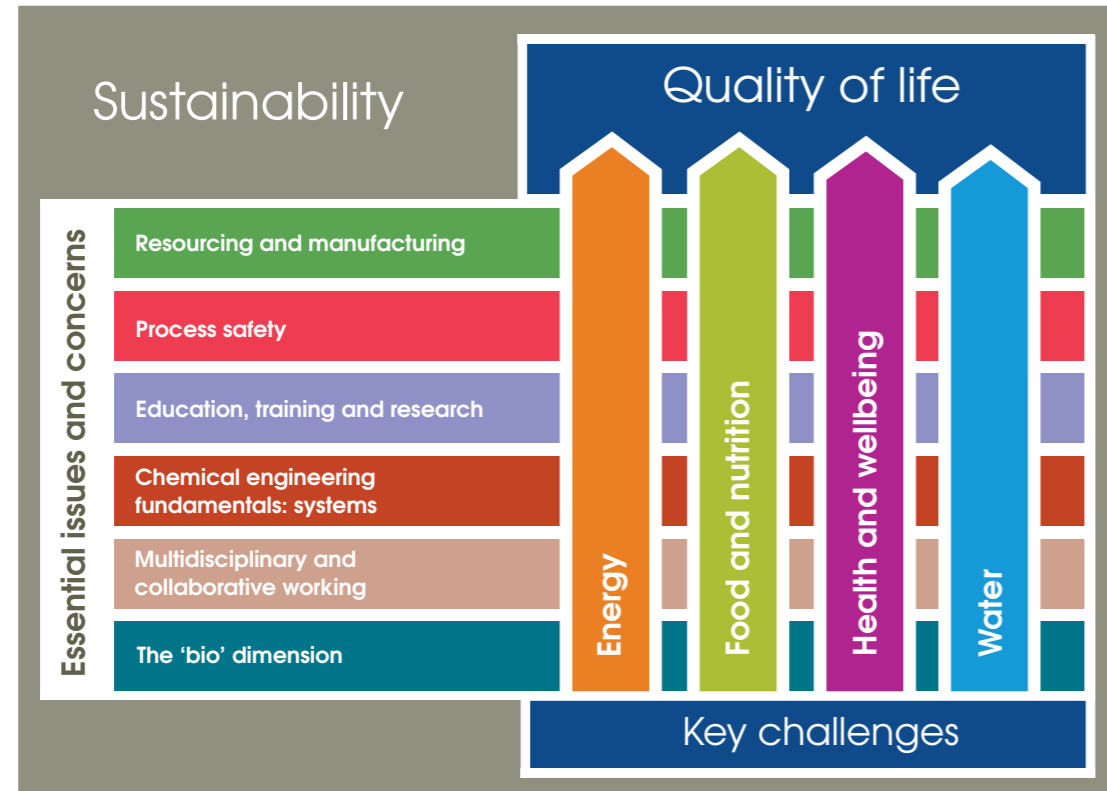
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# Introduction

Chemical engineers play an important role in increasing and maintaining quality of life. This is recognised in *Chemical Engineering Matters* and can be visualised through the chemical engineering model with the four challenge themes being affected by cross-cutting issues and concerns, all fundamental to the chemical engineer and their skillset.



This chemical engineering model was initially developed in 2011 and identified the bio dimension as a specific area of importance. This continues to be a growth area for the application of chemical engineering, but the bio dimension is relevant to and influenced by the issues of resources, manufacturing, process safety and the environment. The growth of the bioeconomy requires consideration of current and future education and the opportunities and needs for new research, innovation and development.

The fundamental principles of chemical engineering applied in the bioeconomy affect complex, sometimes living systems (eg cell cultures) and therefore cannot exist in isolation. Consequently, chemical engineers must work across disciplines in a collaborative environment now more than ever.

The work done in developing the career profiles presented here highlights examples of careers from across the bioeconomy. The diversity of these careers

demonstrates the wealth of opportunities within the chemical engineering profession, across a wide range of sectors and all around the world.

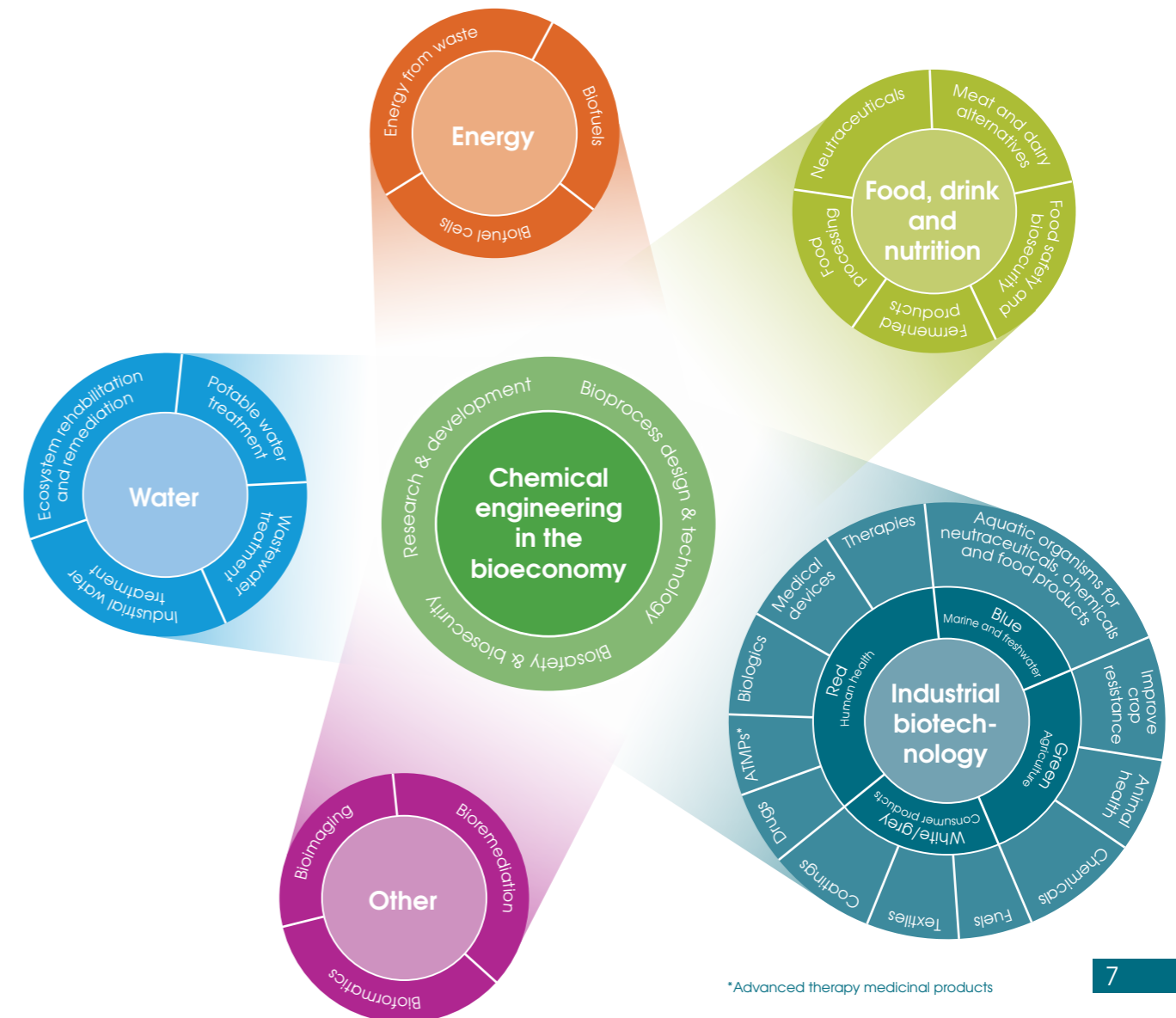
There are a wide range of areas in the biosector in which chemical engineers can work. This includes the different branches that sit within biotechnology. The diverse areas of biotechnology are matched by the diverse skillset of chemical engineers. This enables the profession to help to tackle many global challenges such as climate change, an aging population, and water, energy and food security. Biotechnology encompasses a broad range of technologies that utilise living organisms to make a variety of products. These range from biofuels and bio-derived chemicals and materials to drugs, therapeutics, medical devices and novel functional biomaterials for use in areas such as regenerative medicine, eg injectable nanocomposite hydrogels for cartilage tissue regeneration.

Biotechnology can also be applied to aquaculture where the versatility and different properties of microorganisms such as algae makes them suitable for a wide range of applications. These include as a potential feedstock for commercial biofuel production in the future, for use in water filtration systems, or as additives in food such as infant formula and ice cream or as a source of omega 3 fatty acids in nutritional supplements as an alternative to fish oils – beneficial for vegan and vegetarian consumers!

Chemical engineers also have a fundamental role in environmental protection, biosafety, and biosecurity. They play a key role in designing systems for the safe and efficient disposal of waste as well as the development of bioremediation processes and technologies which utilise microorganisms to remove contaminants, pollutants, and toxins from soil and

water, eg bioaugmentation, which is commonly used in municipal wastewater treatment.

Ultimately, the purpose of this document is to raise awareness of the impact that chemical engineers have in the world, to highlight the wide range of opportunities available to chemical engineering graduates, and to inspire the next generation of students when considering their options post-secondary education. The possibilities are endless, and contrary to the stereotype that chemical engineering can only lead to careers in the oil and gas industry. This document presents a small number of potential career paths that chemical engineering graduates may follow upon completing their education. The illustration below further highlights some of the areas open to chemical engineers wishing to pursue careers in the bioeconomy.



\*Advanced therapy medicinal products

# John McAndrew

Asia Pacific Process Discipline Leader

Stantec  
Dunedin, New Zealand



## Degree(s) – year, subject and university

2003 – MEng Chemical Engineering and Environmental Technology, University of Manchester Institute of Science and Technology (UMIST), UK

2004 – MSc Clean Technology, University of Newcastle Upon Tyne, UK

## Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?

IChemE Fellow (FIChemE)

Chartered Chemical Engineer (CEng) professional registration

## What is your role and how do you apply the principles of chemical/biochemical processing engineering?

I am a consultant process engineer in the water sector. My role includes the selection and design of processes to treat wastewater as well as commissioning, optimisation and troubleshooting. I use core chemical engineering principles like process modelling; unit process selection and sizing; and of course, 'safety in design'.

## Please briefly outline your journey from graduation to your current role.

After graduation I completed a master's degree which included an industrial placement. I spent three months conducting a waste minimisation study at a chemical plant and was eventually offered a permanent role.

## Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?

After three years working at the chemical plant, I moved into the water sector and after two years in Warrington (UK) I relocated to Australia ... eight years later I moved to New Zealand.

## When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?

The enduring theme has been that I always wanted to do something which is making a difference to the environment and our planet. I have found that a career in chemical engineering is a powerful tool to do this in a whole range of industries.



## What is the best thing about your job and working in the bioeconomy?

Understanding the importance of relationships and networks. You don't always need to know how to do everything, but if you know someone who does and the right questions to ask, then combined with your core analytical and engineering skills you can deliver powerful solutions.

## What does it take to do your job (skills, strengths and knowledge)?

Having a positive impact on the environment. Adopting biological solutions is a great way to achieve this and we can learn a lot from natural processes. Work hard, work well with other people, understand their perspective, ask lots of questions.

## What are the biggest challenges in your job?

Taking a step back from the pressure of day-to-day technical project delivery to be a little more strategic and look to the future.

## What do you think is the same as other chemistry or process related industries and what do you think are the main differences?

Similarities: common unit processes and technologies.

Differences: wastewater 'feedstock' is inconsistent, and we need to treat whatever we get.

## What do you think sets the biosector apart as a good place to work?

There's a lot we can learn from nature and working in the biosector is a chance to really embrace this and make a positive contribution to society and our planet.

## What is the most exciting part of working in the biosector/in your company?

The push for resource recovery and the change in perception from wastewater treatment plants to resource recovery plants.

Working in a global company means there are lots of phenomenally talented people to learn from and diverse project opportunities.

## What are some of the exciting recent developments in your sector/company?

The water industry is really excited about producing 'products' from wastewater like bioplastics and power – which is really cool.

## What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?

Look for as much work experience as you can during your studies and be flexible about the type of work you try.



# Molly Bell

**Technical Plant Engineer,  
UK Energy Division**

SUEZ Recycling and Recovery UK  
North East, UK



**Degree(s) – year, subject and university**

2017 – BEng Chemical Engineering, Newcastle University, UK

**Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?**

IChemE Associate Member (AMIChemE)

I may complete a Master's, which will facilitate career development and support me in future roles.

**What is your role and how do you apply the principles of chemical/biochemical processing engineering?**

My role as a Technical Plant Engineer is to offer technical support to our UK Energy from Waste (EfW) facilities. I am responsible for conducting operational performance evaluation and plant optimisation.

Current projects include a design review of the flue gas treatment systems. This is being achieved using computational fluid dynamics (CFD) modelling and analysis of the reactions taking place within the reactors.

**Please briefly outline your journey from graduation to your current role. Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?**

I was introduced to a Chartered Chemical Engineer, who was a plant manager at SUEZ, and he sparked my interest in engineering.

During my degree, I completed two summer internships with SUEZ resulting in an offer for a place on its Graduate Scheme. During the internships I worked with a female senior engineer who was an excellent role model and I have already learned a great deal from her.

**When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?**

When I started my degree, I had no idea what I wanted to do with my career. I studied engineering because of the wide range of career possibilities it offered. However, following my internships with SUEZ, I decided that the waste industry was a suitable starting point.

**For those who didn't start out in biotechnology, what transferable skills made the transition possible?**

The combustion process is basically a chemical reaction for waste breakdown. It's important to understand the waste composition and what it deforms into. Similarly, knowledge of thermodynamics is required to understand the overall process of energy production.

**What is the best thing about your job and working in the bioeconomy?**

The waste industry is emergent in terms of technology and constantly going through changes to find alternative and innovative uses for waste such as the End of Life (EoL) plastics plant which is being designed to produce oil from waste plastic.

**What does it take to do your job (skills, strengths and knowledge)?**

Fundamental engineering and chemistry knowledge are essential. Thermodynamics is relevant for energy production processes and knowledge of predictive modelling is advantageous. Innovative thinking is also important to address issues with inconsistency with waste composition.

**What are the biggest challenges in your job?**

As a young engineer, my main challenge is lack of experience. I am working hard to improve my knowledge of all aspects of SUEZ, including landfill and processing. I've increased in confidence and look forward to being handed further responsibility in the future.

**What do you think is the same as other chemistry or process related industries and what do you think are the main differences?**

It is difficult to say as my experience is solely in the biosector. The fundamentals of chemical engineering apply to most industries, but each sector requires specific knowledge. Some industries are optimising existing processes; however, the biosector demands new skills and technologies in order to find solutions to challenges the world faces today, such as global warming.

**What do you think sets the biosector apart as a good place to work?**

The waste industry is constantly changing and developing, leaving room for engineers to be involved with a wide variety of projects. Additionally, we need to work with the community to shape its views/thinking towards waste and its disposal.

**What is the most exciting part of working in the biosector/in your company?**

SUEZ is involved in energy from waste, landfill management, water treatment and waste processing and recycling. This allows me to learn something new by working with people from different disciplines and to be involved in a wide range of projects.

**What are some of the exciting recent developments in your sector/company?**

SUEZ is in the process of building an eco-park where waste will be anaerobically digested to produce biogas and used as a fuel for combustion. At the same facility there is a gasification process which will use waste as the feedstock. It's exciting to have potentially found an alternative to simply burning the waste.

**What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?**

Keep up to date with changes and developments in the industry, using IChemE special interest groups and publications. Get involved with your professional body – there are many opportunities to volunteer with IChemE throughout your career and I am currently the Vice-Chair and Secretary for the Teesside Members Group.

Gain work experience and get networking! I was offered my first placement, and subsequently my position as a graduate with SUEZ by keeping in touch with staff I had met on a previous site visit.



# Alexander Smith

## Production Engineer

United Utilities  
North West England, UK



### Degree(s) – year, subject and university

2015 – MEng Chemical Engineering, Newcastle University, UK

### Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?

IChemE Associate Member (AMIChemE)

### What is your role and how do you apply the principles of chemical/biochemical processing engineering?

I am the onsite technical authority for optimal operation of the United Utilities Sludge to Energy (S2E) process and fertiliser production and I am also responsible for providing technical support to four anaerobic digestion sites. I analyse the process performance and efficiency of every process step. To do this, I assess the site mass and energy balances to correctly size unit operations for future investment and to manage biogas to ensure the anaerobic digesters have adequate process heating for optimal gas yield and sludge treatment.

I also apply many safety principles when managing complex sites. These include having an appreciation for the Dangerous Substance and Explosive Atmospheres Regulations (DSEAR), change management procedures, carrying out Layers of Protection Analysis (LOPA) and Root Cause Analysis (RCA) following incidents.

### Please briefly outline your journey from graduation to your current role.

Following graduation, I worked as a graduate Chemical Engineer at Sellafield, decommissioning nuclear legacy facilities that have waste sludge in them. I also completed a secondment to the operations department of a spent nuclear fuel reprocessing plant. This allowed me to better understand how a chemical plant runs day-to-day and how operations are managed safely and improved.

### Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?

Following my graduate scheme at Sellafield, I wanted to apply the knowledge I developed to the renewable energy sector as well as continue to develop my knowledge in sludge treatment and processing. I also wanted a role where I could apply and develop technical knowledge and be involved in day-to-day operations to have a more hands-on approach. This led to me applying for my current role at United Utilities.

### When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?

I wanted to study chemical engineering as I believed it was a degree that would give me skills to make important decisions around improving the environment.

### For those who didn't start out in biotechnology, what transferable skills made the transition possible?

I wanted a graduate job that would allow me to develop as an engineer and provide interesting real-world challenges to learn from.

I developed a lot of transferable skills in data analysis and unit operation performance/efficiency analysis.

I also developed skills on how to communicate complex technical information effectively to engage and influence important stakeholders, to drive operational and process changes.

### What is the best thing about your job and working in the bioeconomy?

The variety of activities involved in the role which can vary from technical design support for projects to operation and management of sites.

The best thing about working in the biosector is that it is a fast-moving sector and you can achieve a lot of change in a short space of time.

### What does it take to do your job (skills, strengths and knowledge)?

The most important skill is to condense technical information into easily understandable communications that can be used to drive change at all business levels.

### What are the biggest challenges in your job?

The industry is similar to other chemical or industrial processes, as individual unit operations, regardless of industry sector have issues and do not run perfectly. Therefore, I am often problem-solving using similar thought processes and techniques.

The biggest difference for me is scale of treatment processes. When I was in the nuclear industry, I was treating thousands of m<sup>3</sup>/decade. Since moving into bioresources, I can treat thousands of m<sup>3</sup>/day of sludge.

### What do you think is the same as other chemistry or process related industries and what do you think are the main differences?

I feel like I can achieve a lot in a short space of time in my industry.

### What do you think sets the biosector apart as a good place to work?

The wide range of opportunities to develop as an engineer; opportunities to support projects, commission plants, provide technical support to operations and manage operations.

### What is the most exciting part of working in the biosector/in your company?

The UK anaerobic digestion and biogas market is being reformed which opens the possibility of trying new types of digestion such as co-digestion of different waste streams and opening up different sludge and biogas treatment technologies.

### What are some of the exciting recent developments in your sector/company?

It's important for students and graduates to know what they enjoy about chemical engineering, what they want to achieve from their career and how an employer can help them achieve this.

### What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?

Many aging unit operations are reaching their design lifetime but not much funding is available. A challenge is to determine how best to spend money and change operations to maintain high process efficiencies.



# Lewis Eaton

## Wilton Energy from Waste (EfW) Plant Engineer

SUEZ Recycling and Recovery UK  
North East, UK



### Degree(s) – year, subject and university

2014 – BEng Chemical Engineering, University of Teesside, UK

### Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?

IChemE Associate Member (AMIChemE)

After university, I considered studying a Master's degree but decided that I wanted to gain some industry experience and apply the knowledge I gained from my degree. It's something I'll consider in the future.

### What is your role and how do you apply the principles of chemical/biochemical processing engineering?

Plant Engineer – performance monitoring and optimisation. The main principles of chemical engineering are applied as part of performance monitoring and troubleshooting include thermodynamics, heat transfer and mass and energy balances.

### Please briefly outline your journey from graduation to your current role.

I joined SUEZ as a Graduate Engineer on the End of Life Plastics (ELP) project. After one year, I transferred to the Wilton Energy from Waste (EfW) project. I was promoted to site Process Engineer after one year and I am currently the Plant Engineer. I've received huge support and opportunities during my years with SUEZ and this has allowed me to gain some fantastic experience.

### Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?

During my degree I became more interested in the energy side of things and wanted to move into a role that would give me this exposure.

### When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?



### What is the best thing about your job and working in the bioeconomy?

It provides environmental responsibility that is exciting and challenging. There are always new ideas and my experience with the ELP project was a great example, processing end-of-life plastics to produce a crude hydrocarbon fuel that was refined into fuel oils. The energy-from-waste process that I currently work with is now an established process around the world.

### What does it take to do your job (skills, strengths and knowledge)?

Coffee! As with many industry roles an understanding of the fundamentals of engineering is important. There is chemistry involved on both the flue gas side and within the water/steam cycle. The knowledge I've gained around other engineering disciplines also helps. The role requires an analytical mind and an eye for detail. Strong interpersonal skills are also very important.

### What are the biggest challenges in your job?

I think the biggest challenges are fault finding and trying to improve the process. Working with complex systems can make investigations and root cause analysis (RCA) difficult, although very satisfying.

### What do you think is the same as other chemistry or process related industries and what do you think are the main differences?

As above, but the main differences are surrounding the legislation. The EfW process has developed greatly and we are now operating true energy recovery plants. However, the primary purpose of an EfW is still diverting waste from landfill as a valuable resource. This brings social and environmental responsibility which is maybe not as great in other related industries. Part of this responsibility is maintaining healthy relationships with local authorities/communities and helping educate where we can.

### What do you think sets the biosector apart as a good place to work?

The sector is continuously demanding improvements, which is a great driver for you as an engineer.

### What is the most exciting part of working in the biosector/in your company?

The responsibility of the biosector to improve processes and develop new ideas is increasing. This healthy pressure helps promote a natural growth within the industry and working within SUEZ I feel very much a part of this.

### What are some of the exciting recent developments in your sector/company?

The ELP process that I worked with was very exciting. Having the opportunity to work with and help develop this process was unique. Another exciting development within SUEZ is the use of gasification to treat waste.

### What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?

I think the best advice is to get some exposure to the industry through networking and keep up with recent developments and publications in the industry. IChemE is a useful learning resource too with the special interest groups.



# Charles Madondo

**Biomass Process Commissioning Engineer**

Bouygues  
Northern Ireland, UK



**Degree(s) – year, subject and university**

2014 – MEng Chemical and Nuclear Engineering, University of Leeds, UK

**Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?**

IChemE Associate Member (AMIChemE)

I studied Java Programming after my degree.

**What is your role and how do you apply the principles of chemical/biochemical processing engineering?**

My role is Commissioning Engineer. Plants are built to perform to a design specification, and at commissioning stage I witness testing by the vendor and sign off on behalf of the organisation that all functionality complies as per design.

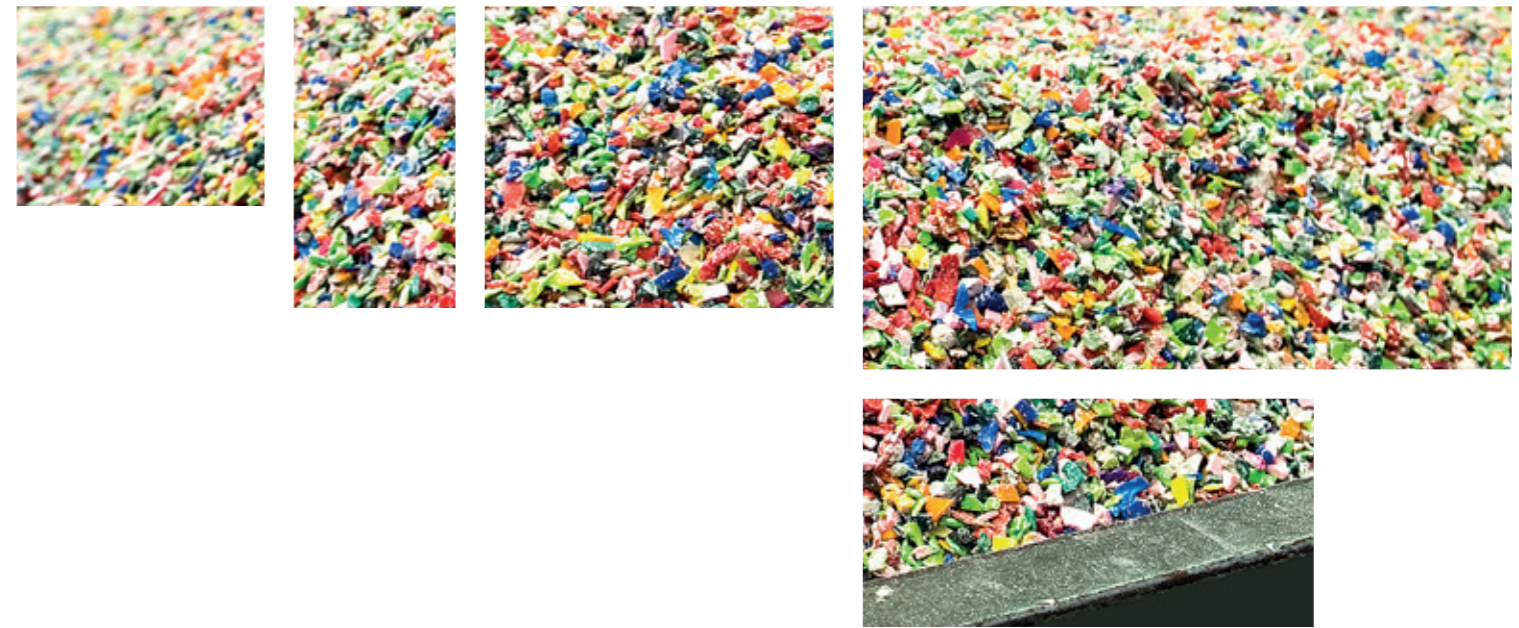
**Please briefly outline your journey from graduation to your current role.**

After graduation, I moved straight into the energy-from-waste industry as a Technical Plant Engineer. I reported to the Plant Manager and Technical Manager. I handled reports that answered to projects they allocated me. Both the technical manager and plant manager supported me and valued my work. I was included as a point of reference in projects that required chemical engineering skills at other sites in the UK.

**Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?**

**When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?**

I wanted to work at a power station. That was fulfilled when I joined Suez.



**For those who didn't start out in biotechnology, what transferable skills made the transition possible?**

I think the IT course in the university syllabus was important, in the sense that most companies immediately give you a laptop and a phone to use when joining them.

**What is the best thing about your job and working in the bioeconomy?**

The ability to explain in simpler terms the complex nature and behaviour of a process and use tools and maths to justify the reason for a certain behaviour being abnormal or normal.

**What does it take to do your job (skills, strengths and knowledge)?**

You need to be able to visualise and relate concepts in mathematical form. You are faced with data and phenomena in a complex and sometimes uniformed manner. This amount of data can be repetitive and seemingly normal. Therefore, the ability to correlate and see the differential is important. This can be achieved when the engineer collects relevant data and transforms this into a picture with the use of graphs and equations.

**What are the biggest challenges in your job?**

The biggest challenge is selling your ideas to senior managers who have great experience but less engineering knowledge.

**What do you think sets the biosector apart as a good place to work?**

The biosector is thriving and new. The biosector work culture is not predetermined; it is currently forming. There is opportunity for starters to be able to influence this culture to their advantage as compared to readily established cultures eg oil and gas.

**What is the most exciting part of working in the biosector/in your company?**

The knowledge that material previously regarded as waste and disposed of in landfill or elsewhere is now being recycled and making the environment better and being turned into useful energy.

**What are some of the exciting recent developments in your sector/company?**

Almost every borough in the UK will be investing in the biosector.

**What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?**

Computer skills are essential in this sector. Students could ask their university to come up with different assignments to resolve issues like NOx emissions, heat energy transfer, material handling and analysis. These projects can make a student stand out at the application stage as it demonstrates knowledge and interest.

# Peter Smith

President/CEO

PWS Technology  
Western Canada and UK



**Degree(s) – year, subject and university**

1961 – HND Applied Chemistry, Medway College of Technology, Royal Institute of Chemistry, UK

1962 – Diploma in Chemical Engineering, West Ham College of Technology, UK

**Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?**

IChemE Fellow (FIChemE)

Chartered Chemical Engineer (CEng)

PEng (Canada)

**What is your role and how do you apply the principles of chemical/biochemical processing engineering?**

I lead a company that is involved in the development of new technology for the cleaning and extraction of value-added products from biomass. We use counter-current extraction, distillation and reverse osmosis.

**Please briefly outline your journey from graduation to your current role. Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?**

I worked for BP Kent Oil Refinery as a 'sandwich' student and later as a qualified chemist where I specialised in distillation. In 1962 I moved to Sarnia, Ontario with Dow Chemical as a process engineer, designing chlorine and ethylene plants.

I moved to Alberta in 1966 to work with Bechtel on the development and design of the extraction plant for the Athabasca Oil Sands (now Suncor plant) and project engineering on oil and gas production plants for Imperial Oil (Esso).

I returned to the UK in 1968 and worked for Woodall Duckham on business development in Pakistan and the UK. In 1970 Bechtel London approached me and I returned to work on a Belgian oil refinery and troubleshooting on a copper concentrator project in Mauritania, West Africa.

In 1972 I was head-hunted to join Kvaerner Engineering in Oslo to help develop the company into offshore, mainly North Sea engineering work including Cod, Tor, Frigg and Statoil projects, and the Abu Qir gas project in Egypt.

I then worked for many years mainly with Scandinavian engineering and oil clients on business development and planning of major projects. Work in Sweden included consulting on floating fertiliser projects for the Swedish Shipbuilding Corp. yards, and LM Ericsson on a diversification into pipeline control for the gas company in Qatar.



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**When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?**

In 1990 I started PWS Technology (PWST) in British Columbia, Canada. In 1990, PWST built a pilot plant with Agriculture Canada to demonstrate low/no alcohol wines, beers, cider, spirits, with a key aroma recovery stage. The process was further developed to produce refined natural products from essential oils, the first being Terpinen-4-ol from Australian tea tree oil.

I was head-hunted to Suncor as Technical Director. I worked on the development of a new process to clean oil-sand bitumen, consortium with Syncrude, Suncor, and Esso.

I first worked with large companies and moved around to get good training in multi-discipline engineering contracting. This helped me to identify process design, project management and sales as my way forward.

**For those who didn't start out in biotechnology, what transferable skills made the transition possible?**

My knowledge of distillation has helped, together with marketing, sales experience and project management.

**What is the best thing about your job and working in the bioeconomy?**

My work is all new.

**What does it take to do your job (skills, strengths and knowledge)?**

Wide experience and taking risks.

**What are the biggest challenges in your job?**

Projects are new and take a long time to develop and that means cash flow is difficult.

**What do you think is the same as other chemistry or process-related industries and what do you think are the main differences?**

The basic chemical engineering technology is similar; the main difference is unusual operation conditions.

**What do you think sets the biosector apart as a good place to work?**

New opportunities, often with new companies.

**What is the most exciting part of working in the biosector/in your company?**

When we start up a new process and it works!

**What are some of the exciting recent developments in your sector/company?**

Renewable fuels from forest waste.

**What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?**

Get wide experience.

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# Yvonne Owens

## Whey Intake Production Manager

Glanbia Ireland  
Leinster, Ireland



### Degree(s) – year, subject and university

2009 – MEng Chemical Engineering, Queen's University Belfast, UK

### Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?

IChemE Associate Member (AMIChemE)

- Dairy Science and Technology Diploma
- Accounting and Project Management Diploma
- NEBOSH Certificate
- City & Guilds Operation of Evaporative Cooling Towers
- Lean Six Sigma Yellow Belt
- Text Processing Diploma.

### What is your role and how do you apply the principles of chemical/biochemical processing engineering?

Production Engineer in food manufacturing – using principles of heat transfer, chemistry, personnel management and health & safety to optimise and make process improvements.

### Please briefly outline your journey from graduation to your current role. Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?

After graduation, I started the Shift Operations Manager Graduate programme with British Sugar. This included a NEBOSH diploma in Health & Safety, and after three years, I progressed to the Shift Operations Manager role.

After British Sugar I took up the role as Casein Production Manager in Glanbia Ireland and recently moved to whey production. Glanbia sponsored a Diploma in Food Science and Technology and an Accountancy Certificate.

### When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?

I knew I wanted to work in industry, rather than in academic research. I enjoy seeing how things work and fixing problems. The food industry gives me this through engineering and process technical challenges.

### For those who didn't start out in biotechnology, what transferable skills made the transition possible?

My structured training gave me responsibility for safety, throughput, quality and personnel which made me very employable. I also undertook an online course in lean six sigma as I knew this would be attractive to any future employers.

### What is the best thing about your job and working in the bioeconomy?

I enjoy the diversity of working in food processing. The dairy industry is expanding and Glanbia is investing heavily. This means there are always opportunities for development.



### What does it take to do your job (skills, strengths and knowledge)?

Tasks include; managing throughputs and maximising yields, scheduling activities, developing and coaching operators, identifying and supporting health and safety initiatives, responding to safety incidents, ensuring product quality and optimising product constituents, investigating quality non-conformances, managing variable costs – embedding continuous improvement principles/lean six sigma and ensuring environmental compliance

Strengths: leadership, good communication – for peers, service providers, suppliers and line reports, report writing skills, troubleshooting, investigation and technical ability.

### What are the biggest challenges in your job?

The biggest challenges come from trying to balance workload, issues from aging infrastructure and changing markets. We are now selling our product into 'value-add' markets – this changes the specifications/requirements of the product, which cannot be easily/consistently met.

### What do you think is the same as other chemistry or process related industries and what do you think are the main differences?

- technical aspects eg pumps/valves
- cleaning – the hygiene of lines/tanks etc is critical to our products
- people skills
- safety skills
- troubleshooting/six sigma tools

### What do you think sets the biosector apart as a good place to work?

I enjoy the flexibility offered by the dairy industry as it allows me to make process changes and optimise the process rapidly. We manage change, but our response time must be immediate because of the live nature of the milk we use as a feed material.

### What is the most exciting part of working in the biosector/in your company?

The dairy industry is significantly expanding. This means there are always opportunities for development.

### What are some of the exciting recent developments in your sector/company?

New markets for dairy products, new product developments and the investments required for both areas.

### What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?

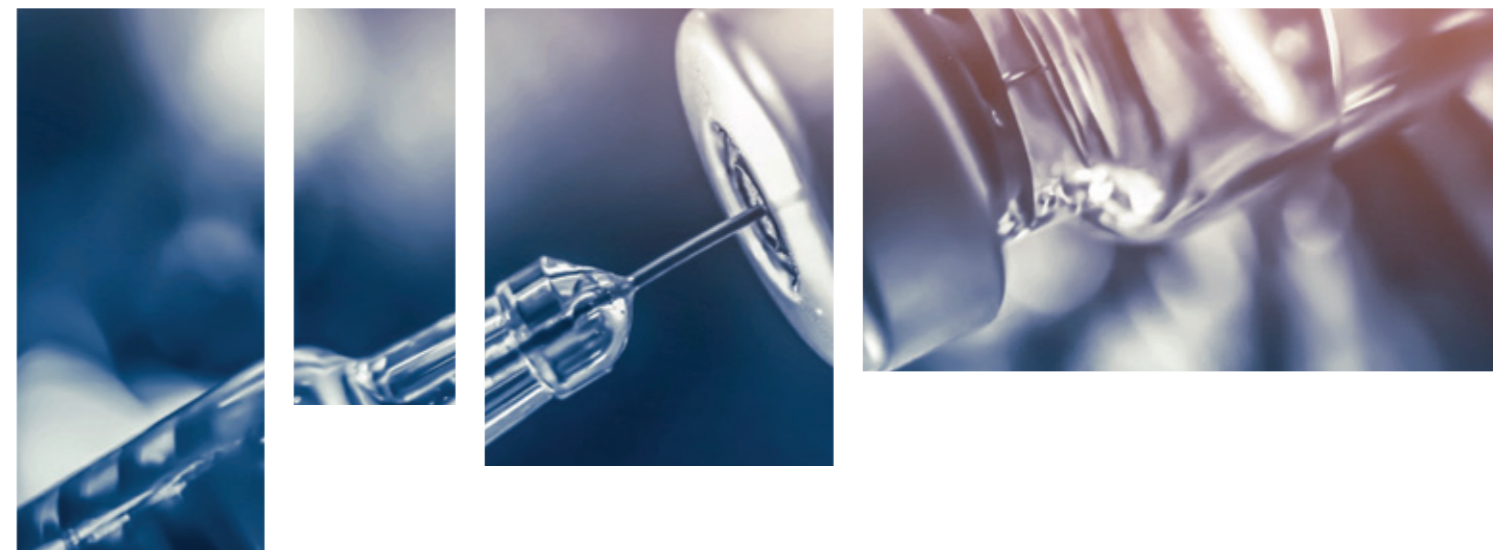
Gain as much work experience as possible.

Keep your skills base broad – my role requires a range of skills rather than one speciality.

# Joe Rogers

Process Engineer

Mace/Porton Biopharma  
South West, UK



**Degree(s) – year, subject and university**

2016 – MEng Chemical Engineering, University of Bath, UK

**Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?**

IChemE Associate Member (AMIChemE)

I completed the Institute for Occupational Safety & Health (IOSH) Managing Safely course as part of my permit-to-work issuer training. I have also completed the Project Management Qualification from the Association for Project Management.

**What is your role and how do you apply the principles of chemical/biochemical processing engineering?**

As a Process Engineer, I am responsible for supporting several capital projects as well as carrying out troubleshooting activities and process improvements. I led a project to install a plant steam system in an existing facility where I had to consult steam tables, estimate steam consumption, calculate pipe sizes and select materials of construction.

**Please briefly outline your journey from graduation to your current role.**

After graduating, I joined GSK where I supported a major project for the revamp of active pharmaceutical ingredient (API) manufacturing facilities. I also managed an API production facility, ensuring that all safety, quality and production targets were met.

**Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?**

I then joined Mace as a Project Manager, where I supported and led a number of projects ranging from £10k–£15m.

**When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?**

I didn't know what I wanted to do, I just knew that I wanted to get some experience and start paying off my student loan.

**What is the best thing about your job and working in the bioeconomy?**

The industry is very innovative, and I like that the products we make have a significant impact on people's lives.

**What does it take to do your job (skills, strengths and knowledge)?**

I'm required to think on my feet and apply my engineering knowledge to come up with a solution to the problem which often needs to be rectified quickly. A level head, tenacity and logical thinking are a must.

**What are the biggest challenges in your job?**

Aging equipment and regulatory barriers.

**What do you think is the same as other chemistry or process related industries and what do you think are the main differences?**

Due to the highly regulated nature of the pharmaceutical industry, there is a lot more 'red tape' compared to other industries. However, the principles of applying good engineering practice are relevant across all industries.

**What do you think sets the biosector apart as a good place to work?**

There are a lot of innovative products which have a significant impact on a lot of people and save lives.

**What is the most exciting part of working in the biosector/in your company?**

I am given a lot of responsibility which I find really rewarding, but also develops my skills and knowledge at an accelerated rate.

**What are some of the exciting recent developments in your sector/company?**

The recent commercialisation of Chimeric Antigen Receptors Cell Therapy (CAR-T) is a very exciting innovation in the industry as it has the potential to revolutionise the way that a very damaging disease is treated.

**What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?**

Read up on good manufacturing practice (GMP) and understand how it applies to different dosage forms eg tablets or injections.



# Naomi Atkinson

## Process Engineer

Fujifilm Diosynth Biotechnologies  
North East, UK



### Degree(s) – year, subject and university

2013 – MEng Chemical Engineering, Loughborough University, UK

### Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?

IChemE Associate Member (AMIChemE)

### What is your role and how do you apply the principles of chemical/biochemical processing engineering?

Currently, my role is two-fold. I complete the technical transfer of the processes between process development and manufacturing. This involves hazard and good manufacturing practice (GMP) reviews and ensuring the equipment is suitable and qualified for the process requirement. I am also involved in choosing and qualifying new equipment.

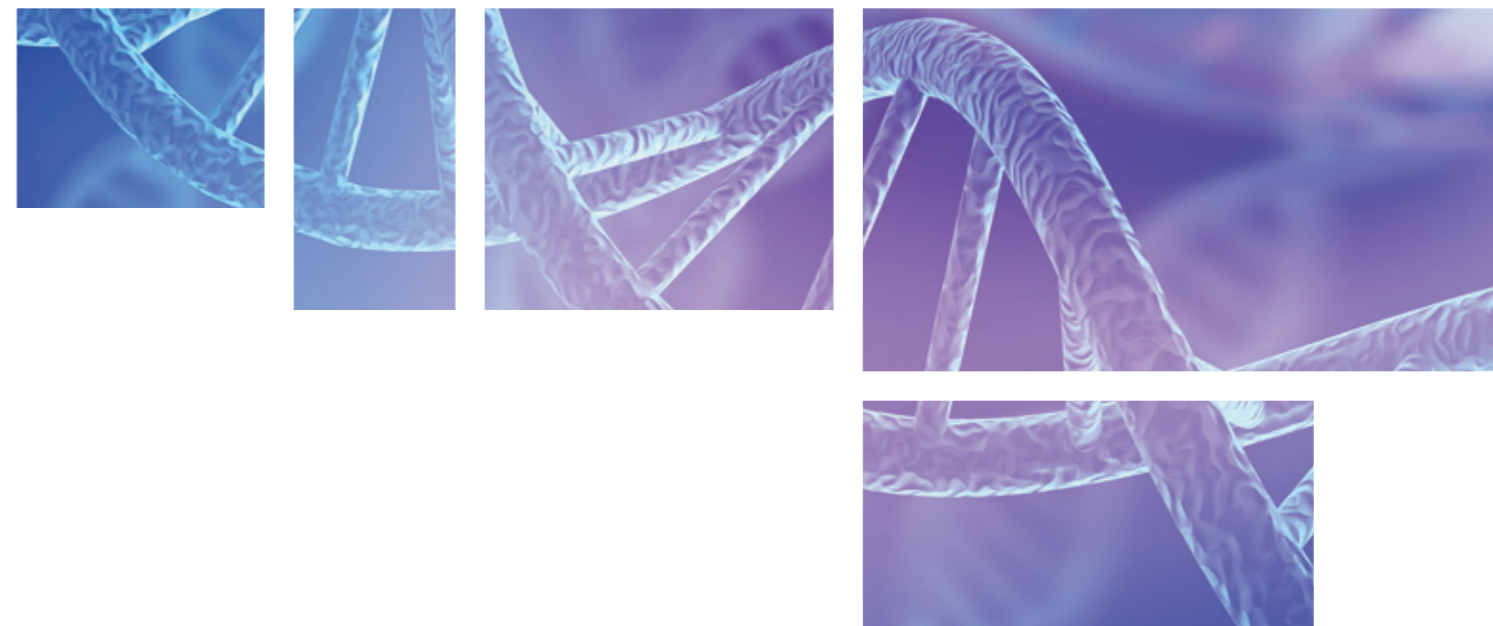
### Please briefly outline your journey from graduation to your current role.

### Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?

I completed a sandwich year during university which led to a job offer after graduation. My line manager during this sandwich year encouraged me to grab every opportunity given. I carried this on to my permanent job role which has allowed me to progress from a graduate engineer to a process engineer and then quickly onto becoming a Quality Auditor which involves completing internal and supplier audits.

### When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?

I knew I wanted to work in pharma but not specifically what I wanted to do. I also knew that I wanted to become chartered. Once I graduated, I knew that biopharma was the place for me and that I enjoyed the changeability of working for a contract development and manufacturing organisation (CDMO).



### What is the best thing about your job and working in the bioeconomy?

The products we make really do help people and make a difference to people's quality of life.

### What does it take to do your job (skills, strengths and knowledge)?

Problem solving, communication, teamwork, safety consciousness and the ability to train people.

### What are the biggest challenges in your job?

Differing priorities throughout the site as we run so many streams in parallel. Always trying to find ways to make processes leaner and smarter.

### What do you think is the same as other chemistry or process related industries and what do you think are the main differences?

A lot of the skills are transferable. Scale of work and speed of work at Fujifilm is more rapid as we are a CDMO.

### What do you think sets the biosector apart as a good place to work?

The technology is still developing, which makes it a very exciting sector.

### What is the most exciting part of working in the biosector/in your company?

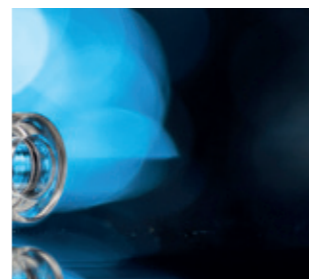
Bringing in the new technology and watching/being involved in the innovations and improvements.

### What are some of the exciting recent developments in your sector/company?

Automation (although I think it has a way to go yet).

### What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?

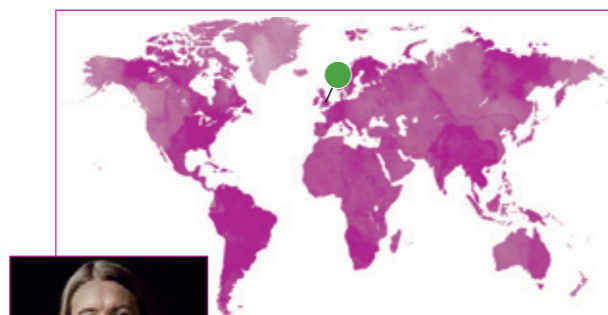
Get as much experience as you can.



# Sophie Cox

## Lecturer in Healthcare Technologies

University of Birmingham  
West Midlands, UK



### Degree(s) – year, subject and university

2010 – BEng Civil Engineering, University of Warwick, UK

2013 – PhD Biomedical Engineering, University of Warwick, UK

2017 – PGCert Teaching and Learning in Higher Education, University of Birmingham, UK

### Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?

I undertook a Postgraduate Certification in Teaching and Learning in Higher Education.

### What is your role and how do you apply the principles of chemical/biochemical processing engineering?

I am a Lecturer in the School of Chemical Engineering. My research is focussed on improving the functionality of medical devices. Our team develops new methods of processing biomaterials and ways to manufacture them into structures that may support tissue regeneration.

### Please briefly outline your journey from graduation to your current role.

### Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?

When applying to university I was unsure which engineering discipline I wanted to pursue. After taking optional modules in biomedical engineering and biomaterials, I secured a PhD in this area through an independent scholarship. I love that research requires me to think creatively and engage regularly with other professionals. It also demands a lot of determination and I have found immense support from colleagues and mentors throughout my career.

### When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?

Definitely not. I sort of fell into research and the biomedical sector, and I'm very glad I did!

### For those who didn't start out in biotechnology, what transferable skills made the transition possible?

An ability to break down complex problems and having a curious mind has helped me transition smoothly.

### What is the best thing about your job and working in the bioeconomy?

I love learning new things, and biotechnology is an inherently multidisciplinary field that brings together engineers, scientists and healthcare professionals to solve some of the biggest challenges facing society.

### What does it take to do your job (skills, strengths and knowledge)?

Hard work, creativity, determination, teamwork and leadership. Having a curiosity and passion for learning also really helps.

### What are the biggest challenges in your job?

Staying motivated. Research is something that never works first time and getting funding for new ideas/projects is very competitive. I try to focus on what I learn from every experience.

### What do you think is the same as other chemistry or process related industries and what do you think are the main differences?

As with other scientific disciplines, working in biotechnology requires good understanding of core principles and an ability to adapt them to individual problems. I think in biotechnology, the societal impact of innovation is particularly distinctive.

### What do you think sets the biosector apart as a good place to work?

It has direct impact on people by helping them live longer and happier lives while also improving the efficiency of our NHS and economy. The bio sector is also fast paced with lots of exciting innovation areas.

### What is the most exciting part of working in the biosector/in your company?

Being the first person to try something in a field that could directly impact people around me is very exciting. Working in higher education also provides me with the opportunity to share this passion with the next generation of engineers.

### What are some of the exciting recent developments in your sector/company?

Biosensors are an exciting area that will provide researchers focussed on materials and manufacturing aspects of biotechnology, like myself, with a better understanding of real-time patient needs.

### What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?

It's not just what you know but also who you know. Don't be afraid to ask questions and make new connections with different stakeholders in the biochemical engineering sector.



# Rhys Macown

## Lead Scientist

Cell and Gene Therapy Catapult  
London, UK



### Degree(s) – year, subject and university

2010 – BE Chemical and Process Engineering, University of Canterbury, New Zealand

2015 – PhD Biochemical Engineering, University College London, UK

### Apart from your degree/ further degree, have you taken any further qualifications or professional memberships or professional registrations?

IChemE Associate Member (AMIChemE)

### What is your role and how do you apply the principles of chemical/biochemical processing engineering?

As a lead scientist in the industrialisation team at Cell and Gene Therapy Catapult, I help develop processes to manufacture the next generation of human cell and gene-based therapies. Biochemical and process engineering approaches are applied throughout the development process including identifying and mitigating risks, developing bioreactor control strategies, and integrating multiple unit operations into a complete manufacturing process.

### Please briefly outline your journey from graduation to your current role. Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?

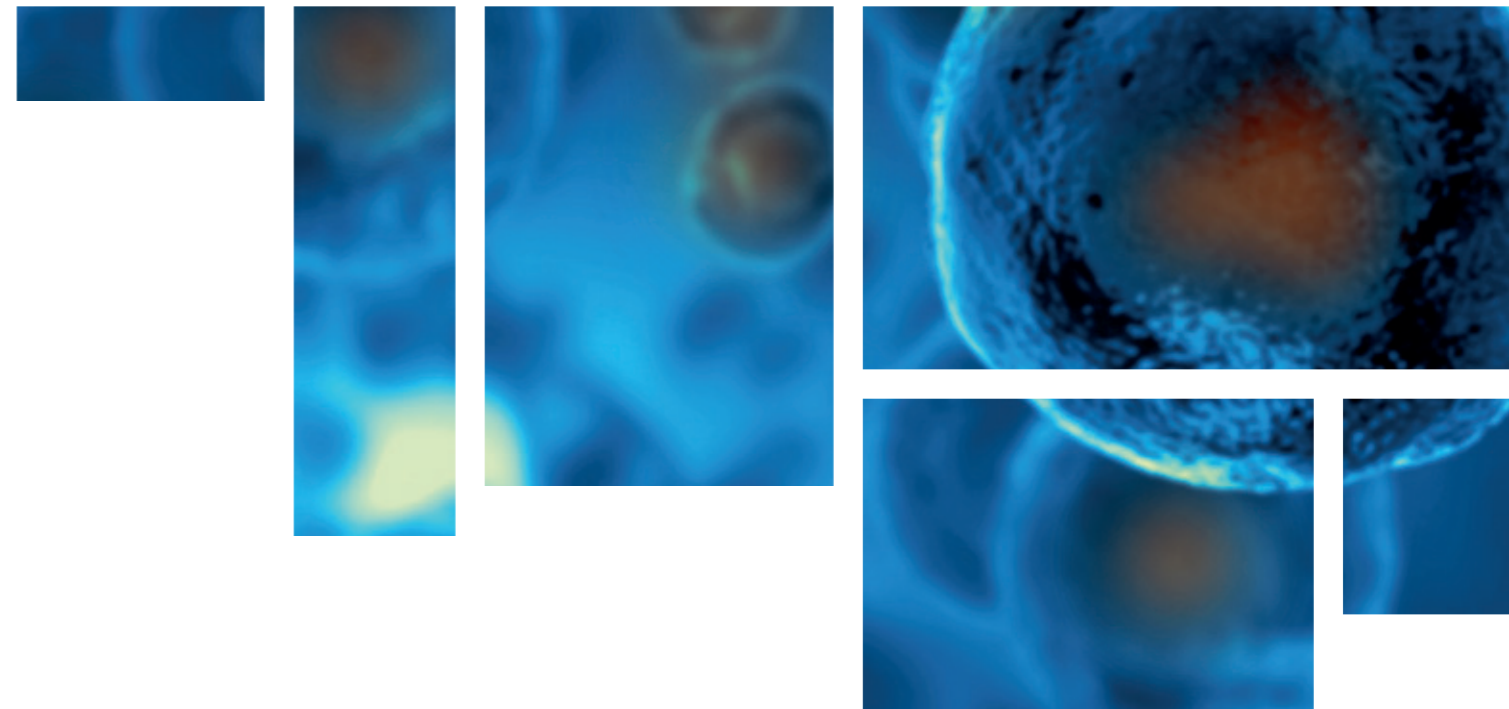
Upon completing my undergraduate studies, I was a research assistant for nine months, purifying a biopolymer from bacterial lysate, before joining UCL at the start of the UK academic year. At UCL, I worked on the development and testing of a microfluidic system for embryonic stem cell culture, introducing me to the world of cell and gene therapies. I now develop cell and gene therapy processes at the Cell and Gene Therapy Catapult, first as a scientist, then a senior scientist, and now as a lead scientist.

### When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?

No, my career aspirations have developed and changed throughout my education.

### For those who didn't start out in biotechnology, what transferable skills made the transition possible?

Skills such as process control approaches and mass transfer principles are equally applicable to bioprocessing and so are the more fundamental engineering skills of design, modelling, risk assessment and reporting. The commercial understanding engineers bring to scientific development, with a strong focus on the end goal of development – an economically viable process for a marketable product – is very valuable.



### What is the best thing about your job and working in the bioeconomy?

The rate of development of new life-changing and lifesaving therapies. We work at the cutting edge of medicine, performing novel science that will have a real impact on the lives of patients and their families.

### What does it take to do your job (skills, strengths and knowledge)?

Working in the Cell and Gene Therapy Catapult industrialisation team requires some knowledge of both process development and the biology behind the therapies' production processes and mechanisms of action.

### What are the biggest challenges in your job?

The novelty of the science demands the enthusiasm and resolve to move past experiments that don't turn out as hoped and the adaptability to adjust plans in a rapidly changing field.

### What do you think is the same as other chemistry or process related industries and what do you think are the main differences?

The additional understanding of the biology is the major difference from other chemical and process-related sectors. Due to the high rate of development, it is essential to be able to rapidly develop understanding of both new processing equipment and new biological approaches.

### What do you think sets the biosector apart as a good place to work?

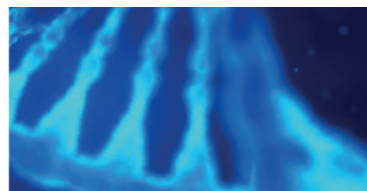
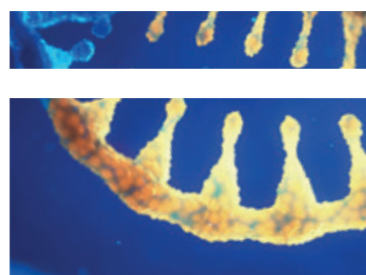
I see the biosector as the most dynamic and rapidly growing sector due to the combined drivers of an increasing understanding of, and control over, biological systems; the strain of a growing and developing global population; and the need to find more sustainable approaches to processes.

### What are some of the exciting recent developments in your sector/company?

There are regularly exciting results from clinical trials of cell and gene therapies and some of these are starting to get coverage by major news outlets like the BBC. It is particularly exciting seeing evidence of major improvements where no treatments were previously available.

### What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?

Look to take courses not just in the theory of biology but courses with practical basics like aseptic cell culture and molecular biology.



# Ali Bahari

## Bioprocess Consultant

Scitech  
South East, UK



### Degree(s) – year, subject and university

2002 – BSc Chemical Engineering, Sharif University of Technology, Iran

2005 – MSc Biotechnology, Sharif University of Technology, Iran

2009 – PhD Chemical Engineering, University of Birmingham, UK

### Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?

Chartered Chemical Engineer (MIChemE)

Chartered Chemical Engineer (CEng) professional registration

I have completed training sessions at work including safety and hazard courses, good manufacturing practice (GMP), Six Sigma and lean manufacturing.

### What is your role and how do you apply the principles of chemical/biochemical processing engineering?

As a Bioprocess Consultant, I formulate the bioprocess and biological manufacturing requirements of projects and develop solutions in process design, facility and operation for different product categories.

I use my knowledge of bioprocess design, biotechnology and biology on almost a daily basis to understand problems and develop solutions in design projects and help clients to develop their requirements and define manufacturing strategies.

### Please briefly outline your journey from graduation to your current role.

### Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?

Once I graduated, I worked as a technology advisor in consultancy firms on projects relevant to the biotech industry. After finishing my PhD and my postdoctoral projects, I moved to industry as a development engineer in a biologic manufacturing company to support the technology transfer for manufacturing biologic drugs. I now work in a design and engineering consultancy company as a bioprocess consultant.

### When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?

I was inspired by the science and outcomes of biotechnology and how engineering solutions resulted in commercialising products for better healthcare, green chemicals and innovative medicines.

### What is the best thing about your job and working in the bioeconomy?

The life-science industry is going through significant technological changes, resulting from new discoveries for better therapies as well new manufacturing methods.

In my role, I am working with the most innovative companies in the world as both my clients and solution providers.

### What does it take to do your job (skills, strengths and knowledge)?

When working in a consultancy environment, you need to be able to work for many different projects and different clients.

In my role, a good knowledge of manufacturing systems for biologic molecules and proteins is critical.

You also need core engineering skills, a good understanding of unit operations in bioprocess engineering, basic biology and knowledge of biological materials.

### What are the biggest challenges in your job?

Learning about challenges that you only realise when working in industry. Also learning about other related disciplines and how to work closely in a design environment.

### What do you think is the same as other chemistry or process related industries and what do you think are the main differences?

Similarities – mass balance, sizing basics, heat transfer and separation techniques.

Differences – Designing Biological processes requires a basic understanding of biology, protein, purification techniques and protein and biologic properties.

### What do you think sets the biosector apart as a good place to work?

It is a multi-disciplinary field which gives an opportunity to work with the latest technological advancements in the pharma and biopharma industries.

### What is the most exciting part of working in the biosector/in your company?

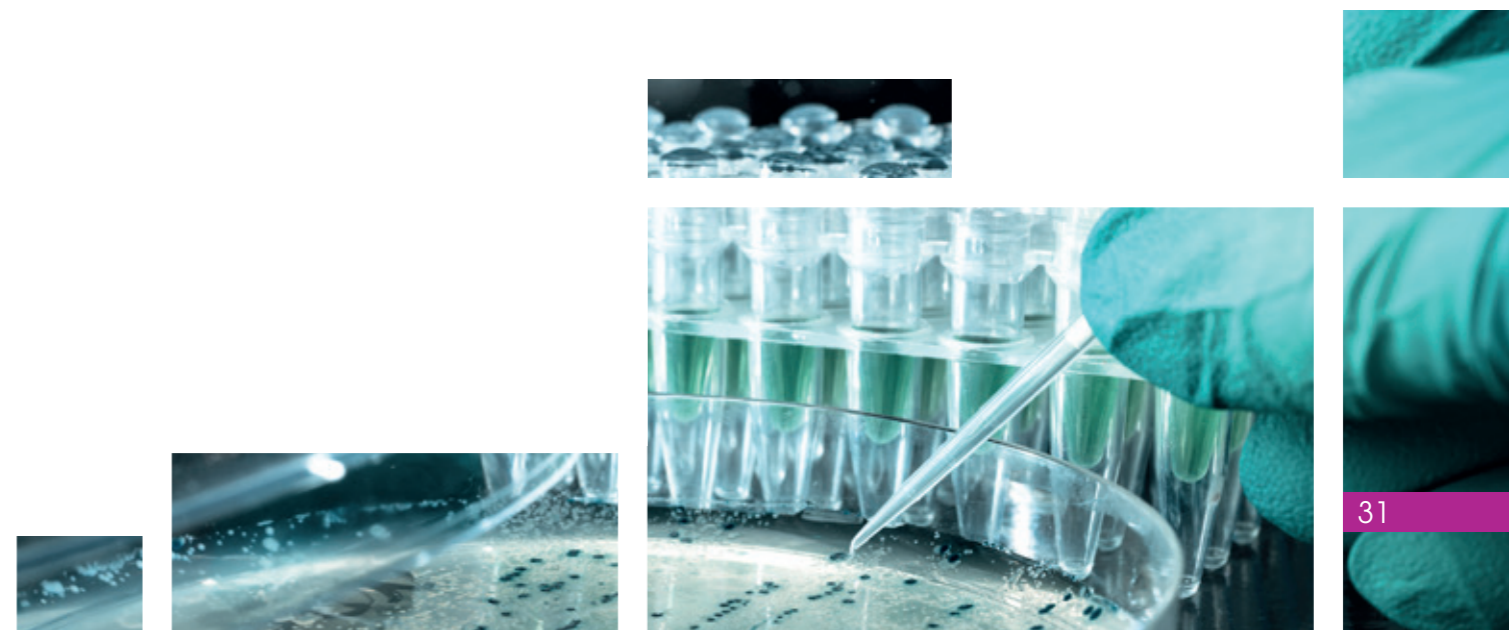
Most of the products and processes are related to manufacturing a medicine, which impacts the life of millions. The introduction of new systems and more advances and novel techniques in bioproduction systems lets you enjoy a fast-pace and continually changing environment.

### What are some of the exciting recent developments in your sector/company?

New products such as cell/gene therapy and synthetic biology and innovative processing solutions such as continuous biomanufacturing and intensified bioprocessing which makes facilities smaller, smarter and helps build them in a shorter time.

### What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?

In-depth knowledge of the subject. Keep an eye on the latest advances in the field, technical solutions, new manufacturing concepts, new drugs and therapies.





# Phil Bowles

Associate Director, Consultancy and Laboratory Operations

eXmoor Pharma  
South West, UK



## Degree(s) – year, subject and university

1984 – BEng Chemical Engineering, University College London, UK

1985 – MSc Biochemical Engineering, University College London, UK

## Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?

IChemE Fellow (FIChemE)

Chartered Engineer (CEng) Professional Registration

I have completed management training and various technical and quality control courses through the International Society for Pharmaceutical Engineering (ISPE) and the Parenteral Drug Association (PDA) focussed on areas like purification or regulatory requirements.

## What is your role and how do you apply the principles of chemical/biochemical processing engineering?

My role is to manage a portfolio of consultancy and process development projects through the planning and execution phases. Most projects are in the area of cell and gene therapy process development and require an understanding of the bioprocess techniques involved aligned with our client's expectations for what we deliver.

## Please briefly outline your journey from graduation to your current role. Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?

My master's degree in biochemical engineering seeded my interest in biotechnology. I spent four years doing industrial biotechnology research for Shell oil company, then moved into engineering design and construction with Kvaerner John Brown, building biopharmaceutical production facilities for a variety of interesting manufacturing processes.

In 2004, I moved to Thousand Oaks California and spent nearly 15 years with Amgen, a leading biotechnology company that develops and manufactures therapeutic products using fermentation and cell culture techniques. I returned to the UK in 2018 and now work for eXmoor in the cell and gene therapy sector.

## When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?

I wanted to be a chemical engineer and follow a family tradition but was fortunate to find a path into biochemical engineering and the life science industry early in my career development. I knew I wanted to work overseas at some point in my career and was fortunate to spend nearly 15 years working in California.

## For those who didn't start out in biotechnology, what transferable skills made the transition possible?

I was offered a chance to do an MSc course and secured a grant to pursue my studies. Chemical engineering provided a good foundation for this path.

The life science content was challenging and unlike set principles in traditional chemical engineering, this is a fast-moving area.

## What is the best thing about your job and working in the bioeconomy?

Developing more effective treatment for patients that could dramatically improve their lives.

## What does it take to do your job (skills, strengths and knowledge)?

A combination of technical knowledge for the processes we use, project management skills and an ability to work in and lead teams.

## What are the biggest challenges in your job?

Keeping up with technology development. Assigning resources to get things done. Balancing tasks, quality compliance including safety, how we design facilities and financial compliance.

## What do you think is the same as other chemistry or process related industries and what do you think are the main differences?

A key difference in this industry is the pace of development and the fast-changing nature of the science.

## What do you think sets the biosector apart as a good place to work?

Multidisciplinarity. A broad group of people are needed to commercialise a biotechnology product. Quality is extremely important which is reflected by stricter regulations that continue to evolve.

## What is the most exciting part of working in the biosector/in your company?

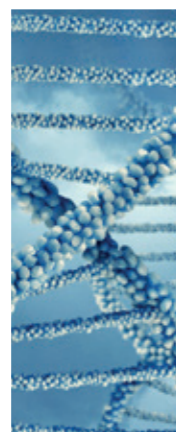
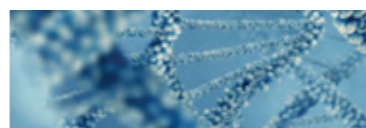
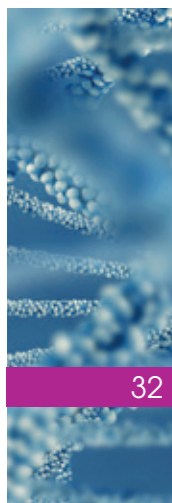
Seeing the potential of biotechnology to dramatically improve the lives of patients who will receive the therapies that we work on.

## What are some of the exciting recent developments in your sector/company?

There is a shift towards more efficient, smaller scale and continuous processes based on single use technology. Cell and gene therapy offer a chance for engineers to be involved in the development of personalised medicines.

## What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?

Be open to a change in direction. Build your network of contacts as widely as you can. Embrace new opportunities, continue being interested in new biotech developments and trends.



# Donal McLaughlin

Associate Director Technology  
(Biologics)

MSD  
Dublin, Ireland



## Degree(s) – year, subject and university

2001 – BSc Biochemistry, University College Cork, Ireland

2002 – MSc Biochemical Engineering, University of Birmingham, UK

## Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?

IChemE Associate Member (AMIChemE)

Courses in Project Management and Lean Six Sigma green belt.

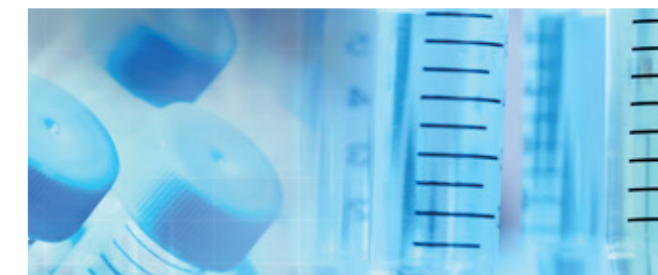
## What is your role and how do you apply the principles of chemical/biochemical processing engineering?

I lead a team of engineers and scientists responsible for system validation, process technology transfer, process optimisation and process troubleshooting for a microbial based biopharmaceutical facility to produce various recombinant medicinal proteins. Bioprocess engineering principles are applied during facility design, commissioning, process fit exercises, process technical studies and process investigations. I also coach and mentor teams on bioprocess engineering principles.

## Please briefly outline your journey from graduation to your current role.

### Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?

I joined a biopharmaceutical company following graduation, gaining experience in equipment commissioning and process validation. I took the opportunity of a secondment to the US to work in a pilot plant working on process technology transfers. I then moved into leadership roles initially leading shift teams in manufacturing before moving to project lead roles – a quality control laboratory lead role and now into my current technical lead role. I have no specific role model, but I try to keep learning by seeking new technical and managerial challenges.



## When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?

I had changed from science to engineering so was keen to prove myself as a competent engineer and to get process experience.

## What is the best thing about your job and working in the bioeconomy?

In a leadership role I really enjoy the mixture of developing and leading my team but also having to engage in significant technical discussions on complex biological manufacturing issues.

## What does it take to do your job (skills, strengths and knowledge)?

Good communication is essential. It's important to understand that you won't always know the answer but through problem-solving tools and a cross functional approach, solutions can be found to any problem.

## What are the biggest challenges in your job?

Being involved in complex technical investigations or transfers with time pressures to find a solution or complete a project.

## What do you think is the same as other chemistry or process related industries and what do you think are the main differences?

A lot of the equipment and the principles of operation are similar. The biological processes are not as robust and living cells and more complex molecules give rise to a myriad of potential effects on product yield and potency.

## What do you think sets the biosector apart as a good place to work?

The rate of change with the number of new molecules and advances in areas such as gene therapy make this a very exciting time to be a part of the biosector.

## What is the most exciting part of working in the biosector/in your company?

Knowing that the products we manufacture are making a significant difference to people's lives.

## What are some of the exciting recent developments in your sector/company?

The combination of biological medicines with chemical molecules to deliver a more targeted approach to treatment.

## What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?

Have a willingness to keep on learning as your qualifications don't mean you know everything; they provide you with a skill set to adapt to any situation.

# Richard Ryrie

## Tech Transfer Lead

Eli Lilly/Elanco  
North West, UK



### Degree(s) – year, subject and university

1988 – BEng Chemical Engineering, Heriot-Watt University, Scotland

### Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?

IChemE Associate Member (AMIChemE)

I completed a Masters in Pharmaceutical Engineering at the University of Manchester early in my career. This was a distance learning module course but provided a great grounding in the specifics of pharmaceutical engineering that supplemented my core chemical engineering knowledge.

### What is your role and how do you apply the principles of chemical/biochemical processing engineering?

I manage a team of about 15 process engineers, providing front-line support to a range of manufacturing processes. I apply my knowledge via one-to-one coaching with my team. I also set direction for significant initiatives and facilitate root cause investigations into significant process issues.

### Please briefly outline your journey from graduation to your current role. Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?

I started my career as a project engineer at Dista Products Ltd (now Elanco Animal Health Ltd), before joining the start-up team for the new Biotechnology Centre (BTC). Here, I gained experience in chromatographic separations, high grade utility generation and clean room operations. I then moved to a pilot plant role, working closely with development, before helping design, commission and validate a facility for purification of a therapeutic protein. I was promoted to engineering manager with oversight for process and automation engineers, and plant maintenance. My next role was as commissioning and qualification manager for a new biotechnology facility, built using modular technology. I then joined the technical services function and expanded the role to cover development & biotechnology manufacturing. Later, I led a technology transfer project to in-source a fermented enzyme product, before a secondment to a German vaccines manufacturing site to set up the technical support team.

### When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?

I'm from Aberdeen but I didn't want to work in oil and gas. I looked into pharma and particularly biopharma as the Speke site was just starting to commission the large Biotechnology Centre when I applied.

### For those who didn't start out in biotechnology, what transferable skills made the transition possible?

Chemical engineers naturally tend to have a broad skill set. They are inquisitive and process focussed. If you look at the biotechnology sector, it's a hugely diverse area. There may be some areas where specific training is needed, but in manufacturing my learning was very much on the job.

### What is the best thing about your job and working in the bioeconomy?

Diversity – every day is different. On the pharma side the processes are established and less likely to change. In biotechnology there tends to be more interaction with process development and technologies and equipment sets are constantly evolving.

### What does it take to do your job (skills, strengths and knowledge)?

Like any job in industry, technical skills need to be under-pinned by great communication, flexibility and teamwork. I have developed a strong good manufacturing practice (GMP) focus, largely due to my involvement in audits by external regulators, and it is important that you thoroughly know, understand and can apply the rules applicable to your sector.

### What are the biggest challenges in your job?

Trying to drive strategic change in a very busy and ever-changing manufacturing environment.

### What do you think is the same as other chemistry or process related industries and what do you think are the main differences?

The day-to-day challenges are similar in any sector, as is the need to combine technical and soft skills. However, the concepts of GMP and validation are unique to my area.

### What do you think sets the biosector apart as a good place to work?

It is still an evolving sector which brings a diversity of opportunities.

### What is the most exciting part of working in the biosector/in your company?

My site manufactures both pharma and veterinary products. Learnings from human biotechnology products are being applied in the veterinary products area, and there is a significant challenge in right-sizing the requirements for veterinary products.

### What are some of the exciting recent developments in your sector/company?

Still fairly novel in biotechnology is the use of the quality by design approach. Robust process development results in a well-defined "operating space" and the benefit is a more flexible product registration, which avoids lengthy and expensive product license variations. One of our Elanco products was the first Lilly product to be registered in the EU under this Quality by Design (QbD) approach.

### What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?

Get hands-on work experience. Develop a basic understanding of GMP guidance in biopharma. Research opportunities beyond the basic internet headlines.



# Jonathan Welsh

## Senior Manager

AstraZeneca  
East of England, UK



### Degree(s) – year, subject and university

1991 – BSc Biochemistry, University of Birmingham, UK

1992 – MSc Biochemical Engineering, University of Birmingham, UK

1997 – PhD Biochemical Engineering, University of Birmingham, UK

### Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?

IChemE Affiliate Member

No, I've always been too busy. I've always wanted to try to become a Chartered Chemical Engineer.

### What is your role and how do you apply the principles of chemical/biochemical processing engineering?

My role is in upstream process development. The main principles of chemical/ biochemical engineering are applied in the control of process parameters, scale-up and technology transfer.

### Please briefly outline your journey from graduation to your current role. Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?

I finished my PhD in 1997 and worked as post-doctorate doing medical research before moving into industry. I started at Lonza Biologics in 2006 as a senior scientist and worked there for eight years, rising to principal scientist. I moved to the Centre for Process Innovation (CPI) in 2014 and then onto AstraZeneca in 2018. I've worked with great technical people and learnt a lot from them.

### When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?

I had a vague idea of doing applied research in biotechnology, that would lead to relevant products. This has been the only constant in my career, as my research interests have changed over time.

### For those who didn't start out in biotechnology, what transferable skills made the transition possible?

Good scientific method and thinking is always transferable, as is organisational ability. Specific techniques in cell culture and molecular biology are also transferable, as is data analysis.

### What is the best thing about your job and working in the bioeconomy?

Getting medicines to the market to help patients. Knowing that there is still so much to achieve.

### What does it take to do your job (skills, strengths and knowledge)?

Seeing the process as a whole and paying attention to detail. Success is in the planning. Team leadership requires good communication and clear objectives. Technical know-how, reinforced with experience is important.

### What are the biggest challenges in your job?

There are a lot of things to juggle, so keeping all the balls in the air is a particular challenge.

### What do you think is the same as other chemistry or process related industries and what do you think are the main differences?

Logistics and supply chains are similar, and both industries have definite deadlines and deliverables. The main differences are the regulatory oversights.

### What do you think sets the biosector apart as a good place to work?

The many opportunities driven by advances in medicine and a need to develop these advances into tangible products. The complexity of drug development processes means that niche businesses can be established, and specialised know-how can be developed to serve a particular niche.

### What is the most exciting part of working in the biosector/in your company?

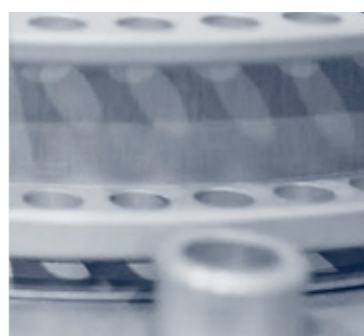
Although progress has been phenomenal in the past decade, I'm very excited about new tools and techniques that will help our understanding of bioprocessing and lead to more life-saving products.

### What are some of the exciting recent developments in your sector/company?

Advances in cell and gene therapy.

### What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?

- seize opportunities
- have a focus and plan of where you want to be
- keep learning and stay up to date with skills in demand
- look at new emerging technologies
- develop 'soft' skills
- build up relationships and networks to help you on your way.



# Nick Kotlarski

Chief Operating Officer (COO)

Bioworkshops  
Jiangsu, China



**Degree(s) – year, subject and university**

1993 – BE Chemical Engineering, The University of Adelaide, Australia

1998 – PhD Chemical Engineering, The University of Adelaide, Australia

**Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?**

Chartered Chemical Engineer (MIChemE)

Chartered Chemical Engineer (CEng) Professional Registration

**What is your role and how do you apply the principles of chemical/biochemical processing engineering?**

The COO role involves establishing and managing development, manufacturing, engineering, IT, and administration departments for a start-up biomanufacturing company. In our first year this involves creating all policies and procedures to operate. Planning, regulatory compliance, and safety management are important. Chemical engineering principles are essential for:

- project design to conceive and model the business
- design safety systems (chemical, biohazardous), bioprocesses, process architecture, utilities, electrical capacity, automation, staffing, and ergonomics
- meeting necessary regulations (good manufacturing practice (GMP), national standards & some international standards)
- site safety, maintenance, and calibration.

**Please briefly outline your journey from graduation to your current role.**

**Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?**

My interest in biotech was sparked in the final year of undergraduate study, so I applied for a PhD scholarship. I was fortunate to be awarded an industry-linked scholarship and launch into detailed theory and practice of biopharmaceutical manufacturing. This included intermitting studies for one year with the sponsor to manage the design, build, and commissioning of a small pilot plant.

In 1999, I took a job in applied R&D at a veterinary biotech manufacturer. This introduced me to working in an international company and several product licensing, transfer, and development projects.

The company that had sponsored my PhD recruited me in 2002 as head of manufacturing, and there I learnt plant management across multiple sites.

In 2007 I realised a long-held ambition to live and work overseas when I joined an engineering life sciences consultancy in Singapore to head up its biopharmaceutical division. In Singapore I reaffirmed links with IChemE and served on the local Chapter Organising Committee for several years.

After six years' consulting, I moved to a biopharmaceutical company in Taiwan. In three years, I established their three R&D and one commercial manufacturing facilities in Greater China. In 2016, I moved on to be an Operating Partner with several life-science venture capital funds in China.

**When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?**

In 2019, with more than 20 years of experience in design, building, operating, and business around biotech, I decided to set up my own biomanufacturing-based company, Bioworkshops, where I am the COO.

I chose chemical engineering to pursue an applied subject based on chemistry, physics and mathematics.

During undergraduate studies, I realised working in a mature industry did not appeal as much as the major impact potentially achievable by engineers in manufacturing biologics.

**For those who didn't start out in biotechnology, what transferable skills made the transition possible?**

Grounding in process engineering, transport phenomena, and chemistry was essential to starting in biotech.

Broader understanding of material science, electronics, statics/dynamics help interaction and management of other engineering disciplines.

**What is the best thing about your job and working in the bioeconomy?**

Working to develop and manufacture new biologic medicines that tackle horrible diseases and improve quality of life for many people.

**What does it take to do your job (skills, strengths and knowledge)?**

Skills: staff management, financial control, facility design, and operation experience.

Strengths: communication, numeracy, persistence, spirit of collaboration.

Knowledge: bioprocessing, GMP, basic mechanical, electrical, civil and structural engineering, industry network.

**What are the biggest challenges in your job?**

Alignment of budget and timeline for safe and cost-efficient schedules with overly ambitious or non-technical audiences.

**What do you think is the same as other chemistry or process related industries and what do you think are the main differences?**

Similarities: standards, regulatory compliance, equipment and material providers, commercial environment, environmental protection.

Differences: specialist licences/permits, intrinsic biological variability and control mechanisms.

**What do you think sets the biosector apart as a good place to work?**

Biomanufacturing is relatively immature and provides great scope of technology development in modern, safe facilities.

**What is the most exciting part of working in the biosector/in your company?**

Bioworkshops is a start-up based on bioprocessing services. Working in the China's dynamic biotech sector brings great technical challenges and commercial environment.

**What are some of the exciting recent developments in your sector/company?**

Regulatory reform in China.

Increased standardisation as process control and IT merge.

Standardisation in bioprocess equipment simplifying process design and saving costs.

**What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?**

Be engaged and interested in the industry.

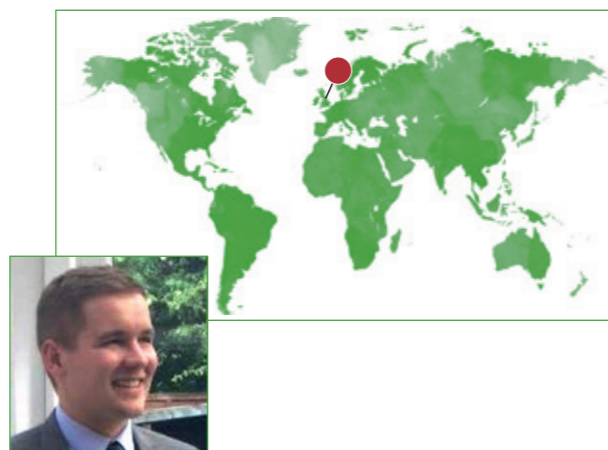
Learn about products, technologies, and the companies that provide them.



# Ashley Clare

Graduate Process Engineer

Centre for Process Innovation (CPI)  
North East, UK



**Degree(s) – year, subject and university**

2017 – MEng Chemical Engineering, University of Sheffield, UK

**Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?**

IChemE Affiliate Member

**What is your role and how do you apply the principles of chemical/biochemical processing engineering?**

Junior Process Engineer – I mainly work on a project to scale up a process which uses a solvent to recycle used polymers and cellulose-based materials to be re-used in the clothing and manufacturing industry. This process runs under vacuum at high temperatures which make the design and operation challenging. As well as designing the utilities required, I consider safety and the Atmospheres Explosible (ATEX) requirements of the process.

In the past I have worked on a pressure relief review and a project to optimise fermentations in single-use plastic bags. The challenge was to optimise the parameters which cause fermentations to succeed (oxygen mass transfer, heat transfer, agitation etc) against the limitations of using a plastic bag.

**Please briefly outline your journey from graduation to your current role. Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?**

I worked at the Centre for Process Innovation (CPI) as a summer student. I helped to produce the commissioning protocols for a methane-fed fermentation process which was under construction at the time. Once I graduated, CPI offered me the chance to apply for a graduate process engineering job and I was offered the position.



**When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?**

To do the best I could in my degree and then get a job in a company which would support my development and expose me to different sectors within engineering.

**What is the best thing about your job and working in the bioeconomy?**

The best thing about working at CPI is that I have been exposed to many types of challenges within engineering. From sterility issues with fermentations, to safety issues with ATEX certifications and pressure relief devices to difficult design and operation of a process under vacuum at high temperatures.

**What does it take to do your job (skills, strengths and knowledge)?**

You need to be able to actively learn as much as you can. University gives you a good basis of knowledge, but you need to apply knowledge with initiative and logical thinking to solve a problem to a good quality and within time.

**What are the biggest challenges in your job?**

To deliver projects on time to a good standard while also learning and gaining as much experience as you can.

**What do you think sets the biosector apart as a good place to work?**

It is only going to become more important in the future as people look for more sustainable ways to produce energy/products.

**What is the most exciting part of working in the biosector/in your company?**

Working on several different projects at once encompassing several sectors of engineering.

**What are some of the exciting recent developments in your sector/company?**

It is exciting to be working on a project looking to benefit the circular economy which recycles would-be-wastes into useful products which can be used again productively.

**What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?**

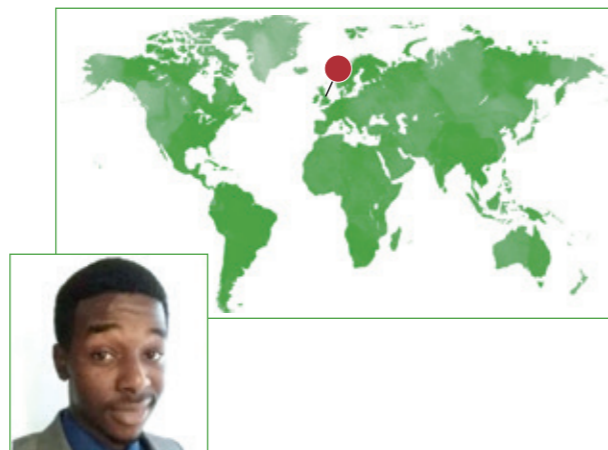
Look seriously into the sector, it is only going to grow in the future and has a lot of transferable skills into other sectors such as pharmaceuticals.



# Keith Nyatsungo

Process Engineer

Centre for Process Innovation (CPI)  
North East, UK



**Degree(s) – year, subject and university**

2013 – BEng Chemical and Process Engineering, London Southbank University, UK

**Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?**

IChemE Associate Member (AMIChemE)

**What is your role and how do you apply the principles of chemical/biochemical processing engineering?**

As a Process Engineer, I carry out calculations and assessments using chemical engineering principles with the aim first and foremost, to ensure process safety, additionally, process operability and optimisation.

**Please briefly outline your journey from graduation to your current role. Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?**

My route into the biosector was direct from university. After graduation, I joined CPI as a Graduate Process Engineer in February 2014. I then took on the position of Junior Process Engineer. In March 2018, I was promoted to Process Engineer.



**When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?**

Yes, I knew I wanted to be a chemical engineer and my aspiration is to be a renowned expert in the field of chemical engineering.

**What is the best thing about your job and working in the bioeconomy?**

The nature (process development and scale-up) of CPI means we are continuously taking on very interesting and novel projects. This brings with it a variety of challenges and as such, whilst bringing value to the bio space, it is very interesting and provides thorough job satisfaction.

**What does it take to do your job (skills, strengths and knowledge)?**

Knowledge of chemical engineering principles like fluid mechanics, thermodynamics etc. Also, being a team player and being able to communicate with other disciplines.

**What are the biggest challenges in your job?**

Juggling a multitude of tasks.

**What do you think is the same as other chemistry or process related industries and what do you think are the main differences?**

The principles of chemical engineering remain the same across all industries. The differences come with regards to the questions that need answering through the use of these principles. For example, maintaining sterility and ensuring full sterilisation within vessels in the biotech industry will not be an issue that needs addressing in the nuclear industry.

**What do you think sets the biosector apart as a good place to work?**

The biosector is very much at the fore with regards to enabling a much cleaner and greener future.

**What is the most exciting part of working in the biosector/in your company?**

Getting to work on a whole array of projects that involve novel and cutting-edge bioprocesses.



# James Pattison

Capital Projects Manager

Cabot Corporation  
South Wales, UK



**Degree(s) – year, subject and university**

2000 – MEng Chemical Engineering, University of Leeds, UK

**Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?**

Chartered Chemical Engineer (MIChemE)

Chartered Chemical Engineer (CEng) Professional Registration

I have completed a range of training courses but not academic qualifications.

**What is your role and how do you apply the principles of chemical/biochemical processing engineering?**

I work within the Engineering Department covering projects for both Capital and Maintenance. I also lead engineering modifications for the site, write change controls and associated work. The work I do is directly related to my degree, so I apply all the fundamental principles of chemical engineering on a daily basis.

**Please briefly outline your journey from graduation to your current role.**

After graduation I started at Rhodia (Manufacturing Development Group), making phosphorus-based chemicals. Rhodia was a great start to my career as I had a lot of support and mentoring from more experienced members of the team.

**Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?**

I then had a few roles in the food, aerospace and energy industries before moving to Fujifilm Diosynth Biotechnologies as a Senior Process Engineer in 2012.

Since Fujifilm Diosynth I have taken up a position as a Capital Projects Manager in Cabot Corporation, South Wales.

**When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?**

I had decided that being a chemical engineer was what I wanted to do before I went to university as I knew people that were already qualified. I didn't know what area of industry I wanted to work in, so that part has just been a development through the roles I have had.

**For those who didn't start out in biotechnology, what transferable skills made the transition possible?**

The transferable skills I have used come from many years in capital projects and plant support. I have found the fundamentals of chemical engineering can always be applied no matter where I have worked. Chemical reactions, mass and energy balances, and fluid flow is the same in all the industry sectors I have worked in. Similarly, the project process does not really change much between industries; it is all about separating projects into specific stages and planning project execution.

**What is the best thing about your job and working in the bioeconomy?**

Fujifilm Diosynth Biotechnologies is a contract development and manufacturing organisation (CDMO) therefore there were always new projects coming along with new and unique challenges. Every day was different, and I worked with some great like-minded people. I also like hearing when products have been used in successful drug trials and knowing we are making a positive difference to people's lives.

**What does it take to do your job (skills, strengths and knowledge)?**

To do my job you need the ability to analyse problems quickly and effectively. Planning is also a big part of the role when managing projects. I need good people skills to work effectively with others.

**What are the biggest challenges in your job?**

Time: there are always a lot of different tasks to complete within a short timescale.

**What do you think is the same as other chemistry or process related industries and what do you think are the main differences?**

The fundamentals of biopharma are very similar to other industries I have worked in such as the mixing of adhesives, purifying dextrose solutions etc. The main difference in the pharmaceutical industry is the level of control over the manufacturing process and the equipment. Procedures are far more detailed; everything is checked, and double checked going into manufacturing.

**What do you think sets the biosector apart as a good place to work?**

The biosector is a growth area with the potential to make huge differences to people's lives with the development of new medicines. I think a lot of the people who work in the biosector share this view and it makes for a very positive 'can-do' place to work. At Fujifilm we were always looking for ways to improve our manufacturing techniques and bring in new technology. There is no other area I have worked in that has so much drive to continuously keep at the forefront of developments.

**What is the most exciting part of working in the biosector/in your company?**

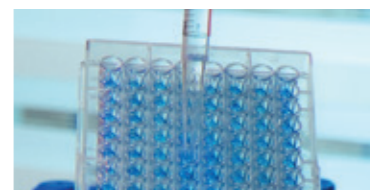
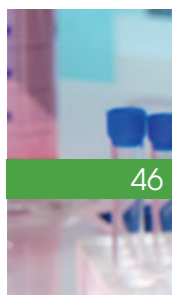
Every day was different, there was a great range of work to do. Hearing when a process has been successfully packed off is a good feeling as it represents months of work by a large team of people.

**What are some of the exciting recent developments in your sector/company?**

The introduction of single-use equipment is one of the areas Fujifilm has been focussing on over the last few years.

**What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?**

The biosector is a good place to work, you will find yourself working at the leading edge of technology. It is challenging at times, but the rewards are worth it.





# Bruce Williams

Owner and Principal Consultant  
(Independent)

Williams Process  
North East, UK



**Degree(s) – year, subject and university**

1994 – MEng Chemical and Process Engineering, Newcastle University, UK

**Apart from your degree/ further degree, have you taken any further qualifications or professional memberships and professional registrations?**

IChemE Fellow (FIChemE)

Chartered Engineer (CEng) Professional Registration

**What is your role and how do you apply the principles of chemical/biochemical processing engineering?**

Much of my consultancy is in a wide variety of innovative processes and technologies. Some examples are continuous membrane emulsification and microencapsulation, continuous freeze drying, optimisation of biologics manufacturing, and continuous aerogel production of carbon nanotubes. Being able to apply basic process engineering principles to new situations, and to transfer concepts between sectors is crucial to successful innovation. Skills in HAZOP, process modelling and project management help to ensure success.

**Please briefly outline your journey from graduation to your current role. Was there anything in particular that helped? Eg did you have a mentor that inspired or supported your journey?**

I joined Imperial Chemical Industries' (ICI) Technology group in Teesside where I was responsible for developing technology to create novel structured solids, especially continuous freeze drying. My manager sparked my interest in innovation, and my mentor taught me the importance of pragmatism in engineering.

I moved to Zeneca (now AstraZeneca) in Billingham, as a senior process engineer to gain large-scale industrial biotech experience. After divestment by AstraZeneca, it began to develop into a biopharmaceutical contract development and manufacturing organisation (CDMO). I introduced novel single-use technologies and created systems to streamline new product introduction.

Having established my engineering credentials, I did a variety of roles: managing the Manufacturing Technology Group, a techno-commercial role, and then leading the site project for FDA pre-approval inspection.

For the last 11 years I have run my own process consultancy, helping customers to make their processes more efficient, effective and compliant. Much of this work involves "treading the untrodden path" so every day holds something new.



**When you started your degree and when you graduated, what were your career aspirations – did you know what you wanted to do?**

Before starting university, I talked to process engineers working in chemicals, polymers and chocolate! I wanted variety in my degree. Throughout my degree I carried on getting experience of different sectors, including industrial work on process modelling and control of ice cream and detergent processes, and research on electrochemical processes. I joined ICI because of the superb graduate training and career development it offered. However, what I didn't know was how valuable it would be to have a very broad role with a focus on innovation. That was more by luck as it wasn't typical for graduates in ICI. That set me looking for another innovative sector and led me into biotechnology.

**For those who didn't start out in biotechnology, what transferable skills made the transition possible?**

The standard tools of process engineering – transfer processes, fluid flow, separation processes... Being able to work effectively in a multi-disciplinary team with scientists and manufacturing experts is also key when moving sectors.

**What is the best thing about your job and working in the bioeconomy?**

I love the variety of the job. There is a lot of room to move technology forward in the biosector. Particularly in consultancy because customers are often looking for something innovative.

**What does it take to do your job (skills, strengths and knowledge)?**

Good analytical and conceptual thinking. Working closely with others to take risks and manage them. But all the time it's underpinned by chemical engineering basics.

**What are the biggest challenges in your job?**

Innovation requires some risk taking. In a regulated environment this needs really good communication and risk management processes.

Living systems add natural variation to the process.

**What do you think sets the biosector apart as a good place to work?**

It has massive potential to improve human health, and sustainability.

**What is the most exciting part of working in the biosector/in your company?**

The biosector provides a lot of variety and there is a constant stream of new discoveries to commercialise.

**What are some of the exciting recent developments in your sector/company?**

I've worked with Micropore Technologies to develop robust and scalable membrane emulsification technology. This is being used to formulate a variety of microencapsulated drugs where control of size distribution is critical and requires a gentle process that doesn't damage the product.

**What are your top tips for current students and anyone considering a career as a chemical/biochemical engineer in the biosector?**

It's what you don't know rather than what you do know that matters. Always challenge the status quo and look to continuously improve.

Try and get some work experience.



# IChemE supporting chemical engineers in the bioeconomy



Members that shared their career profile were asked about the accessibility of IChemE membership in their area of work, what their membership offered them, and what IChemE could do to be more relevant to chemical engineers working in the bioeconomy. Their feedback is summarised below.

## Membership and support

- IChemE membership is relevant and accessible to chemical engineers in the biosector
- IChemE Chartered status gives members continued recognition among peers
- many employers are willing to sponsor IChemE membership for their employees
- members feel supported to get Chartered
- members felt Chartered status recognised commitment to the profession
- employers readily recruit graduates who have completed IChemE accredited courses.

## Connection to a professional network

- the SIGs and members groups provide a vast professional network worldwide
- members can join multiple SIGs of interest
- there are opportunities to volunteer through SIGs and members groups
- there are opportunities to contribute articles to *The Chemical Engineer* magazine
- members can access *Interface* to connect with likeminded professionals.

## Information and online resources

- members have access to the latest news through *Member News*, SIG newsletters, and IChemE social media
- members have access to IChemE journals and publications
- members receive an update on the latest affairs and technical features through *The Chemical Engineer* monthly magazine
- members have access to online tools, eg Knovel
- IChemE outreach events at colleges and sixth forms have inspired members to join the profession.

## CPD opportunities

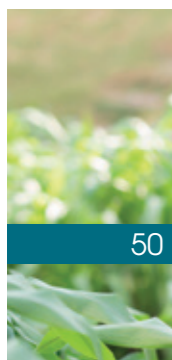
- members have access to a wide variety of technical webinars
- there are opportunities to attend an interesting range of events, site visits and conferences
- IChemE provide quality training courses and workshops
- employers find IChemE HAZOP training and other health and safety courses very credible
- there are opportunities for senior engineers to receive mentor training and become IChemE mentors.

## What IChemE can do better

- IChemE can better cater to graduates working in different areas of industry and levels
- the Biochemical Engineering SIG should continue to balance its focus between industry and academia
- IChemE should increase global connectivity between chemical engineers in the bioeconomy worldwide
- IChemE should organise specific training courses on topics such as sterile engineering, the basics of good manufacturing practice (GMP), validation, clean utilities, clean-room environments, regulatory framework of therapy manufacture, and the sales aspects of engineering
- IChemE should increase focus on emerging areas such as biologics and give this greater attention in *The Chemical Engineer*. Synthetic biology has many engineering challenges, and biosafety could have similar checks and diligence as chemical safety
- IChemE should provide more examples of people working in the bioeconomy that have achieved Chartered status
- IChemE should offer targeted support for CPD, and more affordable training to SMEs.

IChemE will use this feedback and identify opportunities where we can support members more effectively.

These case studies will be reviewed in the future to ensure their continued relevance, and updated accordingly. If you would like to share your case study or contribute ideas on how we can better support you and your colleagues in the biosector, please contact us at [chemengmatters@icheme.org](mailto:chemengmatters@icheme.org)



# Led by members, supporting members and serving society

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