

DIRECTORY

A COMPREHENSIVE GUIDE TO THE CHEMICAL-PROCESSING SECTOR IN NORTH EAST ENGLAND



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Integrity analysis in focus

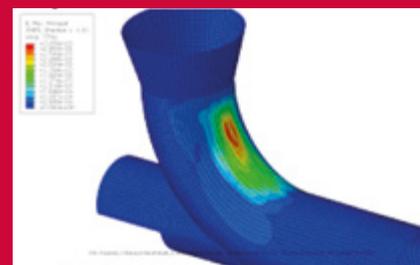
The issue: our client discovered a pipework bend that had suffered corrosion and a loss of wall thickness, which put the integrity of the pipe in doubt. At considerable cost and with disruption to the plant's operations, a sub-contractor was appointed to undertake an emergency composite repair. Our client sought to retrospectively substantiate the appropriateness of the work.

Our approach: we worked with the client's team to understand the pipe's operational requirements. We then undertook a fitness for service assessment, including a finite element analysis.

Our findings: our analysis identified that the pipe would have continued to operate safely without the composite repair. An earlier analysis would have assured our client of the safety and continuing viability of the pipework bend - saving them money and preventing disruption to production.

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- maximising process and plant performance



Fitness for service assessment of corroding elbow

WELCOME



LOUISE GWYNNE-JONES
PR & Communications
Manager, NEPIC

On behalf of the NEPIC team, I would like to extend a very warm welcome to the readership of the Directory 2016. I take this opportunity to thank this year's authors whom have volunteered to contribute to the success of this publication.

NEPIC is dedicated to the promotion of North East England's chemical-processing sector and that of the companies that operate within its footprint. Now in its tenth year, this publication has proved a vital tool in marketing the region as a place of future process sector investment and showcasing the capabilities and passion for growth that lie within.

The cluster was extremely proud when, in 2015, this in-house produced publication was cited 'best in class' for cluster marketing and international SME development by the European Cluster Secretariat, ESCA.

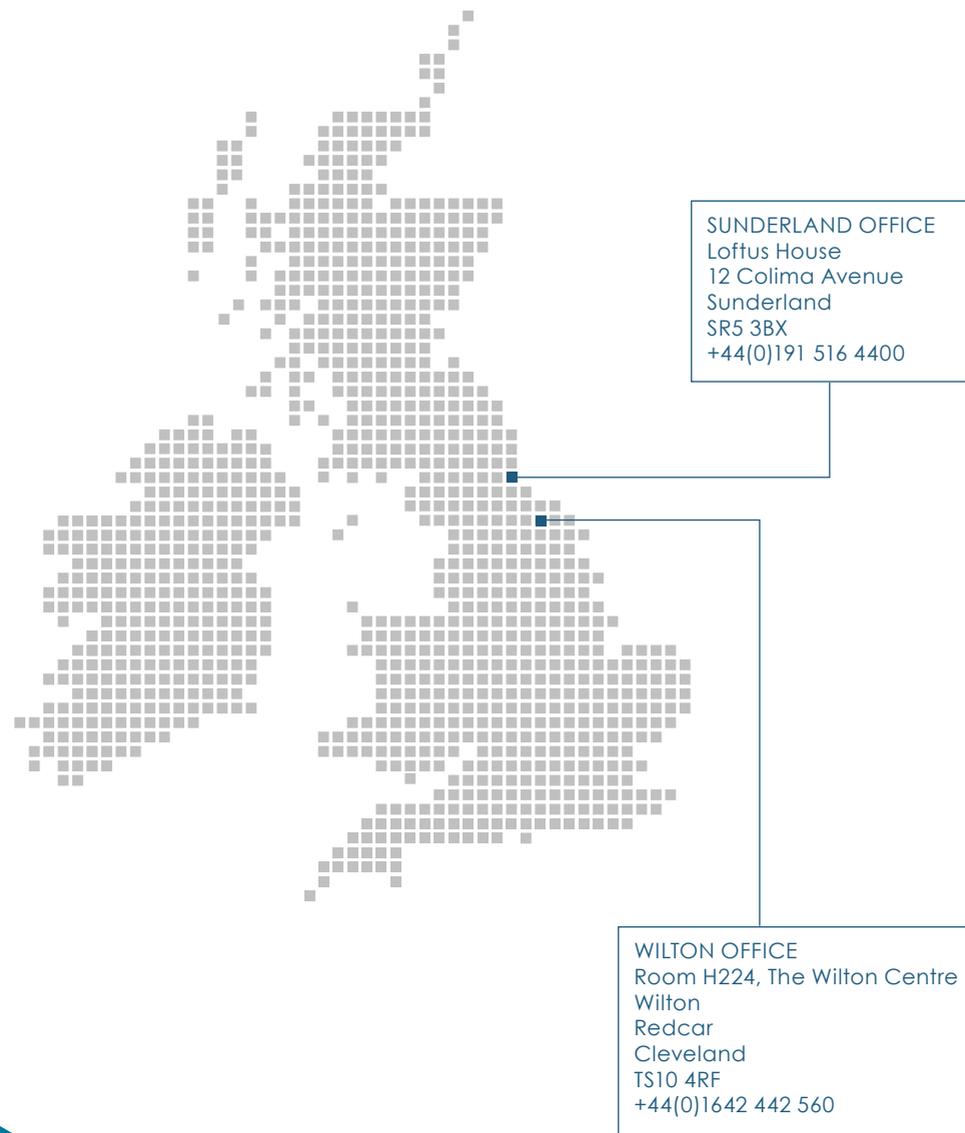
We will work to build on this success and, over the course of the edition's 12-month shelf life, strive to take our message and that of our members far and wide to help us collectively succeed in making North East England Europe's premier location for chemical-processing sector investment.

Through NEPIC, this region boasts one of the most powerful and influential business clusters in the UK, with collaborative, inter-regional working at the heart of this success. I, therefore, hope that you find this publication to be an informative and practical resource guide to the extensive products and services available within the network.

Thank you.

Louise Gwynne-Jones

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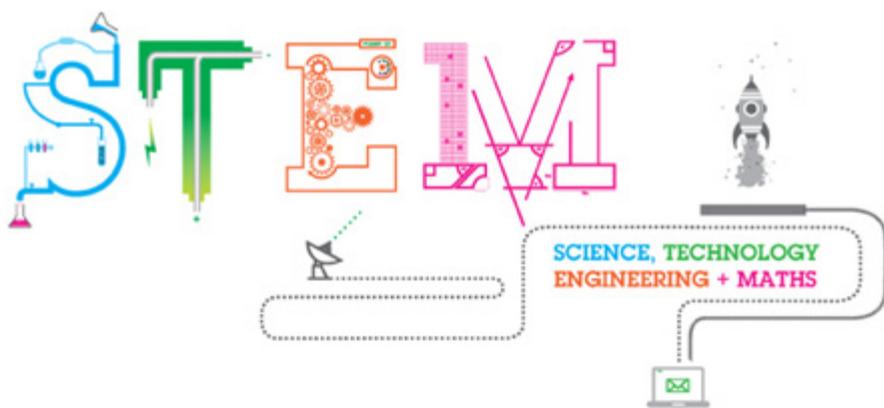
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To get involved with outreach activity in the region please contact the **STEM** team at **RTC North** on: 0191 516 4400 or stem@rtcnorth.co.uk



WE NEED YOUR HELP...

to excite and enthuse young people about the real life application of **Science, Technology, Engineering** and **Maths** (STEM). The STEM team at RTC North work closely with businesses in the region to encourage them to invest in their future workforce.

We help bridge the gap between education and industry by coordinating opportunities for students and professionals to meet through activities such as, careers talks in schools, interactive sessions and site visits. RTC are also the host organisation for the Regional Education Coordinator for the Royal Society of Chemistry.

You can engage in STEM outreach by volunteering as an ambassador, bringing learning to life for students and giving them an insight into exciting career choices in the region.

CHAIRMAN'S NOTE



IAN SWALES
Director & Chair, NEPIC

Having taken over as Chairman at the end of 2015, I should first pay tribute to my predecessor Paul Booth. Paul was a tower of strength for NEPIC and remains very important to us in his various roles. He is a hard act to follow.

NEPIC continues to flourish and I have been very impressed by the events I have attended so far starting with chairing the AGM. The awards dinner was once again an outstanding occasion and the stories of the award winners were truly inspiring.

Our industries typically involve a lot of capital equipment but it is people that make the difference. It was great to celebrate some excellent contributors. NEPIC looks outwards on behalf of the region and it was a special privilege for me to present the first International award to Mr Kamal Nanavaty of Reliance Industries, India.

I have also attended various other cluster events including one for the pharmaceutical industry in Cramlington. This was very well attended and the presentations on the theme of continuous processing of pharmaceuticals seemed of great value to those attending.

NEPIC continues to be the "voice of the industry" in our region with an impressive number of articles published in journals. Lobbying policy makers and others on matters of shared interest is a key part of the job and the NEPIC staff have both a wealth of experience and the powerful network on which to draw. The recent Tees Valley Process Industry study has produced a huge number of commercial opportunities for our companies and policy recommendations for local and national government.

There are so many success stories in the region driving economic growth and I am confident that there will be many more. Those companies that network and support the cluster also derive the most benefit and increase their chances of success.

NEPIC has recently been externally assessed and once again rated as an outstanding cluster organisation. Thank you for the continuing support through your membership. I wish you a successful year in business and look forward to meeting you at one of our future events.

Ian Swales

More than just Oxygen



BOC supports a range of industries in the UK with industrial and speciality gases, plus related equipment and know-how. The company's gases and expertise have contributed to advances in many industries and aspects of everyday life, including steelmaking, refining, chemical processing, clean energy, wastewater treatment, welding and cutting, food processing and distribution, glass production, electronics and healthcare. BOC is a member of The Linde Group - a leading supplier of industrial and speciality gases across the world.

For several decades BOC has been meeting the needs of businesses in the North East and in particular the needs of the Teesside process industry by supplying vital gases and local expertise to ensure that BOC customers get the most out of industrial gases and gas processes. BOC has built an extensive presence across the North East which includes over 100 km of pipelines supplying oxygen, nitrogen, hydrogen and argon. BOC's operations in Teesside represent the largest industrial gas facility in the UK and one of the largest in Europe. BOC's local infrastructure, is a cornerstone for many companies operating in the process industries.

BOC recognises that process efficiency, safety and environmental compliance will remain fundamental issues for successful operations in the process industry. Consequently BOC will continue to deploy specialist knowledge in these key areas to help achieve benefits for its customers. BOC is eager to help develop new projects and is encouraged by a number of new investment opportunities in the region particularly in the clean energy sector.

Dr Dave Lockyer, Commercial Manager says that "BOC will continue to work alongside NEPIC and other local bodies to ensure that the region makes the most of these opportunities".

BOC is part of The Linde Group which has global turnover of more than £17.9bn with operations in over 100 countries. Since becoming part of The Linde Group, BOC's UK operations have benefited from investments and access to new markets. Over £250m has been invested in new UK facilities including air separation plants at Scunthorpe and in Scotland, new acetylene production on Humberside and a new hydrogen facility in Teesside.

In addition to industrial gases, BOC is building up a nationwide service to provide a comprehensive range of safety products and safety related workwear. This service builds on and extends BOC's long tradition in welding and cutting related sectors. BOC is also rolling out a nationwide technical facilities management offering whereby BOC technicians, based at the host companies' site, take over stock and inventory control to yield impressive efficiency improvements.

BOC takes its environmental responsibilities very seriously and encourages environmental awareness in others. In conjunction with NEPIC, BOC are proud to sponsor annual environmental awards for schools and businesses from across the region. Dr Dave Lockyer, commented that "the BOC-NEPIC Environmental Awards recognise and stimulate environmental activities, whilst encouraging schoolchildren to carry out an environmental project and to engage with industry".

Working together for industry, education and the environment

BOC supplies gas and related products to a wide range of customers including; large chemical plants; power producers; metals and glass manufacturers; medical facilities; food processors; pubs and restaurants

In Teesside, BOC operates one of the largest industrial gas pipeline clusters in the world and we have supported our major customers in the region by investing more than £100m on industrial gas related facilities in the past decade.

We are helping to create a cleaner future, being actively involved in the hydrogen economy and by offering technologies to reduce emissions and enhance process efficiency.

BOC is actively involved in the communities in which it operates, through the sponsorship of environmental awards for schools and industry and BOC's Inspiring Gases programme which encourages schools' engagement with science, engineering and technology



For more information on BOC in the UK please visit www.boconline.co.uk or Dave Lockyer on davelockyer@boc.com or +44(0)7768 177 961
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FOREWORD



STAN HIGGINS
Chief Executive, NEPIC

Together, these industries employ some 35,000 people directly and a further 200,000 indirectly, creating a location with a community that welcomes the chemistry based sectors as it has all the skills and experience to make the most complex and hazardous processes work safely and efficiently.

The infrastructure of North East England is also aligned to the process sector, particularly our ports, airports and other logistics assets. In terms of engineering, one of the highest concentrations of engineering consultancy firms are based here ready to support new investment, large scale maintenance turnarounds, process modification, project design and delivery.

Furthermore, our schools, colleges and universities all have training courses and facilities that support the sector, with many having specialist training equipment that realistically simulates working on chemical process plant.

NEPIC is a private not-for-profit company, limited by guarantee and owned by its members. The Cluster, created by Industry in 2004, continues to be led and supported by industrialists from the process sectors and their supply chain.

The NEPIC cluster management team and their operations were initially quality assessed some two years ago and reassessed by the European Secretariat for Cluster Analysis in February 2016.

Following this reassessment, NEPIC retained Gold Label cluster status and continues to be one of only 70 Gold Label cluster organisations from over 2,000 clusters that have been assessed across Europe and elsewhere in the world. NEPIC remains the UK's only Gold Label cluster organisation.

I am also pleased to report what the assessor stated that this reaccreditation confirms that NEPIC is one of the leading cluster organisations in Europe - providing added-value to our members and stakeholders through sound management procedures that support NEPIC's efforts to deliver the right services for the future development of the cluster.

The professionalism and dedication of the NEPIC cluster team is matched by the enthusiastic support and input from our membership. We are working collectively and collaboratively towards our common goal; that is growth of the process sector here in North East England.

Together we are stronger - come and join us.

Stan Higgins



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LOUISE GWYNNE-JONES
PR & Communications
Manager, NEPIC

NEPIC is an award winning cluster organisation working with the chemical-using industries in North East England. Together with our member companies, we work to build upon the already powerful industrial base located here and make this region one of the most competitive and successful chemical-processing locations in Europe.

Privately-owned and led-by-industry, we work to support cluster members to become thriving, sustainable organisations, operating in a collaborative business environment that enables growth.

Formed in 2004, NEPIC was the result of the merger of two industry bodies – the Teesside Chemical Initiative, who represented heavy base chemicals in the south of the region, and the P&S Cluster who worked with the pharmaceutical and life science businesses that were predominately based towards the north.

Steered by Michael Porter's theory of clustering for competitive advantage, NEPIC's remit was clear – reconnect the fragmented industrial sectors – a result of ICI's exit from the region in

the late 90's – and create an industrial powerhouse to rival all other global locations.

NEPIC has now passed the £3 billion mark in terms of Gross Value Added brought to the economy of the North East of England since our inception. Our annual gain now exceeds £0.5 billion per annum and we are currently the only Gold Label accredited cluster in the UK and is recognised across Europe for Cluster Management Excellence.

Industrial roots

North East England is renowned for its industrial heritage and boasts more than 2,000 years of manufacturing and industrial activity. Today, the region is home to the chemistry-using industries of chemicals, fine & speciality, petrochemicals, polymers and composites, pharmaceuticals, biotechnology, bioresources, biofuels and renewable energy and low carbon materials.

There are more than 1,400 companies directly involved or in the supply chain of these industries, which collectively generate £26 billion of annual sales and employ 190,000 people. Together these companies

manufacture almost 50 per cent of the UK's petrochemicals, 33 per cent of UK pharmaceuticals and export £12 billion each year – making this region the only net exporting region in the UK.

Going for growth

The Process Industries of North East England are dynamic and successful and have experienced substantial growth. Since 2004, 85 process sector investment projects have been delivered in the region valued at £4.3 billion.

During 2015, we witnessed some major successes but also a stark reminder of the realities that we face as a sector. Two major landmark projects were announced in July 2015. First came planning approval for the Sirius Minerals £2 billion York Potash mine and mineral transportation system following a 4 year investment that to-date has totalled £150 million. Planners' ruled it was "transformational" for the region's economy.

Meanwhile, the region's industrial carbon capture and storage blueprint – a UK first – was launched in London by Teesside Collective. Teesside Collective is a cluster of North East energy-intensive partners that hope to have an operational ICCS project on Teesside by 2024.

The project would initially capture CO₂ from Sembcorp Utilities UK, GrowHow,

Lotte Chemical UK, BOC – and the most recently announced producer, SABIC UK Petrochemicals - and store it permanently in aquifers beneath the North Sea.

Teesside Collective estimate that the total cost of the work will be £5.4 billion and that the scheme will support 1,200 jobs during construction. Upon expansion the project is expected to support an extra 2,600 new jobs in new plants on Teesside and bring an extra £2 billion to the economy.

Furthermore, the UK's largest biomass plant at Teesport has almost cleared its final hurdle - giving the green light for hundreds of Teesside jobs. Work on MGT Power's landmark £650 million plant at Teesport could start by the end of the year, with an ECP contractor already in place.

Investments are also underway from Estova Energy, SNF Oil and of course, the eagerly awaited Gas Port Clarence Biomass Power Station but to name a few.

Delivering a circular economy

However, the days of wine and roses felt a distant memory as news hit our screens regarding the potential mothballing of the Teesside SSI steelworks. Within weeks, confirmation of what was feared – closure of the plant, 2,000+ jobs lost, huge supply chain ramifications and

the end of steelmaking for the region.

Global steel market conditions ultimately led to the fires going out at the Redcar steel plant with significant impacts on the local process industry supply chain companies. Firstly, uncertainty over oil prices slowed down global investment in the oil and gas industry, which normally takes 10% of world steel output. Secondly, China's faltering economic growth also slowed investment in its construction industry, resulting in the surplus flooding world steel markets – and slashing prices.

This brings us to the crux of the problem. Without an integrated industrial strategy and policies to make it happen, energy intensive industries will find it hard to compete in global markets. Industrial integration, both within and across all sectors, is at the core of the ideas surrounding a circular economy, which is a key component in industry's response to its climate change, productivity and sustainability challenges.

We believe that a UK integrated industrial manufacturing strategy is essential to underpin the process industry. This will help ensure that we are, and we remain, globally competitive in the short, medium and longer term. A high-level analysis of the Tees Valley process industry was the first step in aiding this process – see Smart Industrialisation, pg. 29-31.

SME and supply chain development

The principle characteristic of the NEPIC supply chain is SMEs. In 2012, the cluster set upon a path to further develop this community and the business acceleration programme for SMEs – known as BASME - was developed.

Over the course of the project's three year lifespan, we provided a gateway for the 424 small businesses to gain access to established manufacturers within the sector, which in turn generated a staggering £50 million of new sales and 1012 new jobs.

The success of BASME highlights the region's significant supply chain capability and also why such activity will remain at the fore of NEPIC's work going forward, with two new projects now underway.

Firstly, NEPIC, the Materials Processing Institute and Teesside University are collaborating to identify companies that can benefit from innovation diagnostics and signposting to either local or global innovation expertise via the innovate TEES VALLEY project. NEPIC will perform the diagnostic and participate in the signposting, while MPI and Teesside University enable prototyping and piloting of new products and processes.

The second is the SME Growth via Facilitated Market Access & Energy Management project. Utilising process industry experts, senior industrialists and external consultants to mentor SMEs to grow within the process - and proximate - sectors, regionally, nationally and internationally. Consultants will be used to upskill SMEs in selling and energy efficiency so they can develop within the process sector, offer carbon footprint credentials and increase their resource efficiency.

This project will help 120 companies grow and aims to create 75 new jobs, whilst reducing energy usage and greenhouse gas emissions. Overall, the project will help to strengthen the

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Membership, which starts from as little as £300 per year, offers immediate connectivity to a wide and diverse process industry.

To find out more and hear how your business can benefit from our support, contact **Ebba McGuigan**, ebba.mcguigan@nepic.co.uk or call **0191 516 4400 / 07711 375 426**.

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region's manufacturing supply chain capability and increase its total GVA.

Future projects

The cluster will continue to seek and identify new market opportunities and build collaborative projects particularly for products such as Hydrogen & Carbon Dioxide as we seek to help decarbonise the process industry through their additional uses and technology innovations whilst also being proactive in seeking globally competitive feedstocks via unconventional routes including syngas.

In addition to the delivery of the Tees Valley Process Industry High Level Analysis; innovate TEES VALLEY and SME Growth via Facilitated Market Access & Energy Management projects (see Developing strong cluster connections, pg. 40-41), the cluster also has a number of projects currently under development.

International projects have been submitted into various funding channels and we await the outcome of evaluation over summer 2016. Proposals include bids into SPIRE consortium promoting a circular economy and building collaborative programmes both for, and on behalf, of our members via Horizon 2020 covering advanced manufacturing, industrial symbiosis, SME growth, energy and innovation.

Branch office effect

Another challenge faced by the region is the effect of the branch office. The North East of England has over 180 chemical, pharmaceutical, polymer and biotechnology companies that handle chemicals in laboratories, production facilities and warehouses every day. The vast majority of these facilities, more often than not, are branch offices that are headquartered elsewhere, resulting in a well-known effect on our Country's industrial statistics called the "branch office effect" – and North East England suffers from this more than any other region in the UK.

NEPIC has been working with colleagues at the Office of National Statistics and the Department for Business, Innovation and Skills for some time now to determine if there is an effective way of correcting this, and the negative impact it is having upon the region's economic statistics.

In 2016, we participated in a recent "big data" study to clarify if gathering industrial information via the internet was any better at determining industrial intensity, but the study - "Industrial Clusters in England" led by BIS and the National Institute of Economic and Social Research, SpazioDATi and City RED1 at the University of Birmingham - found that the Branch Office Effect could not be overcome in that way either.

Table top studies of industry undertaken in the UK still suggest that there is no chemical nor pharmaceutical industry in this region. However, rest assured that we will certainly make those inquisitive enough to look know that we are here and are very much open for business! ■



WEATHERING THE STORM



JOHN BRUIJNOOGE
Site Director, SABIC UK
Petrochemicals

The basic chemical sector in Europe is currently enjoying a temporary window of opportunity. This step-change, following a turbulent number of years, is due to very low oil prices coupled with a euro exchange rate that is unattractive when importing large volumes of product – a welcomed shift that is ultimately levelling the variable cost playing field and allowing Europe back in the game!

The unplanned and bigger outages of some organisations on mainland Europe has led to tighter supply and with that, a market price that stayed higher than would be justified by the current feedstock prices and thus yielded, and still does yield, reasonable margins.

Several companies in this industry are taking advantage of this period to re-invent themselves and structurally improve their cost position both in variable and fixed costs. SABIC, along with INEOS and Borealis, are revamping their installations to enable the intake of US shale gas that will result in a shift away from oil-based naphtha.

Naphtha-based production installations do well in an environment of low oil price versus the gas-based assets from the Kingdom of Saudi Arabia and the USA. With a reasonable

oil price outlook for the coming years, depending on of course who makes the prediction, one would be wrong not to think that the good times are here to stay – at least for a while - however, that is very likely deceiving!

Up to 10 million tons of cracking capacity is being built in the USA that will come on-line in the next three to five years. This capacity is not needed solely to serve the USA market and may well replace some local aged oil-based installations and also take care of growth in the American region. However, it will most surely lead to a sharp increase in imports to Europe, with both basic chemicals and derivatives feeling the impact.

Sector specialist, IHS, is organising an annual conference in Europe to debate this forthcoming concern. The introduction of this conference states that the Polyethylene industry is about to move from being a relatively well-balanced industry on a global basis, to a wavering industry as it experiences a period of unprecedented oversupply that will have significant impact on prices, margins and trade flows. The new supply will be a boon for plastics processors yet, subsequently, it will be a curse for the players in the basic chemicals and commodity markets. In popular terms, we have little time to build a shelter for the storm.

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A point of interest, more specifically for the UK, is the fact that value chains flowing from basic chemicals are broken. Where there is significant capacity still available in the basic chemicals that is being readied for the upcoming battle with imported material, most of the product produced finds its way to the mainland Europe for further processing. It then makes its way back to the UK for the final steps in the value chain e.g. the automotive industry and consumer goods.

Other than the fact that this practice holds a large potential for sustainability improvement, it leaves a sizeable opportunity on the table for cost reduction in the value chain and employment in the UK. However, the major threat to the UK basic chemical industry is the likelihood of being by-passed by US imports into mainland Europe, resulting in semi-finished goods entering the UK. The outcome of which will culminate in goods that should originate from these shores entering the market and instilling pressure on that industry's chance of survival. If the UK would re-establish its value chains it would be in a much stronger position to make use of its own existing basic materials and basic chemicals.

All of these in-between process steps were once present in integrated sites such as Wilton on Teesside, UK. Age and economy of scale have driven owners to close assets and regroup somewhere else, however, the land, infrastructure, skills and supporting service industry remain available allowing for rejuvenation. The UK government could play a decisive role in this process, persuading installation owners to return, reconnect the chains and contribute to strengthening the position of the existing industry to weather the upcoming storms.

There are, however, further opportunities for the UK including promising innovations. Two specific opportunities include waste-to-chemicals and syngas-to-chemicals. When we hear talk of recycling waste, one mostly thinks about the burning of waste to make energy. Yet

there is a higher level of value retention possible, for instance when plastic waste is transformed to a feedstock for the same basic chemical industry where it originated in the first place.

The UK has a lot of waste that goes to landfill and several good locations where infrastructure is present to pursue waste recycling opportunities. It would be a great initiative to support this innovation or as a minimum bring this to a pilot scheme. Several multinational companies are working to make this a reality and with further support and encouragement could lead to a multi-beneficial establishment.

In my view, the second big opportunity is to revisit UK coal reserves for feedstock – reserves that are still significant. The Chinese have proven that there are several methods from coal to chemicals and have brought many world scale plants to life in the past few years. For the UK, one would propose to pursue underground coal gasification with modern techniques that are proven in other parts of the world to be profitably exploitable.

The advantages being that gasification takes place underground, preventing the emission of CO₂ into the atmosphere and also the need for people to work in mines. It also allows the valuable syngas to the surface to feed installations that produce basic chemicals.

During the window of opportunity available, we should make huge efforts to investigate, develop and pilot, practical and profitable use of these innovations to be ready with alternatives when either the oil price rises once more or the tsunami of US imports come our way. As the famous quote states "Life isn't about waiting for the storm to pass. It's about learning to dance in the rain." ■



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GAS LEAKS NULLIFY BENEFITS OF COAL SHIFT



STAN HIGGINS
Chief Executive, NEPIC

We are currently witnessing a strategic shift away from coal and towards gas at the moment, however, unless urgent action is taken, the climate benefits of choosing this cleaner fuel will be lost.

Following the climate change discussions in Paris in December 2015, it has emerged that the developed world has, by and large, signaled the intent to move away from carbon dioxide (CO₂) emitting coal-fired power stations, using natural gas as a 'bridging fuel' towards more carbon-neutral forms of energy including wind and solar power.

In the UK, government has ordered all coal-fired power plants close by 2025 and, alongside the opening of the Shetland gas terminal last month and Shell's megamerger with BG Group in a bid to become the world's leading liquid nitrogen gas player, we're already seeing changes take place.

When generating electricity, on a furnace-to-furnace comparison, natural gas consisting primarily

of methane produces about half the carbon dioxide per unit of energy compared with coal.

However, few realise that the picture looks less rosy when the current state of the gas production and supply system is taken into account. A host of recent studies indicate that accidental and intentional leaks of methane from production and transportation threaten to cause more net climate change damage than coal. Methane is 20 times worse a greenhouse gas than CO₂, and the level of escape from engineered systems is significant.

A study published last year by engineers at the University of Colorado Denver found that in terms of greenhouse gas emissions, just 4 per cent of gas leakage during production and supply would eliminate any advantage over coal. This may sound impossibly high but a review by the authors of leakage estimates from other studies found estimates as high as 10 per cent.



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Clearly, our natural gas production systems are not sealed tight. There are some areas where methane is allowed to leak intentionally in the interests of safety but there are also a lot of leaky valves and cracked pipes allowing gas to escape. Estimates do vary wildly but it looks safe to assume that the "official" estimates are low.

So, if there is to be any benefit from closing coal-fired power stations and building gas fired units, the impact of methane leakage is a big challenge for the natural gas-methane supply chain. It must eliminate these incidental losses.

This clearly represents both an economic opportunity to improve, but most importantly, eliminating both the intended and unintended leaks of natural gas is the only way that it is possible to have a positive impact on the carbon

footprint of the world when using it as fuel to make electricity.

However, this will very much depend on improved gas production and supply systems, system maintenance, new operating procedures plus an improvement in the gas industry's approach to emission prevention.

The Union of Concerned Scientists suggests that technologies are available to reduce much of the leaking methane, but deploying such technology would require new policies and investment.

Writing for *Scientific American* in 2014, Claimet Central, an independent group of scientists and journalists, wrote that for President Obama's Clean Power Plan to work, "the amount of methane leaking from the nation's natural gas infrastructure must be capped."

We suspect the call for action would be better served and accelerated if we had a better handle on the nature and scale of the problem. Chemical engineers with their expertise in systems engineering and focus on operational envelopes could play an important role in helping to better map and quantify the problem, including for emerging - and divisive - gas extraction methods such as fracking and underground coal gasification.

Too often the deep linkages between industrial sectors are lost or poorly understood by governments, who may wish to build an automobile sector, a construction material sector, or even a pharmaceutical sector but do not understand the potential to improve efficiency and sustainability by linking them to the chemical sector. ■

SMART INDUSTRIALISATION



STAN HIGGINS
Chief Executive, NEPIC

During the 20th century many chemical manufacturing locations underwent significant fragmentation. This was particularly prevalent in western economies where the break-up of traditional conglomerate organisations was driven by the dubious 'customer focus' mantra of well-paid, self-interested, business consultants and the merger & acquisition appetite of ambitious ceos, many of them financiers rather than industry experts.

During the 21st century, there has been a dramatic volte-face driven by a growing awareness of the needs of industry to compete globally while also taking account of the needs of the Earth. Industry has to address climate change, to improve efficiency and productivity to remain competitive, and to protect carbon reserves and make the best use of carbon. Consequently, a new industrial paradigm is emerging and concepts of 'smart industrialisation' are being established.

Smart industrialisation recognises the benefits of process integration. Not just in one particular factory

but within a sector and its supply chain and also at that sector's boundaries, its downstream users and sometimes local stakeholder communities.

The principles include achieving greatest process efficiency, highest levels of productivity, best use of energy, lowest use of carbon, maximum industrial symbiosis and minimising emissions. Using these principles, analysts and planners focus on developing local infrastructure that underpins the sustainable growth of the industry, its supply chain and associated services. The results should enable companies to improve operating margins and deliver medium and long-term performance. Furthermore, such a proposition is attractive for foreign and indigenous investors and results in a reduced dependency on governmental subsidies and support.

Adopting smart industrialisation in the master planning stage of a new industrial zone is much simpler than in locations with well-developed fragmented industries. Once smart specialisation

principles are adopted they can then be delivered throughout the industrial development lifecycle of that location; becoming the overarching consideration during planning processes, design and construction and operation.

Cluster or Special Economic Zone bodies are central to the delivery of smart industrialisation strategies as they must take into account the vested interests of multiple plant owners. Such bodies can be constitutionally formed to be the holder of sensitive benchmarked information about individual units that enables them to benefit and maximise their returns from local infrastructure and business capabilities.

A trusted Cluster body can help build business cases so individual companies can align their activities towards integrated business and technical solutions that can build high levels of resilience, as well as providing platforms to ensure sustainability. As an example, NEPIC has recently performed a smart specialisation study of the Tees Valley chemical industry in North East England in which 50 process companies have confidentially shared their mass balance, utility, energy and logistical data with the Cluster. Analysis of the data and gaining a bigger picture view of the possibilities has already identified over 150 raw material, waste and energy symbiotic projects for the companies concerned, as well as opportunities for indigenous and new investors – see table overleaf for details.

The study is also informing government of the wider development needs of the sector in an era of lower oil prices, greater global competition and other productivity challenges. To achieve greater materials and energy efficiency, the smart industrialisation opportunity for many petrochemical and commodity chemical manufacturing locations is to attract many more downstream industries to relocate nearby. This has the potential to greatly increase efficiency, reduce road transport miles and improve heat and energy integration. It could also diversify and grow the skills base within local communities in addition to supplying houses and public buildings such as hospitals with utilities such as low grade heat.

Many downstream industries would benefit from participation. For example, petrochemicals to monomers to polymers to polymer extrusion for automobile parts and auto mobile parts to automobiles all could be done on the same location. Disappointingly, many locations will rarely go beyond two steps in the downstream supply chain.

Achieving smart industrialisation requires the development of more integrated manufacturing locations. Greater integration also means higher levels of dependency between operators. Downstream businesses will look for several attributes in their potential partners: cultural, technical, business and societal. For example, is there evidence of a culture of collaboration in the location that will underpin

benchmarking, continuous improvement and innovation? Is the location managed in an open and collaborative way by the 'landlord' organisation in a way that eliminates the 'us and them' mentality?

Smart industrialisation gives governments at national and regional level the opportunity to grow and develop linked industrial sectors. Too often the deep linkages between industrial sectors are lost or poorly understood by governments. Countries which may wish to build an automobile, construction materials, or even a pharmaceutical industry will find this difficult if they do not understand the potential to improve efficiency and sustainability by linking them to the chemical sector. Somehow we in the chemical industry need to help them understand that economies of scale, greater efficiency and low carbon outcomes are possible by bringing such industries together. ■

The Tees Valley Process Industry Integration Study Report is available for download at www.nepic.co.uk/downloads

TEES VALLEY PROCESS INDUSTRY INTEGRATION ANALYSIS OPPORTUNITIES

Opportunity	Downstream Potential
Acrylic Acid and Acrylates production	Acrylic Acid to Esters for Paints and Coatings Acrylic Acid to Super adsorbent polymer for consumer, plant media medical and (emerging) industrial goods
Acrylonitrile (AN) from PDH or Naphtha	Acrylonitrile to AN Butadiene Styrene Copolymer / Styrene and Acrylonitrile to Poly AN to Carbon Fibre
Ammonium carbonate and bicarbonate	Local ammonia plus local waste CO ₂ . There are customer blending opportunities
Animal feed production	Related to previous example. There are existing and potential resources within TVPI, e.g. minerals and bio-based
Cellulosic ethanol (CE), Bio-based materials	Historically sugar based chemistry for ethanol but CE is more attractive for making green ethylene
Chloralkali e.g.	An enabler for Chlorine derivatives e.g. TiO ₂ and other minerals; shale via HCl; esterification of biomaterial
NaOH + Cl₂ + H₂ (pure)	Chlorinated isocyanurates option
KOH + Cl₂ + H₂	Target KOH rather than NaOH
Coal chemistry	Pitch feedstock is basis to make advanced specialty high value materials
Ethylene specialities	Provides basis for revival of fine chemical using EO as a building block. Including "Green EO" Several ethylene LAO technologies available. MMA via ethylene - many downstream markets
Fertiliser - Blending and Exports	Expand on the Mineral base with cheap local power to build unique cost competitive business
Mineral Beneficiation	As with fertiliser, real local resources mean this is a strategic opportunity
Post-consumer waste beneficiation	Numerous TVPI chemistries based in Innovation Parks and local know-how for fillers for rubbers and plastics
Poly-tunnel and Algal Pool Uses for CO₂	Land availability, CO ₂ (and H ₂) plus waste heat to make highly effective plant growth media
Special salts e.g. MgCl₂ to Mg metal from Seawater	Historically magnesium and aluminium production was within TVPI
	Lithium and magnesium are used in the production of light-weighting in cars & Aerospace
Surface chemistry	innovations e.g. graphene and PVD (Physical Vapour Deposition) and CVD (Chemical Vapour Deposition) services
Waste Stream Recovery from Industry – Multiple Options	There are existing immediate opportunities e.g. Scandium and other rare earth elements from TiO ₂

CONTINUOUS PROCESSING COMES TO PHARMACEUTICAL MANUFACTURING



PHILIP ALDRIDGE
Project Manager,
Pharmaceutical &
Biotechnology, NEPIC

It is widely known that the pharmaceutical industry is facing many pressures and that its traditional business model of developing a string of “block-buster” drugs is no longer working. New drugs tend to address smaller patient populations, be they niche products or “personalised medicines”

Furthermore, healthcare costs are rising across the world, putting unsustainable pressure on healthcare budgets. These changes, plus the ongoing unpredictability of drug development are putting pressures on manufacturing to be more responsive to R&D pipelines and to reduce cost of goods.

Continuous Processing (CP) is by no means a new concept and its advantages have already been realised by many companies within the process sector. However, as with a number of manufacturing trends, the pharmaceutical sector has been held back by perceived regulatory barriers to implementation.

Exploring benefits verses barriers

Traditionally, pharmaceutical manufacture has been a batched-based operation with the advantages of being well understood, having a ‘batch’ signature for traceability and there being an established installed capacity. However, if a process is run continuously, the size of the reactors required for

a given output can easily shrink 100 fold. This in itself presents advantages that cannot be overlooked. Smaller facilities give rise to reduced capital costs and lower utility and solvent usages.

Due to the enhanced mixing, increased mass transfer and reduced residence times inherent in CP, yields are often higher and because there is less time for unwanted reactions to take place and impurities are reduced due to reactions closer to stoichiometric quantities. In addition, due to enhanced heat transfer (better mixing and higher surface area to volume ratios), temperature control can be much better than batch. These advantages result in lower variable costs and higher product quality.

CP plants can also be more flexible especially when built in a modular fashion, allowing new processing modules to be swapped for alternative products. In addition, due to the radically smaller size of plant, cleaning for product change-over can also be achieved in a much shorter time scale. Alternatively, the use of disposable product contact parts are easier to incorporate into CP plant due to the smaller size and reduced cost of change out. A length of PVDF tubing is cheaper to make disposable than a stainless steel reactor. This level of flexibility is important where both R&D pipelines and in-market supply forecasts are inherently unpredictable.



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PHARMA CONNECT

Developing Strong Cluster Connections

Pharma Connect is an informal quarterly meet that focuses upon the development of the region's pharmaceutical community through engagement, introductions, best practice sharing and of course, networking.

If you are a member of the cluster and active within this arena, we would love for you to join us. Visit www.nepic.co.uk/events to find out more or alternatively contact NEPIC's pharmaceutical specialist, Philip Aldridge, to discuss.

www.nepic.co.uk



One of the barriers to the adoption of CP is that most processes are developed using a batch approach. A change of culture is needed here so that flow chemistry is adopted as the primary method of process development, naturally leading to continuous processes. Flow chemistry itself has the advantages of accelerating process development as more process variables can be evaluated in a given time. The greater control of reaction conditions afforded by CP can also lead to a reduction in process steps vs. batch systems which will also translate into simplified manufacturing plants.

Another advantage of adopting a CP approach to process development is that the same configuration and size of equipment can be used for development and production eliminating the inherent risks associated with batch process changes with scale up. Furthermore, due to reduced material hold up inherent in CPs, facility safety may be enhanced where dangerous raw materials or intermediates are involved e.g. nitroglycerine

An additional challenge to the adoption of CP for pharmaceutical manufacturing is the large worldwide installed capacity of batch facilities. In addition, existing batch processes may be difficult to convert to continuous, perversely, due to likely improvements in product quality, outside of drug registration submissions. Adoption may therefore have to wait for the introduction of CP for new processes.

Continuous processing often results in smaller facilities, lower capital costs, lower utility and raw material uses, increased quality, increased yields and more flexible facilities. However a greater process understanding is required and not all processes lend themselves to continuous manufacturing. Such greater process understanding can come from a Quality by Design (QbD) approach to process development which results in a known operating window for Good Manufacturing Practice (GMP) compliance. Not all processes are suitable for CP, but reactions in the following categories could benefit: Mixing sensitive reactions, thermally sensitive materials, fast reactions, unstable intermediates, hazardous materials, mass or heat transfer limited reactions.

Biopharmaceuticals

All the above is true for small molecule pharmaceuticals but can also, theoretically apply to biopharmaceutical manufacturing. Indeed, some of the earlier enzyme replacement therapy therapeutics for lysosomal storage disorders are made via continuous mammalian cell culture. These processes make use of a common theme in CP of process intensification.

CHO cells are used in a perfusion culture with the cells being continuously recycled back into the bioreactor increasing cell densities. However, although it is possible to develop a process faster using flow chemistry for a small molecule, fed-batch cell culture process development is the fastest and standard way of

developing biopharmaceutical processes. This is partly due to process validation issues with the long continuous processes.

As speed to first in man studies is key to an important funding milestone, this provides a significant barrier to the wider adoption of CP for biopharmaceutical manufacturing.

Complementary technologies

In order to run a successful CP, Process Analytical Technology (PAT) is required, with key process parameters being measured, for process control, on-line. A widely used measurement technique is Near Infrared (NIR), used on-line for the measurement of a wide variety of chemicals. One barrier that CP practitioners say is not evident are the regulatory authorities who are encouraging towards the introduction of CP as they have been with PAT and QbD.

An extension of the benefits brought by CP to pharmaceutical manufacturing can be gained by adopting real time batch release via NIR measurement. This reduces the need for large final product stock holding whilst conventional assays are carried out. ■

An early paper by NEPIC chief executive Dr Stan Higgins entitled "are more fine and speciality chemicals being moved into continuous processing" (Chemica Oggi, 1998 16 38 -41) and a more recent article "pharma and bio - the march of modernisation" by Rob Smith featured in Process Engineering May 2016 provide further reading.

SO WHAT EXACTLY IS SMART ENERGY?



JANE GATISS
Managing Director,
Scarab4

To put it simply it's the answer to the energy trilemma; ensuring security of supply, reducing costs for energy users and decarbonising in the most cost-effective, affordable way possible.

The UK faces some quite significant challenges in solving the trilemma, especially in making sure the energy system can respond to increases during periods of peak demand and that better use is made of low carbon generation. Coupled with this is the real opportunity to deliver energy differently with the falling cost of technology such as batteries.

A smart energy system founded on flexibility – taking us up to 2050 and the steep target of reducing greenhouse gas emissions by 80% – could see the UK build less power generation, turn generation off less when power is exceeded and avoid the considerable cost of strengthening the national grid.

So how would a Smart Energy System contribute towards solving the energy trilemma? A smart energy system would involve blending combinations including energy storage, demand side response (DSR), smart networks and raising interconnectivity.

Energy Storage includes a variety of technologies all with very different characteristics and all of which can be utilised at all levels of the energy

chain; consumer, network and system. New energy storage could provide advantages to customers in that they could store electricity – in batteries for instance – either for when it is more useful or when grid electricity is more expensive. On the flip side, consumers could convert electricity for later use in heating or cooling.

At a network level, storage could be used to eliminate constraints and postpone costly strengthening and on a system level could help meet peaks in demand.

Whatever the installation, storage could provide invaluable support to the power system for voltage and frequency control and – through conversion into other energy vectors – could allow intra-seasonal transfer of energy.

Demand side response (DSR) does exactly what it says on the tin and is all about the action taken by consumers to change the amount of electricity they take from the grid at a certain time and in response to a signal. Most of us will relate this to Smart Meters, a key building block in enabling DSR. Just like storage, DSR can help realise the benefits of a smart energy system by enabling customers to reduce their demand in response to higher prices, increase demand in response to lower prices, and reduce energy bills by enabling other parties to manage some of their demand.

Ultimately it is a smart network and its interconnectivity that will form the backbone of any smart energy system. Only through this will the system be able to support the incorporation of more storage and DSR technologies, and, as such, act as an alternative solution. Smarter network technologies would increase the flexibility of the existing network infrastructure cost-effectively whilst excess generation could be exported to other countries through greater interconnection.

Bringing together these combinations in a whole system approach means SMART could:

- Ease stress on the network by smoothing peaks in demand and making renewable generation more certain
- Move demand away from the peak, storing energy when demand is at its lowest and when low carbon electricity is available
- Raise the amount of electricity supplied that is renewable
- Store renewable energy when it isn't needed and shift demand to periods of its generation
- Provide a range of more efficient and balancing options to the grid

Certainly smart energy could offer significant opportunity to keep bills as low as possible for consumers and businesses, power the economy through security of supply, decarbonise in the most cost-effective, affordable way and encourage companies to invest in technologies that help meet future energy needs. That said, some of the market barriers faced by the energy sector very recently to add capacity at declining cost cannot be ignored and these barriers need to be addressed if we want to fully realise the potential of a smart energy system. ■

Jane Gatiss is MD of Scarab4, the UK's only Marketing and PR agency to specialise in the Energy and Process Industries and their Supply Chains. Scarab4 is headquartered in Northumberland and works with clients across the UK and the globe.

Reference Document "Towards a Smart Energy System, DECC".

INSPIRING INDUSTRY'S FUTURE LEADERS



As the chemical industry touches everything, from vital medicines, food and clothing, through to housing and transport, communication and leisure activities, the future of industry is vital to UK economy and it is important that we protect it through the attraction of new talent.

Competition for skills in the chemicals sector has never been fiercer. Successfully attracting and managing talented people is a particular challenge. Lingering misconceptions about the industry in general have hampered chemical companies' ability to attract and recruit. Over time, industry bodies and individual businesses should engage with government, trade associations, educators and with the wider population to help shift this perception.

The fragmentation of the industry across the UK has mostly given rise to positive outcomes in terms of encouraging investment, but it has resulted in the severing of some close working relationships and also in there being fewer circumstances in which personnel can interact closely with one another.

Individuals working in senior roles across the industry have a strong track record of working

together but there is less collaboration between people working in positions below board and site management level. In a competitive market, broader aspects of providing networking opportunities and career development in order to address the aspirations of different demographic groups may carry more weight than simply increasing salaries to attract talent.

By implementing programmes to accelerate the development of talent, the chemical industry will be more attractive to those in the early stages of their careers. A philosophy that would apply equally to the manufacturing sector as a whole.

In response, NEPIC has teamed up with the chemicals division at law-firm Bond Dickinson, to launch a young person's network that will aim at establishing a network of people working in chemical businesses located initially within the region who are either at the start of their career or keen to broaden their skills and ultimately voice their opinions on behalf of the chemical industry.

The network's objective is to provide the opportunity to professionals within the sector to enhance their understanding of the chemical industry beyond

just their own job, enable them to contribute to the industry's policy and positions on key issues, and allow them to be involved in building the reputation of the industry by being a key role model and by engaging with stakeholders.

By ensuring that individuals can attend accessible networking and knowledge sharing events through the YPN, we can help to forge more and better links between those performing similar or related roles at every level across businesses in the sector.

If we can foster a thriving and interactive community across the industry's employee-base this is likely to increase the attractiveness of the industry to potential new recruits. It is recognised that the chemical sector forms a vital part and plays a valuable contribution to manufacturing in our region. ■

The YPN will be officially launched during summer 2016, however, if you are interested in finding out more, please visit www.nepic.co.uk/ypn

DEVELOPING STRONG CLUSTER CONNECTIONS



LOUISE GWYNNE-JONES
PR & Communications
Manager, NEPIC

Clusters are defined as geographic concentrations of interrelated companies, specialised suppliers, service providers and associated institutions in particular fields that compete but, most importantly, also cooperate.

Clusters cannot be sustained nor grow without the support of an extensive local supply chain and this has become ever more important due to customer focused strategies that have led to the outsourcing of support activities.

A very large and extensive supply chain supports the Process Industry in North East England and essentially underpins the sector. The key strengths of the region's supply chain companies are their long-term competency, knowledge and innovation, combined with a real understanding of industry's needs.

As a true supply chain cluster, NEPIC actively engages with the entire value chain in order to help drive the regional economy, and has more recently seen an increased desire from the major manufacturing companies to spend more of their budgets locally.

The principle characteristic of the NEPIC supply chain is predominately small to medium-sized businesses, or SMEs to which we all typically refer. In 2012, the cluster set upon a path to further develop our SME community by providing the incentive to develop their businesses, which in turn would bring about economic benefit and reinforce the North East as a region of excellence and innovation.

BASME – the business acceleration programme for SMEs – was developed and, over the course of the project's three year lifespan, we provided a

gateway for the sector's vibrant small business community to gain access to established manufacturers within the sector.

Mentoring from senior industrialists and business people, coupled with the in-house expertise of the NEPIC project delivery team, enabled the support and development of 424 SMEs. This unique, collaborative approach to supply chain development in turn generated a staggering £50 million of new sales and 1012 new jobs in the participating SMEs.

The success of BASME clearly illustrates that the sharing of best practice between large organisations and SMEs results in benefits for both parties and the wider economy. Furthermore, it highlights the region's significant supply chain capability and, also, why such activity will remain at the fore of NEPIC's work going forward.

The project funding for BASME ceased at the end of 2015, however, as one door closes another opens and we embrace the new challenges that we now embark upon. A new year and with that two new SME focused projects that have recently started.

For the first, innovation is at its core. As you will no doubt now be aware, we believe in strength in numbers and have partnered with Teesside University, Materials Processing Institute and Digital City to deliver the innovate TEES VALLEY programme.

Innovate TEES VALLEY has been established to help Teesside's vibrant small business community achieve ambition and growth through service and product innovation – and to help to take forward ideas, whilst overcoming growth barriers to seek success both here and overseas.

Innovation remains a longstanding debate within the SME sector, however, one thing is definite – innovation is a crucial element within the SME ecosystems that is here to stay. Every SME needs to create an innovative environment in order to foster growth and success and through innovate TEES VALLEY we will work to help SMEs make this happen and take businesses to the next level.

Innovate TEES VALLEY combines the knowledge and expertise of four business growth establishments, creating a powerful innovation super network. All with proven growth delivery records and a passion

for small businesses, the innovate TEES VALLEY partners have one goal and that is accelerating growth from your ideas.

The second of our projects, SME Growth via Facilitated Market Access & Energy Management (SME-Growth), will focus upon supporting small businesses within the sub-regions of Northumberland, Tyne & Wear and County Durham. Based very much upon the BASME model of growth through mentoring, the project will focus upon facilitating market access and ultimately work to enhance the cluster's capabilities by further enrichment of its supply chain.

However, SME-Growth will also incorporate an element of energy efficiency. The notion of green credentials is by no means a new one, however, it is typically viewed as a barrier to growth rather than a benefit. But as the multi-nationals focus upon their green credentials, the ripple effect is inevitable and it is only a matter of time before such demands are being imposed upon suppliers – and ultimately – small businesses that are not necessarily readied for the blow.

More often than not, energy efficiency is not at the top of a company's list of priorities, let

alone incorporated into any growth development strategy. However, if we take a moment to remind ourselves of the grand launch of Marks & Spencers' Plan A initiative all becomes apparent. M&S embarked on a journey to protect the planet – to source responsibly, reduce waste and help communities through the delivery of 100 commitments. Did this very honorable act not impact upon their suppliers and in turn their suppliers' suppliers? M&S have since launched a further 100 commitments as part of their 2020 vision.

Through the SME-Growth programme, we are working with eligible companies, not only to help grow businesses through mentoring and industry insight, but also arm companies with the invaluable green credential know-how and data that will put them ahead of the competition in the bid to win new business.

For further information regarding supply chain and SME support provided by the NEPIC core team and that of the innovate TEES VALLEY and SME-Growth projects, please contact the office directly via 01642 442560 or visit www.nepic.co.uk ■

innovate TEES VALLEY and SME Growth via Facilitated Market Access & Energy Management are both three-year, part-funded European Regional Development Fund projects.

DESPITE THE CHALLENGES, CLIMATE CHANGE WILL ALLOW INDUSTRY TO SHINE



STAN HIGGINS
Chief Executive, NEPIC

Deputy director of University of Manchester's Tyndall Centre for Climate Change Research, Kevin Anderson, recently suggested that mainstream climate change predictions understate the challenges because scientists "have not been prepared to accept the revolutionary implications of our own findings, and even when we do, we are reluctant to voice such thoughts openly".

Anderson added that to prevent a greater than 2°C warming of the earth "profound and immediate changes" to energy consumption and production will be required and "global mitigation rates must rapidly ratchet up to around 10%/year by 2025, continuing at such a rate towards the virtual elimination of CO₂ from the energy system by 2050".

And so the optimism from the Paris COP21 agreement in December 2015 cannot yet be reconciled with oft-repeated claims that transitioning to a low-carbon energy system can be achieved without affecting economic growth.

There are ever growing concerns that the level of mitigation required to achieve the 2°C goal will require 'monumental transformations' in the energy production industry, energy intensive industries and carbon-using industries over the next 35 years. So what does the European chemical industry think of the Paris Agreement?

The European chemicals industry association, Cefic has applauded diplomatic efforts to achieve an ambitious and globally-binding agreement. The EU industry has seen greenhouse gas (GHG) emissions fall by 54% on 1990 levels while its production output has risen by 70%. It continues to support efforts by European institutions to achieve a competitive, low-carbon economy by offering up technology that will reduce GHG emissions.

However, Cefic's major concern is that the implementation of COP21 must not come at the expense of "investment leakage", resulting from regional imbalances in environmental regulations and associated cost differences. Such leakage, also referred to as "carbon leakage", can result in



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the relocation of industry and its carbon emissions – but not to an overall global reduction.

Elsewhere in the world, according to the International Council of Chemical Associations, the chemical industry has made giant strides towards GHG emission reduction largely through increased energy efficiency. The Japanese chemical industry reduced unit energy consumption by 2010 to 83% of the 1990 fiscal year level.

Meanwhile, the US chemical industry has reduced fuel and energy consumption per unit of output by nearly half that used in 1974; furthermore, since 1990, the US chemical industry has reduced its GHG emissions by 26%. In a BRIC country, for example, the Brazilian chemical industry association members reduced specific overall energy consumption by 37% between 2001 and 2009, while increasing overall production by more than 45%.

The US American Petroleum Institute President and CEO, Jack Gerard has commented that "America's private sector has already taken the lead on reducing GHG emissions, even as we increase economic activity

and domestic energy production to keep energy reliable and affordable for consumers". This success, Gerard insists, is driven not by government mandate but through innovation, investment and entrepreneurial spirit.

One commentator in India, Divya Spandana of the Indian Express, has pointed out that India's low GHG emissions of 1.7t/capita, against the global average of 5t, shows that India has a smaller legacy of 'dirty' infrastructure, compared with many Western nations.

"We have the opportunity to drive our growth in a more thoughtful way, focusing on renewables, tying these efforts to our local communities and ecosystems. We can respond to climate change not as a result of external pressure, but as a way to tackle our growing domestic challenges" Spandana says.

Apart from continuing to improve the energy efficiency of its processes and making better use of its waste heat, the greatest reductions in GHG emissions from the chemical industry will come from an understanding of life cycle carbon usage during the production and consumption of products and materials. Insulating

materials for the construction industry alone, for example, account for an estimated 40% of the total identified CO₂ savings by the industry to date. In yet other examples, fertiliser and crop protection agents increase agricultural yields and reduce emissions from land-use change, while advanced lighting solutions such as LEDs and compact fluorescent lamps save enormous amounts of energy.

The implementation of the COP21 Agreement presents challenges for the chemical industry worldwide, but it also presents a huge opportunity for the sector to show its worth to society. ■



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Your comprehensive guide to the
chemical-processing sector in
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CLUSTER CONNECT

Developing Strong Cluster Connections

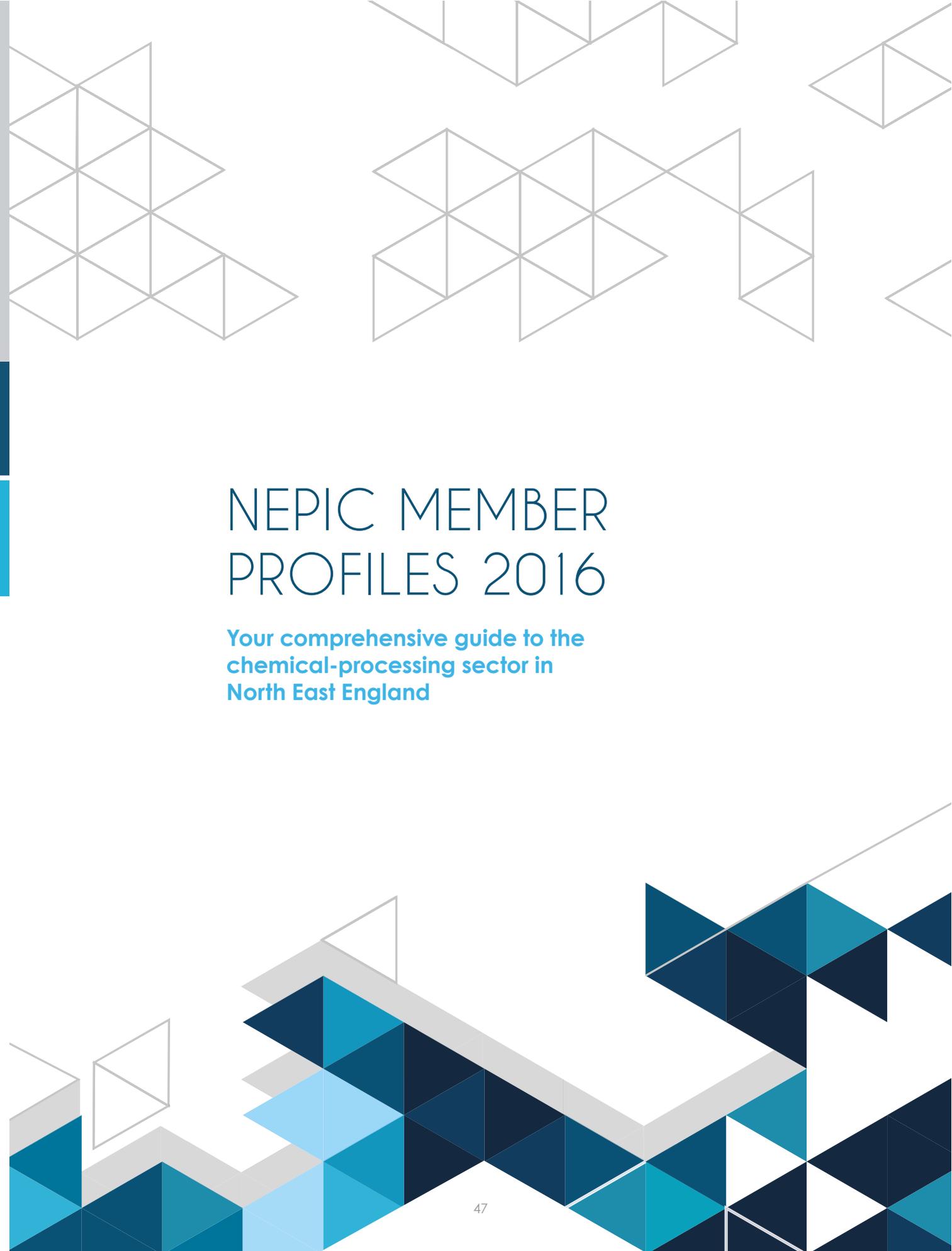
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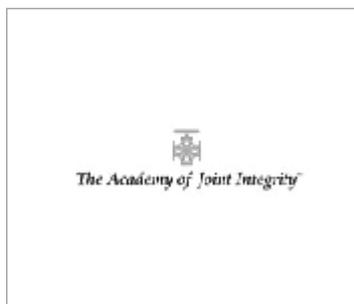
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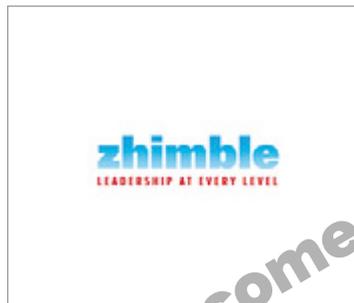
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 Chemie-Cluster Bayern GmbH
 Labtex Ltd
 SGS UK Limited
 Swagelok Scotland, Teesside & Ireland
 Veolia Water Technologies UK

LEGAL & FINANCIAL SERVICES

Bonaccord
 Bond Dickinson LLP
 Evolution Business and Tax Advisors LLP
 HGF Limited
 IP Group plc
 Jacksons Commercial & Private Law LLP
 Murgitroyd
 PCF Solutions Limited
 Square One Law LLP
 Ward Hadaway Solicitors

LOGISTICS

Armagrip Industrial Supplies
 Cordstrap UK Ltd
 CRS Pharma Solutions t/a CRS Rent a Fridge Ltd
 Think Global Growth Ltd
 Esh Facilities
 Chemie-Cluster Bayern GmbH
 Inter Terminals
 MP Storage & Blending Ltd
 Agility Logistic Solutions Ltd
 Auto Executive Corporate Travel Ltd
 AV Dawson UK Ltd
 BOC
 Durham Tees Valley Airport
 Graypen Ltd
 Navigator Terminals Seal Sands Limited
 PD Teesport
 SeerPharma (UK)

PACKAGING & PRINTING

Armagrip Industrial Supplies
 Cordstrap UK Ltd
 Symbol Signs & Screenprint Limited
 Teesprint & Design
 TH Collaborative Innovation (THCi)
 House of Type (HOT)

PETROCHEMICALS & COMMODITY CHEMICALS

Flowserve Flow Control (UK) Ltd
 Induchem UK Ltd
 MaIn Tech industrial Solutions

ProSys Sampling Systems Ltd
 Samson Controls Ltd
 TA Whitfield Polymers Ltd
 Think Global Growth Ltd
 TH Collaborative Innovation (THCi)
 Bakercorp UK Ltd
 Chemie-Cluster Bayern GmbH
 Tanton Industries Ltd
 Brenntag UK & Ireland
 CF Fertilisers UK Limited
 ConocoPhillips Petroleum Co. UK Ltd
 Huntsman Polyurethanes (UK) Limited
 INEOS Nitriles UK Limited
 Lotte Chemical UK Limited
 SABIC UK Petrochemicals
 SNF Oil and Gas Ltd
 Wood Group

PHARMACEUTICALS

Attric Ltd
 Flowserve Flow Control (UK) Ltd
 Induchem UK Ltd
 MaIn Tech industrial Solutions
 ProSys Sampling Systems Ltd
 Samson Controls Ltd
 TH Collaborative Innovation (THCi)
 Bakercorp UK Ltd
 High Force Research Limited
 Shasun Pharma Solutions Ltd
 Thermal Compliance Ltd
 Aesica Pharmaceuticals Ltd
 CPI (Centre for Process Innovation)
 Epax Pharma UK Ltd
 Fine Industries Limited
 Fujifilm Diosynth Biotechnologies
 MSD Limited
 NewChem Technologies Limited
 Piramal Healthcare - Pharma Solutions
 SeerPharma (UK)
 Shott Trinova LLP
 Williams Process Limited

POLYMER & RUBBER

Samson Controls Ltd
 TA Whitfield Polymers Ltd
 TH Collaborative Innovation (THCi)
 Bakercorp UK Ltd
 Chemie-Cluster Bayern GmbH
 IPS Flow Systems Ltd
 Lucite International Speciality Polymers and Resins Ltd
 SNF Oil and Gas Ltd
 Victrex Manufacturing Ltd

PROJECT MANAGEMENT

Attric Ltd
 Energy Drive Systems Ltd
 Frazer-Nash Consultancy
 Induchem UK Ltd
 Optimal Asset Management Ltd
 Precision Processing Services Limited
 ProSys Sampling Systems Ltd
 Think Global Growth Ltd
 Bouygues E&S Contracting UK Limited
 ENGIE Fabricom
 Abfad Ltd
 Bakercorp UK Ltd
 SPIE Ltd
 Unit Engineers & Constructors Ltd
 Balfour Beatty Engineering Services Limited

Bilfinger Industrial Services UK Ltd
 Cavendish Northern Ltd
 Chemie-Cluster Bayern GmbH
 Cordell Group Ltd
 Haden Freeman Limited
 Hertel
 Inter Terminals
 Jacobs Engineering UK Ltd
 K Home International Limited
 Plenary Project Solutions Ltd
 px Group
 Tanton Industries Ltd
 Tolent Construction Limited
 WH Partnership Ltd
 AVEVA Solutions Ltd
 BWC Performance (Beyond World Class)
 GSE Systems Ltd
 Industrial Technology Systems (ITS) Ltd
 IRIS Engineering and Technology Ltd
 JBA Engineering
 Nortech Group
 Parsons Brinckerhoff
 Springfield NE Limited
 The Parker Consultancy
 Williams Process Limited
 WorleyParsons Europe Limited

RECRUITMENT

Attric Ltd
 CDS Recruitment Ltd
 First Class Technical Recruitment Ltd
 KDM Partnership Limited
 Vistech Services Ltd
 CK Group
 CY Partners
 DBA HR Solutions
 DRD Consultants
 GEM Partnership Trading as Premium People Group
 JBA Engineering
 Nortech Group
 NRG (Northern Recruitment Group)
 Techconsult UK Limited
 Wolviston Management Services

RESEARCH

Absolute Antibody Ltd
 First Class Technical Recruitment Ltd
 Precision Processing Services Limited
 T. A. Whitfield Polymers Ltd
 TH Collaborative Innovation (THCi)
 University of Newcastle School of Chemical Engineering & Advanced Materials
 Abfad Ltd
 Chemie-Cluster Bayern GmbH
 University of Sunderland
 Cambridge Research Biochemicals
 Durham University
 High Force Research Limited
 Intertek Wilton
 Materials Processing Institute
 Newcastle University
 Northumbria University
 Teesside University
 GexCon UK Ltd
 NewChem Technologies Limited
 NNFC (National Non-Food Crops Centre)
 Protel Associates Limited
 The Parker Consultancy
 The Wilton Centre

CLASSIFICATION

SOFTWARE SOLUTIONS

Attric Ltd
CD-adapco
Datum360 Limited
Energy Drive Systems Ltd
ITCHYROBOT
Lisam Systems Limited
Process Systems Enterprise Limited
ProFound Mining
Spearhead Interactive Ltd
Strategic Corrosion Management Ltd
Evolution MRO Limited
Rymote
AES Digital Solutions Ltd
AVEVA Solutions Ltd
ecom instruments UK
Industrial Automation & Control Ltd
Industrial Technology Systems (ITS) Ltd
Industrial Thinking Limited
IT Accessed Ltd
Phusion IM Limited
Tad Web Solutions

UTILITIES & FACILITIES MANAGEMENT

CRS Pharma Solutions t/a CRS Rent a Fridge Ltd
Falck Fire Services UK Ltd
InduChem UK Ltd
Precision Processing Services Limited
Rain for Rent International UK
Utilitywise plc
Vistech Services Ltd
Evolution MRO Limited
Bakercorp UK Ltd
Esh Facilities
Chemie-Cluster Bayern GmbH
px Group
Biochemica UK Ltd
21 Degrees Ltd
KGM Refrigeration Ltd
Northumbrian Water
RTC North
Sembcorp Utilities (UK) Ltd
The Wilton Centre

WASTE MANAGEMENT & RECYCLING

CIS Northern Limited
Clean Green Recycling Ltd
Enviro UK Consultants Ltd
Indecom
Pericula Ltd
Precision Processing Services Limited
Rain for Rent International UK
Thermitech Solutions Limited
Suez Treatment Solutions Europe
Bakercorp UK Ltd
Esh Facilities
Thompsons of Prudhoe Ltd
Chemie-Cluster Bayern GmbH
Haden Freeman Limited
KDC Contractors Limited
CatalySystems Limited
AECOM
Augean PLC
Chemical Industries Association
Koppers Specialty Chemicals Ltd
NISP Network
PYReco Ltd
Veolia Water Technologies UK

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