Chemical Sciences
SCOTLAND

STRATEGIC PLAN 2025

CHEMICAL SCIENCES SCOTLAND PURPOSE

The chemicals sector employs **10,000** people in Scotland across **200** organisations (ON,2015)

and is responsible for exports of **£4.2bn** (ONS, 2016)

17% of Scottish Total Exports

Scotland is a global leader investing **£18m** in the circular economy.

Receiving the Award for Circular Economy Governments, Cities and Regions at the World Economic Forum (Davos 2017)

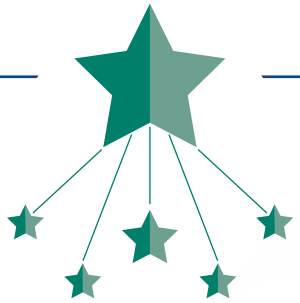
Chemical Sciences Scotland was established in 2007 to create a single voice for the sector in Scotland, to strengthen collaborations across organisations and to focus the priorities of government on industrial growth. Since then CSS has been the catalyst for driving:

- A skills group which has worked closely with Skills Development Scotland to develop a skills investment plan for the sector.
- The identification of common challenges for many companies developing new drugs, chemicals, coatings or food products getting the optimal formulation, leading to the development of the Scottish Formulation Network.
- Innovation – with the creation of the Continuous Manufacturing and Advanced Crystallisation Hub (CMAC) and the Industrial Biotechnology Innovation Centre (IBioIC). In addition, CSS was instrumental in the formation of the Scottish Formulation Network, enabling companies and academics to share best practice and challenges to enhance productivity and innovation.
- Leadership – providing a Master Class Programme for the development of emerging leaders and the establishment of a Skills Investment Plan with comprehensive routes to training and education for all entrants to the sector.
- Investment – since 2013 INEOS has invested over £450M in manufacturing and infrastructure to secure the future of commodity chemicals at its site in Grangemouth.
- Engagement – eg. connecting the chemical sciences community through membership networks eg. IBioIC, Scottish Formulation Network.

Chemical Sciences Scotland works though partnership, engagement and collaboration with local, national and UK government; higher and further education, local and international businesses.

Investing in Scotland

Developing more ambitious plans to attract new investment with innovative new models, including investing in capital assets and targeting key businesses out-with Scotland.



Leadership and skills

Ensuring that we develop a comprehensive leadership and skills pipeline across all disciplines and roles. Empowering business leaders to become ambassadors so that Scotland is recognised as a leading location for sustainable high-value manufacturing.

CRITICAL SUCCESS FACTORS

Communicating and connecting

Showcasing the success of the Scottish chemical industry and building a community of businesses, academics and stakeholder passionate about the future through the CSS website and newsletter

Innovating

Inspiring more businesses to develop new products, processes and services either on their own or in collaboration with other businesses or academia.

We have 4 current priorities:

Grangemouth | Industrial Biotechnology | Manufacturing | Skills

GRANGEMOUTH VISION 2025

"A KEY EUROPEAN HUB FOR SUSTAINABLE HIGH VALUE CHEMICAL MANUFACTURING"

Grangemouth is a regional and nationally significant location for chemicals manufacturing in Scotland, hosting companies such as INEOS, Syngenta, Calachem, Versalis & Fujifilm. It has the scope to become an attractive centre for mobile investments in manufacturing.

Vision:

In February 2015, a partnership was created between Scottish Enterprise, Falkirk Council, Chemical Sciences Scotland and Grangemouth's key chemicals businesses to develop a shared vison for the future development of Grangemouth's chemicals sciences cluster, with the aim to transform the area into "A Key European Hub for Sustainable High Value Chemical Manufacturing".

This transformation will create in Grangemouth a compelling, sustainable, competitive position in chemicals manufacturing, and creating a focal point for investment in high value chemicals manufacturing, significantly expanding the local and Scottish economy in a sustainable way.

Goal:

The result will be a major boost to employment and economic growth in the region, and Scotland as a whole, with net additional Gross Value Add (GVA) of around £250M locally and an approximate additional £160M per year nationally, together with net additional employment of around 4,000 locally and an approximate additional 3,000 nationally. This growth also increases the security of the existing chemicals sector and the local economy which relies on it.

A partnership between government agencies and industry is working together to promote Grangemouth for inward investment and as an internationally-recognised manufacturing, R&D and skills hub.

SEE PAGE 8 FOR THE DEVELOPMENT PLAN

INDUSTRIAL BIOTECHNOLOGY

Industrial Biotechnology uses biology to produce chemicals, fuels and pharmaceuticals offering a route to the long term low carbon and sustainable manufacturing initiatives of the Scottish Government's Economic Strategy.

Vision:

Scotland has the industrial base, intellectual horsepower, infrastructure and unique resources for developing Industrial Biotechnology (IB) as a highly disruptive and transformational next generation manufacturing technology for multiple industry sectors. There is a unique opportunity to build on these capabilities and fully realise Scotland's potential as a global leader in Industrial Biotechnology.

With this aim, an ambitious National Plan for Industrial Biotechnology was launched in October 2013 with the Industrial Biotechnology Innovation Centre (IBioIC) providing critical leadership and resources for the integrated strategy necessary to make this plan a reality.

Goal:

The Industrial Biotechnology National Plan targets are: by 2025 the IB-using industrial cluster will grow to over 200 companies with combined sales of £900m and 2,500 employees. In 2014 there were just 50 companies with £230 million sales and 1,100 employees.

Figure 1 shows the projected growth and the accelerated impact of £466 million sales growth and creation of 115 companies.

IB PLAN ON PAGE 9

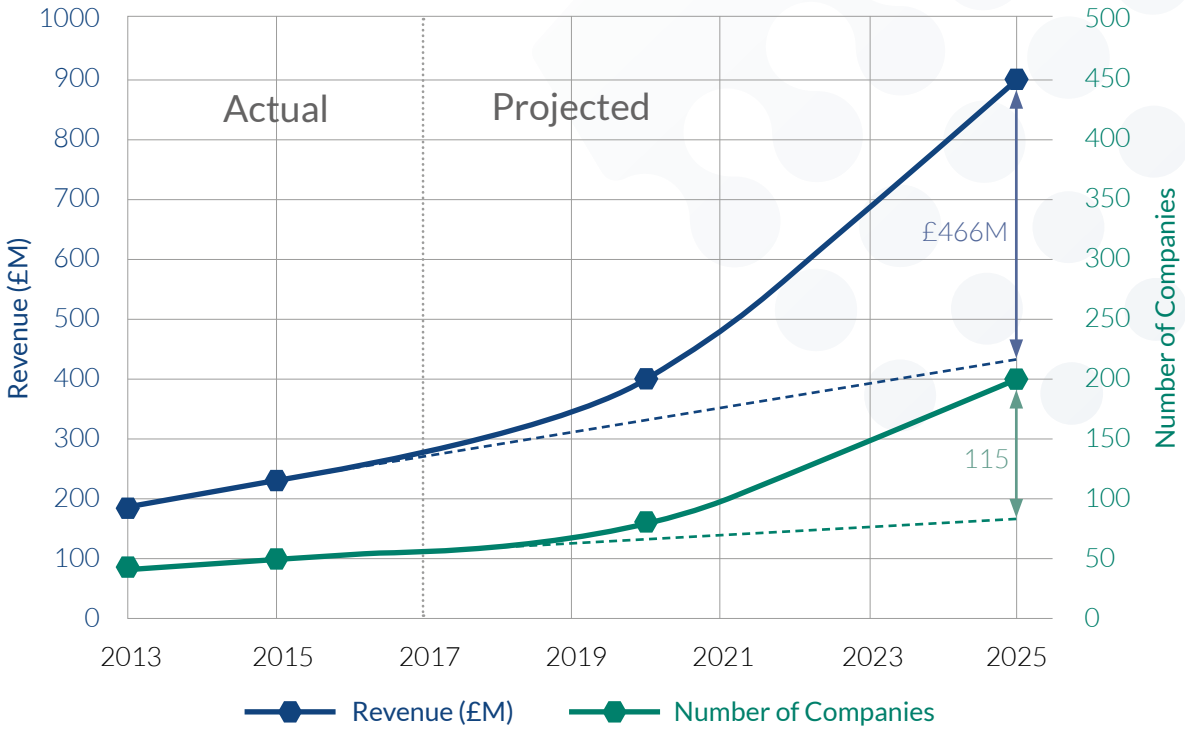


Figure 1: Targets of National Plan for Industrial Biotechnology and predicted growth if no additional support is provided to the IB industry (dashed lines)

MANUFACTURING

High value manufacturing spans the production of chemical ingredients and their formulation into a variety of products including food, personal care products, medicines, inks, paints, animal feeds, explosives and agrochemicals.

Scotland is home to several manufacturing operations owned by multinationals and a large number of SMEs.

Vision:

Scottish chemical manufacturing will respond to market forces by establishing Scotland as a world class centre of high value manufacturing driving innovation in key selected technology sectors thereby enhancing indigenous growth, increasing inward investment and creating opportunities for reshoring production.

MANUFACTURING PLAN ON PAGE 10

Goal:

Our goal is to establish Scotland as a world class centre of high value manufacturing by 2025 delivering £1bn savings in manufacturing through the impact of technology and £1bn gross value added from process and formulation optimisation and data driven innovation. Key to this will be increasing industrial engagement with the centres of innovation directly related to manufacturing, including the Continuous Manufacturing and Advanced Crystallisation Future Manufacturing Research Hub at the University of Strathclyde (CMAC) and the Edinburgh Complex Fluids Partnership (ECFP) at the University of Edinburgh.

SKILLS

Skills are a key enabling factor for the chemical sciences sector, from providing a well-trained technical workforce essential to the attraction of new inward investors, through to the scale-up of our innovative SMEs. Encouraging an entrepreneurial spirit and commercial awareness in our academic community is essential to ensuring that many of the ground-breaking discoveries made in Scottish Universities are commercialised in Scotland.

Working together with the Life Sciences Scotland and public sector partners at Skills Development Scotland, Scottish Enterprise and the Further and Higher Education Sectors, our Life and Chemical Sciences Skills Group works to ensure that relevant, industrially focussed technical and vocational skills training is accessible to the widest possible audience across Scotland, as illustrated in our Skills Investment Plan (SIP).

Vision:

We believe:

- There should be multiple training routes to enter our sector – both academic and practical. Talented people should have the opportunity to progress from a vocational apprentice role through to postgraduate, technical and business leadership level.
- Relevant practical experience should always be provided as an essential part of new entrants' training and education. We will work with skills agencies to develop new qualifications frameworks and standards where needs are identified.
- Innovation and entrepreneurial spirit should be encouraged at an early stage in our workforce. We will work with educators and industry to help provide industrial placements for young people throughout Scotland.
- Flexible routes to training and development, are essential in recognising the need to provide fair and equal access to opportunities throughout Scotland.
- A one-stop resource should be available to SMEs to identify training and development pathways via our website and other communications channels.

Goal:

Delivery of the Skills Investment Plan will provide easy-to-access training and education at all levels which meet the needs of industry and supports the growth of the chemical sciences sector.

SEE PAGE 11 FOR SOME ASPECTS OF THE PLAN

GRANGEMOUTH PLAN

To realise our ambitions for Grangemouth, the following themes are under development:

THEME	OBJECTIVE
Infrastructure	Define a **sustainable Grangemouth energy strategy**, including a focus on attracting new energy investments and **addressing regulatory challenges** to energy competitiveness, with quantitative targets for new investments
	Develop a plan for **utilities and flood prevention infrastructure**
	Develop a plan for improved strategic **road and rail** infrastructure
Refining & Bio-refining	Develop a plan for supporting a **globally competitive refinery and bio-refinery** with reduced support costs and improved supply chain management capabilities
	Establish Grangemouth as **a preferred strategic location** for pilot, demonstration and commercial biotechnology manufacturing assets
Carbon Capture & Utilisation	Establish a **centre of excellence in carbon capture and utilisation**, with pilot and demonstration facilities for CO2 utilisation
Skills	Develop a plan to promote and enhance Grangemouth's capability for **manufacturing skills provision**
Investment	Develop a **marketing and delivery plan** with relevant stakeholder ownership to promote Grangemouth as a high value manufacturing centre

Partners for the Grangemouth Vision include Scottish Enterprise, Scottish Development International, Skills Development Scotland, Falkirk Council, Forth Valley College, ScotCHEM, and chemical manufacturing and manufacturing support businesses.

INDUSTRIAL BIOTECHNOLOGY

The national plan has the following four main themes and objectives:

THEME	OBJECTIVE
Industry Engagement	Ensure organisations have **access to IB information** to inform decision making
	Develop a programme of **company engagement** to raise awareness
	Facilitate **partnership working** and ensure organisations are aware of **collaboration opportunities**
	Facilitate **access to funding and investment**
Bio-refinery/ Bio-chemicals	Clarify the **availability of feedstocks** found in to Scotland
	Engage the entire potential **Bio-refinery/Bio-chemicals value chain**
	Define the barriers around **regulation and legislation**
	Understand the **market access** for the products
	Deliver a **roadmap towards a Bio-refinery/ Bio-chemicals facility** in Scotland
	Ensure adequate provision and **access to R&D scale test** / demo and **scale up infrastructure**
Network of Centres of innovation	Link Scottish academic research base with business
	Deliver a **single point of entry for industry** relevant IB activities
	Build **multinational linkages and collaborations** and leverage project funding
	Ensure investment propositions are leveraged through **industry/academic partnerships**
Skills	Enhance Scotland's training portfolio for **IB skills**
	Deliver appropriate Skills Investment Plans for Life Sciences, Chemical Sciences and Engineering
	Develop appropriate IB skills and training activities based on the Life and Chemical Sciences Skills Investment Plan

Partners include existing companies both aware of and new to Industrial Biotechnology, new companies, Scottish Enterprise, Highlands and Islands Enterprise, Scottish Government, IBioIC, RIUK, Business, Zero Waste Scotland, BioPilots UK, Horizon 2020, Scottish Universities, NIBBs, Syn Bio Task Force, Skills Development Scotland, Scottish Universities and Colleges.

MANUFACTURING

The manufacturing strategy is a joint initiative between LSS and CSS which focuses on the following:

THEME	OBJECTIVES
Processing Innovation	Increase **research excellence and intensity** by delivering major manufacturing research programmes and integrating process and modelling from synthesis to product
	Achieve **outstanding skills development** with specific funding to nurture and grow all researchers through targeted training
	Bring exemplary **research translation to industry** through a portfolio of fundamental, applied and translational manufacturing research projects
	Provide **world class facilities** for the growing applied research programme and the lab of the future enhancing the scope and breadth of support.
Formulation	Optimise formulations and their processes to reduce wastage down to <5%.
	Establish a **Scottish Formulation Facility** to offer access to laboratories and expertise across Scotland, facilitate partnerships with the National Formulation Centre, expose local companies to emerging trends and operate a mobile laboratory
	Promote initiatives that provide **SMEs with free access** to local facilities and scale-up facilities at the UK's National Formulation Centre.
	Through the **Scottish Formulation Network** share best practice and encourage non-competitive partnerships that attract UK funding for innovation.
	Secure industry commitment for proposed Formulation Technician & Engineering Modern Apprenticeships
	Enhance innovation through funding for Masters and PhD students to generate knowledge in translating ingredients through to formulated products.
Automation	Enhance training by **augmented reality and simulation** of physical processes in a virtual environment
	Extend process engineering and design to include computer controlled **additive manufacturing techniques**
	Create **automated value chains** through systems integration of horizontal and vertical data networks.
	Incorporate **artificial intelligence systems** to optimise industrial processes.
	Promote the use of **big data** in maintenance and diagnostic monitoring revealing inconsistent process performance or availability.
	Develop the use of **cloud computing and the internet of things** to improve real time data visualisation and data analysis
	Upgrade safety systems by the development of **cyber security methods.**

Key partners in delivering these objectives include centres of innovation in Continuous Manufacturing and Advanced Crystallisation, Industrial Biotechnology and the Edinburgh Complex Fluids Partnership, the government agencies Scottish Enterprise, Scottish Development International and Skills Development Scotland, the networking forums Interface and the Formulation Network, the funding bodies, National Funding Council, Innovate UK, Engineering and Physical Sciences Research Council and the various industry partners of the Industry Leadership Groups in Life and Chemical Sciences.

SKILLS

Detailed Activity and Outputs plans have been produced for the Life and Chemical Sciences Skills Investment plan and include:

PRIORITY	OBJECTIVES
Distance / online learning	Shortlist identified gaps in provision due to **geographic aspects**
	Identify of suitable and **practical partnerships between FE colleges** and costs associated with this – to include online and residential course provision, and in some cases shared provision of teaching staff between colleges
Develop new Graduate Apprenticeships (GA)	Increase number of **apprentices**
	Increase number of **companies** involved
	Increase numbers of **Graduate Apprentices**
Cross-discipline Modern Apprentice Structures (MAs)	Increase number of companies participating in **cross-discipline Modern Apprentices**
	Increase number of individuals enrolled in Modern Apprenticeships
	Widen geographic spread of Modern Apprenticeships
Enhanced industry engagement with schools/ FE/HE	Increase number of **pupils that are aware of industry opportunities**
	Increase number of **students entering FE/HE that take up industrial placements**
Work placements during university courses	Increase number of **students that are placed with companies**
	Increase number of **positions in companies** advertised
	Increase number of students that are placed
	Widen representation of regions & sectors

Partners include existing companies both aware of and new to Industrial Biotechnology, new companies, LSCS skills group, LS/CS ILGs, FE, HE, SDS, TRainign providers, ESP, Interface, SULSA, ScotCHEM, AGCAS, SFC.

Future vision for the Chemical's Sector in Scotland. We would love you to join us.

Chemical Sciences Scotland would welcome your input as we move into our next phase of development.

Contact us on **ILG@scotent.co.uk**

Some areas which will impact on our sector...

Circular Economy

We need to find Innovative approaches to

- Resource efficiency and emissions reductions
- Enabling recycling and reuse

Green Chemistry

Global market for green chemicals will grow from $11bn to $100bn by 2020.

Energy

We must explore options for Carbon Capture Utilisation and Storage and providing chemical technologies for energy storage enabling renewable forms of energy to replace fossil fuel technologies

Skills

The future of work skills will be shaped by smart machines and systems and increased global connectivity.

Digitisation

The Internet of things, artificial intelligence and the 4th Industrial Revolution technologies will impact the chemicals sector of the future

Advanced Formulation

An informed approach to formulation will lead to products with fewer and more sustainable ingredients.

Environmental Policies

The push for environmentally-friendly products presents opportunities for the chemicals sector to create innovative, sustainable, bio-products.

Supply Chain re-shoring

As a location for sustainable, high value manufacturing it enables key parts of the supply chain to locate in Scotland

Chemical Sciences SCOTLAND

Produced March 2018