



The Centre for Process Innovation
Annual Report 2010/11

the future
inspired...

inspireo

Foreword

The Centre for Process Innovation (CPI) was set up seven years ago to provide UK businesses and research communities with the vision, facilities and expertise for swift and efficient development, testing and prototyping of process technologies.

We are delighted to report some major steps forward. At the forefront is that CPI is part of the government's High Value Manufacturing Catapult. This is fantastic news for CPI and great recognition for the team and the excellent work we have done since inception in 2004.

We are pleased to be part of the Catapult and the government's initiative to grow manufacturing in the UK, and are looking forward to working with our partners. This announcement heralds a sustained investment into manufacturing and CPI's proven ability to help companies create their next generation of products and processes. This is great news for the UK and for the process industry.

CPI continues to make great progress toward its vision of being a world class centre of innovation for the process industry, stimulating a more innovative, sustainable and competitive sector by reducing the risks associated with innovation, allowing businesses to take advantage of growing international demand.

Another key evolutionary step has been the rapid growth of services focused on the private sector. This work is a vital driver of our ability to become self sustaining in the future.

A number of important launches and expansion projects have been completed recently. Dedicated anaerobic digestion development capabilities have been added to CPI's portfolio, and its existing industrial biotechnology facilities have been expanded with a new demonstrator facility that is unique to the UK. CPI's current printable electronics facility in Sedgefield, Durham, has also continued to grow, allowing for greater and more diverse capability. The ongoing development of the collaborative CPI and Tata Steel thermal technologies project, as well as the launch of our Technology Hub and Innovation Accelerator Incubator, all herald exciting times moving forward for the process industry.



As a developer of key technologies in the UK, CPI continues to meet its goals and expand the horizons of innovation. With a total asset base of £55m and growing, CPI is currently delivering a number of forward-thinking and vital projects to steer the UK's process industries, printable electronics technologies and low carbon transition with partners from the public and private sector.

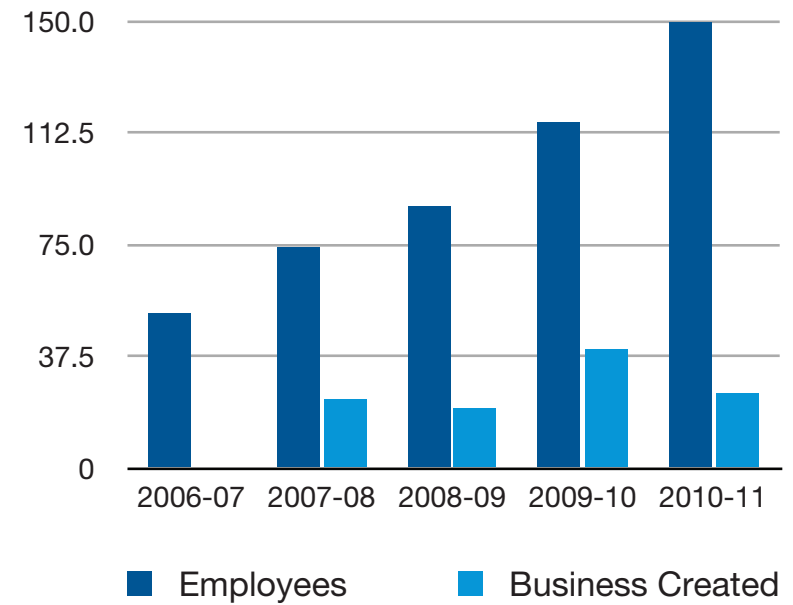
We are excited about the scope for even stronger collaborations across our technology areas that involvement in the technology innovation centre provides.

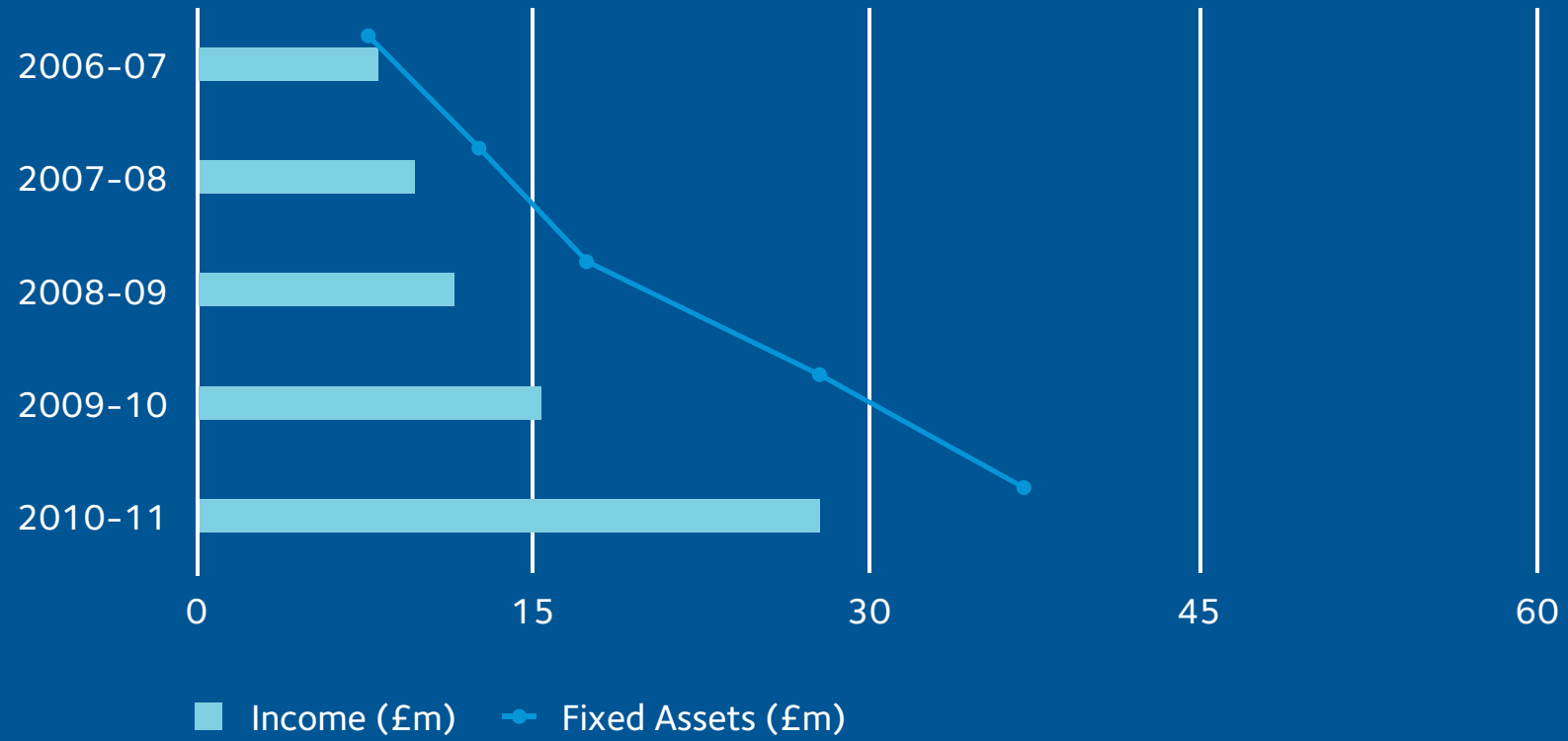
A handwritten signature in blue ink that reads "Nigel Perry". The signature is written in a cursive style with a horizontal line underneath the name.

Nigel J. Perry
Chief Executive Officer

Highlights and Achievements

Following four years of strong growth, 2010/11 was a period of intense activity that saw a number of major projects come to fruition as well as several new initiatives that offer significant potential for the future.





Industrial Biotechnology

CPI officially opened the expansion of its state of the art industrial biotechnology facilities in May. Minister for Universities and Science, David Willetts, opened the facility on a day which provided an opportunity for unique insight into the work of CPI, the High Value Manufacturing Catapult and the potential of its latest facilities.

The purpose of the expansion is to stimulate the use of industrial biotechnology to develop and demonstrate cleaner and more sustainable manufacturing processes in the delivery of vital products. It is tailored to the production of alternative fuels and chemicals using renewable feedstocks such as biomass and waste as an alternative to traditional, chemical and finite resources. This enables the UK to evolve a cleaner, more sustainable future and accelerate its low carbon transition.

The facilities available to clients using the facilities are vast: upstream biomass processing and a new 10,000-litre fermentation capacity, together with enhanced downstream processing, adds to CPI's existing assets and offers an open access unit the scale of which is unique in the UK. It also broadens the existing pilot plant facilities found at CPI: a reconfigurable 'plug and play' capability harnessing bio, chemo and physical transformations in high value manufacturing.

The enhanced facility has been developed for three main applications in a quest to develop, speed-up and improve clients' products and processes: as the next scale step up from CPI's existing industrial biotechnology capability; as a proof of concept facility for materials that will ultimately be produced at industrial scale; or as a product manufacturing facility. It will play a key role in developing novel and sustainable process technologies.

Minister for Universities and Science, David Willetts says: "UK Manufacturing is at the heart of our plan for economic growth and Technology and Innovation Centres are a key element of the plan. Industrial biotechnology is an important part of this with its potential to improve our sustainability, cut CO₂ emissions and reduce our dependence on oil and gas."

“ CPI’s industrial biotechnology facilities commitment to convert science into business facilities are also based in an area where we have created to help boost the local economy”

- Minister for Universities and Science,
David Willetts



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Industrial
Biotechnology



“ This innovative collaboration between world-leading expertise, equipment and the development and commercialisation of new technology. The new facility will provide a platform for testing and validating new technologies to support the low-carbon transition.”

- CPI Director of Strategy,
Dr Graham Hillier

 Thermal
Technologies



Green CPI and Tata Steel will provide
expertise and capabilities to enable
acceleration of thermal processing
technology to play a leading role in developing
the low carbon economy of the future.



TATA STEEL

Thermal Technologies

CPI's thermal technologies facility is a collaborative project with Tata Steel. It provides an open access expertise centre for industries and developers who are involved with, or interested in using, thermal processes. It offers the know-how, capability and physical assets to enable partners to develop new processes, revitalise existing products and improve existing processes.

The thermal technologies offering provides its customers with expertise and demonstration assets to accelerate and de-risk the translation of innovation into new and improved products and processes, through access to high temperature technologies. It combines the knowledge and process technology-based skills of CPI and Tata

Steel to nurture the thermal processing skills base of the UK. It is a key resource for companies and research organisations working with or developing these technologies.

The facility is based at Tata Steel's Teesside Technology Centre. It has a range of demonstration and laboratory scale assets, plus associated characterisation capabilities and a multi-function gasifier and pyrolysis oven. It can host bespoke pilot plants that can be built, operated and then dismantled when no longer required. This capability is supported by a range of support services that are unique in the UK and it is one of only a few such facilities in Europe.



Printable Electronics

2011 has seen CPI's printable electronics focus expand in size, capability and reach in two significant areas: a facility focusing on interactive smart systems, and a new, separate, £20m expansion project.

CPI's significant investment into a new prototyping and development facility for printed electronics devices will be uniquely positioned to work directly with the UK's design, print and packaging industries. It will help bring cutting-edge electronic functionality into manufacturable printed products.

The creation of the facility opens up a huge opportunity for developing entirely new printed products that can incorporate printed moving displays, printed batteries and printed sensors. Putting electronics into print, packaging or point of sale materials can enable a true cross-media experience directly linking traditional print with digital technologies. This will lead to the creation of a whole new generation of value-added products for the wider print and packaging industry.

This facility will raise awareness of these emerging technologies across the relevant industries and be positioned to deliver cost-effective access to expertise, materials and equipment.

A separate project that expands CPI's existing printable electronics facilities, a £20m expansion was completed and also provides a further 700m² of Class 100 cleanroom space.

The flexibility of this expansion enables the optimum selection, positioning, installation and operation of new toolsets to ensure that the facility is closely aligned with the needs of the printed electronics industry.

A primary focus of this project is the development of a Large Area Coating Equipment (LACE) line, which has been designed to enable the development and prototyping of both organic light emitting diodes and organic photovoltaic technology. It is suitable for processing both air sensitive and non air sensitive material sets for the production of devices on a range of substrate sizes up to 200mm square.

The system offers the user the following advantages:

- Cassette-cassette batch operation (up to 20 substrates)
- Capability to run 4-inch, 6-inch and 8-inch substrate sizes
- Full system data logging for maximum data traceability
- Full robotic handling to minimise manual intervention, maximising product yield.

The latest development project not only reinforces CPI's existing capability, but continues to grow its potential and ability to offer potential clients with the facilities and expertise that are required moving forward.

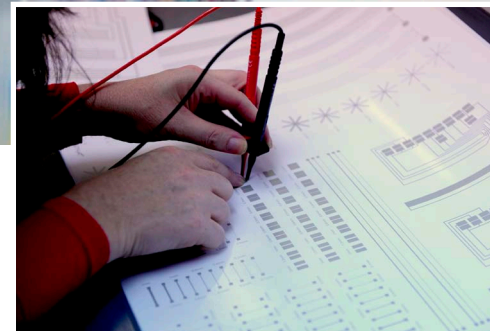
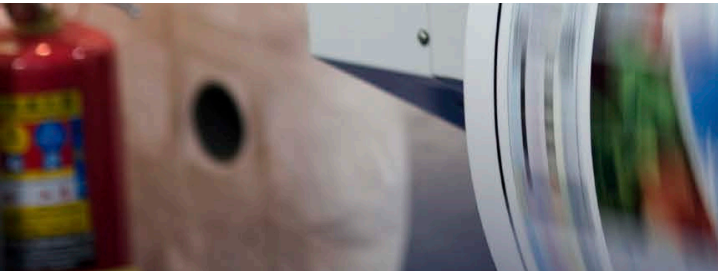
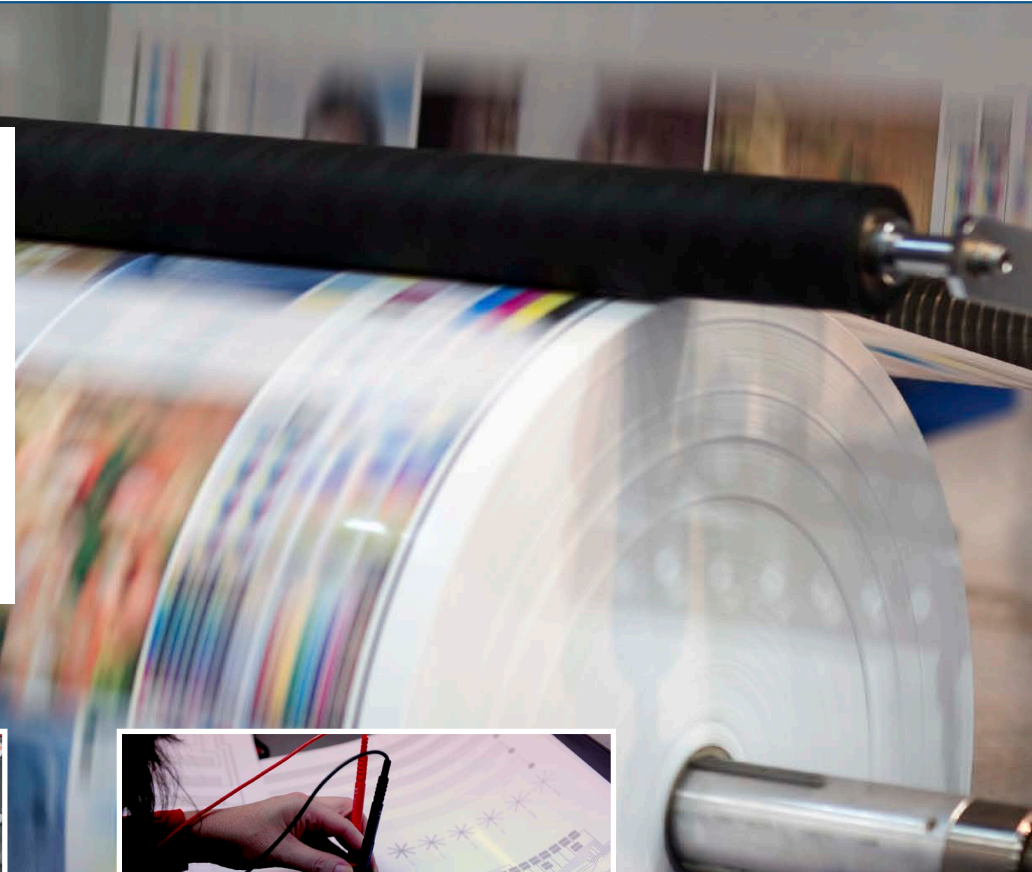
“ The LACE wide range engineering our clients and drive

– Director
Dr Tom

CE line adds significant capability to CPI's combination of engineering skills and expertise. Our commercial, scientific, engineering and administrative staff work closely together to ensure our customers get their new products to market as quickly as possible, and we printed electronics technologies forwards.



of Printable Electronics,
Taylor





“ CPI offers anaerobic digestion-focussed facilities and expertise to provide advice, guidance, trials and new technologies, which will accelerate the development and application of installations turning waste into energy, and other valuable products, naturally.

- Director of Sustainable Processing and Advanced Manufacturing,
Dr Chris Dowle



Anaerobic
Digestion

Anaerobic Digestion

CPI launched its state of the art facilities dedicated to the development of anaerobic digestion technologies in March 2011. The facility is the first of its type in the UK, and was opened by Ian Swales, MP for Redcar.

CPI provides an open access facility where companies can test and develop novel feedstock and technology combinations, with the aim of providing the UK with a base to advance and develop new commercially viable processes and intellectual property in the area of anaerobic digestion technology.

CPI's work to develop this facility received Highly Commended status at the 2011 IChemE Awards, following CPI's shortlisting for the BioProcessing Award.

The UK Government has cited anaerobic digestion as being a vital technology for achieving its goal of becoming the greenest government ever. As waste is increasingly viewed as a resource, AD's importance in converting waste to energy will become ever more significant. It reduces carbon emission, provides energy security and generates green jobs. The Government's aim is to achieve a "huge increase" in deployment of AD technology.

CPI's capability in anaerobic digestion embodies this approach. Part-funded by the Department of Energy and Climate Change (DECC), the facility is open access, designed, built and operated by CPI. It helps organisations to develop tailored AD processes and technologies. It offers a rapidly reconfigurable, 'plug and play' capability which explores alternatives to traditional waste disposal to create cleaner, sustainable AD processes.

Objectives are to work with clients to:

- Reduce the size and cost of AD installations
- Improve process control
- Increase biogas yield from various feedstocks, including co-digestates
- Further develop pre- and post-treatment technologies to improve yields
- Enhance digestate properties to develop high quality natural soil conditioners/ fertilizers
- Improve effluent water quality
- Develop purification and monitoring processes to allow injection of biogas into the gas grid

In this way, CPI will attract wealth and economic opportunities to the UK through the exploitation of anaerobic digestion.

Innovation Accelerator

The Innovation Accelerator is dedicated to nurturing innovative businesses within the science, technology, engineering and life sciences sectors. It combines industry know-how and leading edge facilities to support new and established companies in the North East of England.

2011 has seen the development and opening of a cutting edge new facility comprising a 1000m² fully integrated technology incubator. It enables the Innovation Accelerator to offer pilot plants, specialist laboratories and office space that allows fledgling companies to develop new products and processes while reducing peripheral startup costs, such as provision of industrial services and purchase of general laboratory equipment.

Combined with the diverse industry experience and expertise available to residents, the Innovation Accelerator offers the perfect environment for companies looking to evolve exciting new business opportunities, from inception through development and commercial exploitation.

The Innovation Accelerator can help clients to understand their competitive position, plan around intellectual capital and/or improve business plans to increase growth. Our varied services include:

- Business start-up support, to help develop new business strategies and prepare for investment.
- Market intelligence, to help understand your market opportunities, and identify potential competitors.
- IP landscaping, to aide your understanding of the freedom to operate, planning and protecting your intellectual capital.
- Incubation, allowing you to access plug and play incubator facilities that help your business grow, and eliminate peripheral start-up costs.
- Technology commercialisation, to plan your technology roadmaps, scouting and brokering, and provide access to extensive scale-up expertise.
- Entrepreneur programme, which is designed to develop your entrepreneurial skills and provide you with the tools required for business growth.

The Incubator

The Innovation Accelerator can provide access to a 1000m², fully integrated technology incubator incorporating pilot plant units, specialist laboratories and office space. These cost-effective units are located within the UK's leading process facility with access to established infrastructure and offering room to grow.

These plug and play units will enable fledgling companies to develop cutting edge products and processes, while reducing peripheral start-up costs such as provision of industrial services and purchase of general laboratory equipment. This enables your ideas to be brought to market quickly and cost effectively.

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- Manager
Dr Mike

nothing else like our Innovation Accelerator in the UK.
It has been carefully designed to enable the nurturing and support
of growth for science, technology, engineering and life science
start-ups and SMEs which could result in significant economic benefits for
the region.



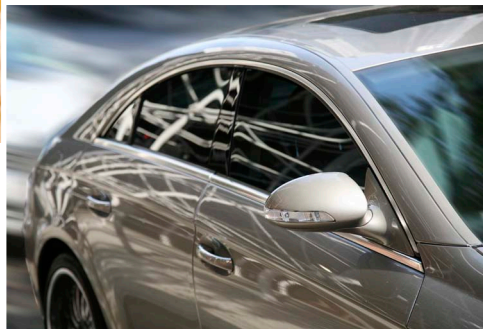
Director of the Innovation Accelerator,
University of Manchester
Dr. Anderson



“ The High Value Manufacturing Catapult will support our objective to rebalance the economy by underpinning current UK manufacturing strengths through the development and deployment of novel technologies...

- Deputy Prime Minister,
Nick Clegg

CATAPULT
High Value Manufacturing



High Value Manufacturing Catapult

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One of the key announcements of the last year has been that CPI will be part of the the governments High Value Manufacturing Catapult. The consortium will receive over £140m of investment over the next six years to maximise the economic growth potential of new technology, building on the UK's strength in basic and applied research, in areas where substantial global markets are forecast.

The Deputy Prime Minister Nick Clegg says: “The High Value Manufacturing Catapult will support our objective to rebalance the economy by underpinning current UK manufacturing strengths through the development and deployment of novel technologies into sectors such as aerospace, automotive and pharmaceuticals, whilst at the same time driving the UK into leading positions in new high growth markets by creating a platform for innovative SMEs to work with larger companies in developing technologies such as plastic electronics, fibre reinforced polymer composites and biotechnology.”

The Business Secretary, Vince Cable, says: “Each of these partners brings with it a strong network of linkages with universities specialising in developing leading edge technologies in their areas of focus, and industrial companies seeking to co-develop and then exploit these in the market place.”

The investment into a network of technology and innovation centres was announced by the Prime Minister in October 2010 and, as a driver of key technologies which continues to achieve tough goals and expand the horizons of innovation, was welcomed by CPI. Based on propositions by Hermann Hauser and James Dyson, the technology innovation centre model has been championed by CPI since its inception.

CPI's proven track record of work in the innovation space between the discovery of an idea and the delivery of a product or service to the commercial market clearly fits the criteria sought by the Technology Strategy Board (which was responsible for establishing and overseeing the network of centres). In technology readiness levels (TRL) CPI works from level 4 to level 7. Universities typically

work in level 1 to 3 and commercial businesses at level 8 and 9 – CPI and the other consortium members help bridge this gap to enable British companies to commercialise the results of world-class research in the UK and access major new high technology markets.

The High Value Manufacturing Catapult is formed from seven regional facilities across the country. These are:

- The Centre for Process Innovation
- Advanced Manufacturing Research Centre
- Nuclear Advanced Manufacturing Research Centre
- Manufacturing Technology Centre
- Advanced Forming Research Centre
- National Composite Centre
- Warwick Manufacturing Group.

Case Studies

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Ecosyl Products Limited is one of the World's leading companies involved in sales and marketing of silage additives. Based at Stokesley in North Yorkshire, it has a long tradition of research and development tracing back to its origins as part of ICI then Zeneca.

Ecosyl is now making use of CPI's extensive industrial biotechnology facilities for testing of its award-winning silage additive product: Ecosyl 100. It is utilising CPI's 10,000-litre fermentation capacity to run trials which will establish the viability of a continuous production run at the cutting edge facility. A successful trial will ensure that production of this globally-successful brand will remain in the UK, specifically the North East, safeguarding jobs and offering opportunities for future collaborations and innovative project development and scale-up.

Dr Andy Beardsmore, Ecosyl Managing Director, says: "CPI provides a readily available resource for companies such as Ecosyl, and I'm hopeful that successful testing can lead to a long term relationship between the two companies."

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Global chemical and polymer company Invista is an established business relying on traditional methods which has utilised CPI's facilities to enable its entry into the industrial biotechnology sector. CPI is able to financially lower barriers to entry and de-risk process development, and has been instrumental in Invista's exploration of this field.

With a long-standing commitment to sustainability, Invista's step towards industrial biotechnology development is timely and, with CPI, has struck collaboration agreements whereby CPI laboratory space and expertise is exploited by the company. Over the next two years CPI's facilities and scale-up expertise will be utilised to clear Invista novel processes, enabling the company to pursue its sustainability vision: seeking innovative technologies and cost-effective ways to further improve manufacturing processes.

CPI's open access, fully interchangeable capability enables access to a custom molecular laboratory tailored to meet Invista's needs, and while acting as a consultancy has ongoing dialogue in the exploration of new technologies and science.



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Ingenza applies state-of-the-art biotechnology approaches to obtain novel biocatalysts, engineered microbial strains and integrated chemo-enzymatic processes, resulting in more cost effective and efficient molecule manufacture in the fine chemical, pharmaceutical, biotech and agrochemical industries. It works with customers and partners to implement proprietary bioprocess technologies and improve existing processes, and has been working with CPI to develop a bench scale fermentation and downstream processing development project.

Ingenza's fermentation and downstream scientists have been working closely with CPI staff to scale up and deliver a *Saccharomyces Cerevisiae* yeast at 750 litre scale. Ingenza took this opportunity to allow its staff the opportunity to work in this scale of processing, taking advantage of CPI's open access set-up to help the understanding of pilot scale processes.

As a synthetic chemicals company, Ingenza's bench scale fermentation and downstream processing experience has developed its process, but CPI's expertise and unique facilities have developed this further and enabled scale-up. Following this success, CPI and Ingenza look forward to working with each other on future projects.



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Solvert has been working with CPI in the development of a fermentation process for high value chemical production, using a particular strain of *Clostridium* bacteria and a food and green waste derived feedstock. Solvert's work is centered on the safe, sustainable and efficient production of n-butanol and hydrogen. n-butanol and hydrogen are considered advanced biofuels and both chemicals offer sustainable routes to a range of household products that are traditionally derived from oil, including resins, paints and cosmetics. CPI executed a tailored programme of work and facilitated Solvert's access to the laboratories and scientists at CPI. The results of the trials have proven to be very encouraging enabling Solvert to move to the next stage of the project – scaling up to 750 litre and then 10,000 litre fermentations at CPI's industrial biotechnology facility.

Solvert CEO, Kris Wadrop, says: "Having access to CPI's biotechnology facilities and experienced technical staff has enabled Solvert to execute the first phase of our business plan for a fraction of the cost and in less than half the time it would have taken had we decided to establish our own in-house capability. "Working, in effect as our in-house technical team, CPI has executed Solvert's Phase 1 technical programme in a professional and comprehensive manner, enabling us to achieve our technical objectives on schedule and ahead of budget. The CPI technical team also contributed to the development of the technical programme offering alternatives to the original proposal which enhanced Solvert's overall value proposition"



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