Microsoft accenture

Driving sustainability in industrial clusters

Delivering net zero through digital partnerships and data

A white paper by Accenture and Microsoft

Contents

Executive summary

The challenge to decarbonise UK industry emissions and deliver a more sustainable future is at its most salient in regions such as the Humber. This "industrial cluster" is currently the focus of a vast transformation initiative – Zero Carbon Humber – that aims to help the UK meet its long-term net zero commitments, laid down by government.

New infrastructure, new business models, new partnerships, new energy markets, unknown costs – this complex terrain is uncharted. Yet the time for action has arrived.

So, given industry's net zero aspirations, how can business decision-makers make the most of today's unique opportunities, while mitigating the accompanying risks?

This white paper from Accenture and Microsoft sets out to help. It offers a new approach based on partnership, business transformation, cloud-based digital innovation and open data.

It starts by reviewing government net zero targets, outlining why industrial clusters are critical to the world's low-carbon transition.

We then discuss new ways to maximise emissions reductions and environmental impact, focusing on our own five-pillar model for the UK's low-carbon transition.

Chapter 3 considers how cluster partners can maximise project ROI by creating innovative business models, driving efficiencies through integration and technology and embracing the power of open data.

Business opportunities inevitably bring risk, and this is never truer than when it comes to complex industrial cluster projects with large upfront CapEx and multiple "known unknowns". So chapter 4 reviews key approaches to mitigating risk, including through new digital simulation and forecasting innovations

Finally, we look at how the power of partnership is already helping industries negotiate the road ahead, forging new models to deliver on sustainability commitments in innovative ways.

1.0

Targeting net zero for industrial clusters

Decarbonising the UK, industry-first

The “green industrial revolution” is under way. In 2019, the UK became the first major economy to legislate a net-zero greenhouse gas emissions target by 2050 (compared to 1990 levels).[1] A year later, the government’s Ten Point Plan for a Green Industrial Revolution[2] committed to promoting, among other things, offshore wind energy, low-carbon hydrogen, zero-emission vehicles, and carbon capture, usage and storage (CCUS). More recently, it has pledged to cut emissions by 78 percent by 2035.[3]

These sustainability commitments are all the more ambitious – as the 2021 Industrial Decarbonisation Strategy[4] acknowledges – because current UK emissions remain high. However, the strategy’s Ministerial Foreword frames this decade as the one that will lay the foundations for decarbonisation:

> “We will begin the journey of switching away from fossil fuel combustion to low carbon alternatives... deploying key technologies... and supporting industrial sites to maximise their energy and resource efficiency to reduce costs for businesses.”[5]

With industry responsible for 30 percent of total global carbon dioxide emissions [6], action is indeed urgent. So, to help accelerate innovation of low-carbon technologies across industry, the strategy identifies five key areas of focus: fuel switching, CCUS for industry, systemic efficiency initiatives (including digitalisation), advanced technologies, and product innovation.[7]

The paper then highlights “industrial clusters”– regional concentrations of industries – as playing a “monumental role” in decarbonisation. Singling them out for priority intervention , it sets targets to deliver at least four low-carbon clusters by 2030, and at least one net-zero cluster by 2040.[8]

An introduction to industrial clusters

Industrial clusters are geographic areas comprised of co-located companies that represent a single or multiple industries, such as refining, cement or steel.
These may be heavy industries, such as steel and chemicals, or lighter industries, such as food processing and electronics – but they are energy-intensive and are responsible for high production of greenhouse gases.

Solutions for reducing industrial cluster emissions can vary widely, depending on many factors, such as fuel requirements, geographic area and regulatory jurisdiction. To illustrate this, Figure 1 compares key features of China's Suzhou Industrial Park (SIP) with those of the Humber industrial cluster in the UK.[9] It shows how the emissions-reduction focus changes according to geography, composition of local industry, existing infrastructure, and energy costs and policy.

SIP's lighter industry and low process-heat requirements favour an approach focusing on system efficiency and electrification with zero-carbon power sources. In contrast, the heavy industry and high-temperature manufacturing processes on the Humber – with wind resources and saline aquifers available offshore – argue for an approach focused on hydrogen and carbon-capture and storage (CCS).

Suzhou Industrial Park, China

- Inland region near metropolitan area
- Mostly lighter industry
- Low process heat requirement (e.g. electronics, light manufacturing)
- Minimal existing infrastructure for repurposing
- Government support for industrial emissions-reduction initiatives

Focus on systemic efficiency, circularity and electrification with zero-carbon power sources

Humber industrial cluster, UK

- Coastal region near large-scale offshore wind resource and saline aquifers that can store CO_2
- Mostly heavy industry
- High temperature processes and hard-to-abate emissions (e.g. steel, refining)
- Situated near large offshore wind farms and natural gas pipelines
- Government funding, commercial and regulatory support for carbon-capture and hydrogen development

Focus on developing green and blue hydrogen and CCS infrastructure

Figure 1. Key characteristics of the Suzhou Industrial Park and the Humber industrial cluster. As shown, their respective features require a different emissions-reduction approach.

Adapted from Industrial clusters. Working together to achieve net zero, Accenture, 2021

Why focus on clusters?

Responsible for half of UK industrial emissions[10], the country's six industrial clusters provide a major opportunity for decarbonisation through new infrastructure, technologies and innovative approaches. With hydrogen emerging as a key net zero solution, the co-location element of industry clusters creates positive conditions to scale hydrogen production by creating an internal hydrogen market.

This is especially the case when high-temperature, high-pressure industrial processes (as are common on Humberside) make electrification solutions less feasible.

With hydrogen production and consumption concentrated in a single area, long-distance infrastructure isn't needed. In addition, industrial clusters can also use hydrogen to store renewable electricity and provide heat, as a cleaner alternative to natural gas.

There's also an economic case for prioritising clusters. They are vital hubs of regional manufacturing and commercial activity, offering high-quality jobs that often pay above the UK average. And they're key to local supply chains and the local economy, creating attractive long-term opportunities for investors.

Decarbonising clusters: four approaches

Accenture has estimated that, based on EU figures, a combination of approaches could potentially reduce industrial greenhouse gas emissions by up to 40 percent (from a 2019 base) by 2030.[11] This figure includes "blue" hydrogen emissions captured through CCS.

The four key approaches are systemic efficiency, electrification, hydrogen and CCUS (see Figure 2).

Systemic efficiency and circularity and electrification may have significant mid-term (pre-2030) impact on reducing emissions.

By contrast, the impact of hydrogen and CCUS solutions will grow only after the infrastructure has matured and become established (post-2030).

But, as the diagram suggests, whether the industries in a cluster are based on chemicals, manufacturing, steel, ports, cement or a combination, a common thread in maximising system value will be **digitalisation, integration** and **stakeholder collaboration**. For example, because clusters are complex and inter-dependent entities, complementary, cross-industry projects backed by multiple stakeholders will likely be most effective.

Synergies can work in many ways. When energy systems are integrated from the outset, for example, overall value outcomes will tend to be maximised. Similarly, a holistic approach to cluster emissions can help optimise individual emissions solutions.

In section 3.3, "Leveraging the power of open data", we'll explore how open data can help empower stakeholders, support joint business decision-making and improve emissions-reduction solutions. But first, we'll look at the vital role being played by partnerships at the Zero Carbon Humber project.

Net zero solutions for industrial clusters

Figure 2. Emissions-abatement options for industrial clusters. To minimise emissions and design an integrated energy system with optimal value outcomes, it is best to consider the cluster as a whole.

Source: Industrial clusters. Working together to achieve net zero, Accenture, 2021

Zero Carbon Humber

The UK's largest industrial cluster is located around the Humber Estuary and next to the country's largest ports complex. This cluster includes the UK's main steel production centre, two oil refineries, two major chemicals clusters, and manufacturers of biofuel, cement, lime and glass.

It's also part of the UK's Energy Estuary, which brings together:

- The world's largest offshore wind farm, Hornsea One
- Several gas-fired power stations, existing and planned
- The UK's largest biomass power station – offering the potential for "blue" and "green" hydrogen production and bio-energy with carbon capture and storage (BECCS)[12]

This brief outline may be enough to explain why the Humber industrial cluster is the priority UK decarbonisation test-bed. It also highlights the awesome ambition of the Zero Carbon Humber project, which aims to make this the world's first net zero industrial cluster by 2040.

How working together, works

Zero Carbon Humber (ZCH) consists of 12 parties – energy producers, industry players, infrastructure operators, engineering firms, academic institutions – working closely across multiple infrastructure initiatives.

Partnership and co-dependency are built into all projects and at every stage.

For example, **Hydrogen to Humber (H2H) Saltend** will be first to use the (shared) carbon dioxide and hydrogen transport and storage infrastructure. While this helps cut emissions, it will also create a virtuous circle by spurring demand for hydrogen to be used as feedstock in further industrial processes.

With shared infrastructure in place and a growing hydrogen market being nurtured, other Humber carbon-abatement projects can then scale quickly, helping to accelerate the reduction of carbon-emissions.

The offshore element of ZCH – including shared pipelines and carbon-storage – will be delivered by the **Northern Endurance Partnership,** funded partly through the government's Industrial Decarbonisation Challenge.[13] This will draw on expertise from across its member businesses to handle emissions from both the Humber and Teesside industrial clusters.

Meanwhile, separately from ZCH, the **Gigastack** project partners are collaborating to produce renewable green hydrogen. This project aims to satisfy up to 30 percent of the Humber Refinery's existing hydrogen demand via a pioneering 100 MW electrolyser.

It's hoped that new business models, developed to support the first industrial-scale 100 MW electrolysers, will enable hydrogen costs to fall below €400/kW and open up the market at scale.

Wider benefits of tackling industrial clusters

As mentioned in section 1.2.1, "Why focus on clusters?", the potential rewards for lowering cluster emissions go beyond mitigating climate change. The effects benefit the economy and society at large.

For example, decarbonising clusters can improve local air quality and health. By cutting industrial emissions across the Humber region, ZCH will extend lives and save £148 million in avoided public health costs between 2040 and 2050.[14]

Tackling industry cluster emissions can also provide employment. The Ten Point Plan for a Green Industrial Revolution claims the "revolution" as a whole will support up to 250,000 UK jobs by 2030.[15] Meanwhile, overall energy costs can also be cut while UK domestic energy security is boosted by reducing reliance on overseas fossil fuel.

Finally, clusters that achieve net zero may also attract international investment, as countries increasingly look for clean industrial energy solutions and the companies that can deliver them.

Planning your project in partnership

Experience suggests that when consortiums establish working groups that include representatives from industry partners, government, investors and other participants, a sense of shared endeavour helps nurture trust across all stakeholders.

Partners can then come to understand key industry needs across the cluster, such as fuel requirements for industrial processes. This allows planners to map out milestones – such as scaling net-zero technologies and deploying digital services – that will constitute a bespoke, cluster-wide roadmap for achieving net-zero targets by a target year.

Partners can then sketch out business models and risk-sharing initiatives (including joint ventures, public-private partnerships and take-or-pay agreements) that will help them reach project milestones faster.

This section has looked at the case for decarbonising industrial clusters. We've touched on key opportunities and solutions, and the importance of partnerships and integration.

In the next three sections we'll turn to specific project-related questions that, as a business decision-maker, you may face now or in the future:

1. What approaches will best help drive emissions-reduction and environmental impact?
2. Given the complexity of cluster decarbonisation projects, how can you best maximise ROI?
3. What are the main areas of project risk, and how can you mitigate them?

2.0

Maximising emissions reduction and environment impact

Unprecedented targets: A recap

In April 2021, following updated scientific advice, the government adopted a new 2035 deadline for its 78 percent emissions cut.[16] Research had found that reductions would need to be made even earlier to keep global heating close to 1.5^{C} above pre-industrial levels.

The Industrial Decarbonisation Strategy[17], released just a month before, had already announced targets "unprecedented in scale, pace and cost." These targets envisaged emissions falling by at least 90 percent by 2050, compared to today's level.[18]

Industry would need to remove about three metric tons of carbon emissions each year by 2030 to stay on track to deliver net zero. Meanwhile electricity, hydrogen and bioenergy would need to replace fossil fuels, unless combined with carbon capture.[19]

Not only would this national transformation be "unprecedented", but it would also have to contend with uncertain costs. The strategy stated that these would evolve over time "as we learn more about decarbonisation and the future shape of industry".

Partly to mitigate these unknown costs, the strategy recommended that decision-making should take into account industry needs across the "whole energy system", especially the gas and electricity grids.

This holistic approach to net-zero targets aligns with the integrated approach to decarbonisation proposed by Accenture and Microsoft, which we'll look at next.

An integrated approach to decarbonisation: Five pillars

Through our joint venture partner, Avanade, Accenture and Microsoft have been helping the energy sector make the transition to net zero through partnership working, open data and new approaches to network design and operation.

This integrated approach to decarbonisation is shown in figure 3.

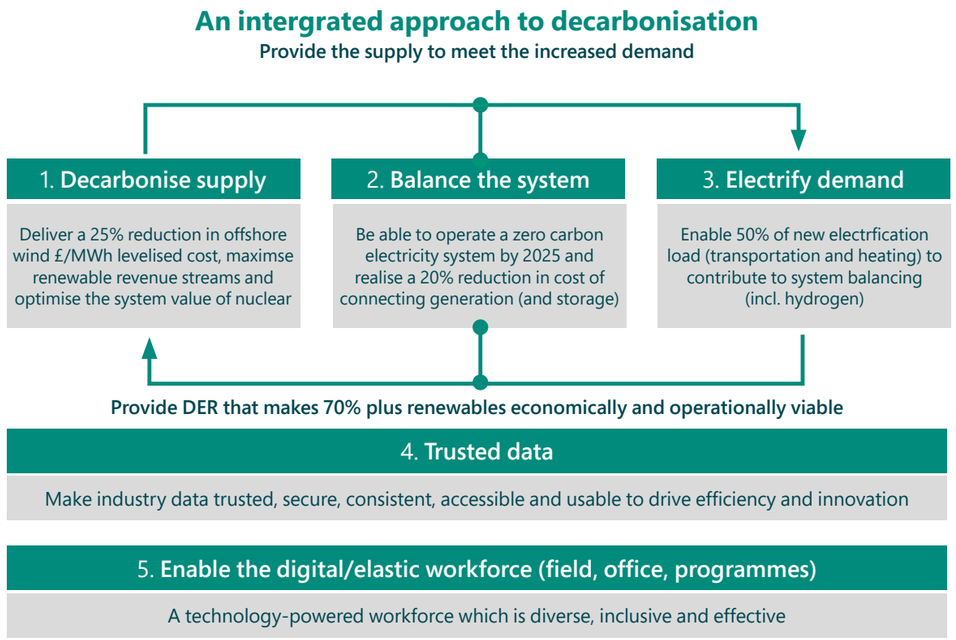


Figure 3. Setting the foundations for net zero. Accenture and Microsoft calculate that the UK needs to deliver this plan in the next three to five years to stay on track for the 2050 net zero target.
Source: Harnessing innovation to accelerate the transition to net zero, Utility Week, 22 February 2021

The five-pillar blueprint incorporates targets for reducing system costs and goals for boosting and balancing the national energy supply. It also advocates that stakeholders adopt open data principles, new skill sets and a shift in organisational culture to support innovation and new business models.

Accenture and Microsoft believe that, if the energy sector can implement these pillars in the next three-to-five years, it will be in a strong position to drive the government's 2050 net zero target.

Industrial clusters have a key role to play across the five-pillar framework by enhancing the economics of carbon capture-enabled generation and hydrogen storage and by providing flexibility services form electrified industrial heating.

Pillar 1: Decarbonise supply

The first pillar targets a 25 percent reduction in the levelised cost* per megawatt-hour of grid-scale renewables. It also aims to maximise percent streams from renewables and optimise the value of nuclear energy by 2025.

The sector has already significantly cut the levelised cost of wind. Accenture and Microsoft believe this can go further through the use of data analytics. For example, Danish renewable energy supplier Ørsted - creator of the world's biggest offshore wind farm at Hornsea One - constantly streams data from thousands of turbines. Using Microsoft-powered analytics and AI, it can maximise capacity and drive down operational costs by predicting and pre-empting.

Pillar 2: Balance the system

Industrial clusters can open up new options for cost-effective system balancing through hydrogen storage – production of green hydrogen when there is excess wind power – and flexible thermal generation with carbon capture and storage.

Accenture and Microsoft have proposed an industry target to cut the cost of connecting generation, storage and load by 20 percent in three to five years. This can be achieved through new approaches to system planning and operation enabled by technology, such as digital twins.

With smart grid solutions to increase visibility and control, the network could also work at higher levels of utilisation, more effectively balancing power flows as demand rises.

Pillar 3: Electrify demand

Accenture and Microsoft call for new business models and operational approaches in the short term. Over the coming decades, this will enable at least half of new electrification load growth to flexibly contribute to system balancing and/or the overcoming of network constraints.

If an integrated digital approach is adopted across the energy system, it will help optimise generation and supply, and create a grid in which system balancing can be fine-tuned. Hydrogen has a key role to play, both as a means to store energy and to help balance the system and decarbonise high-temperature industrial processes where electrification is not viable.

Pillar 4: Trusted data

This pillar extends the integrated digital approach of pillar 3, advocating industry-wide access to trusted, secure, consistent, accessible and usable data. With water, electricity, gas and heating system data available to companies, innovation can accelerate.

For example, stakeholders can better assess the feasibility, location and operation of projects, as well as practical questions, such as where to connect to the system.

Pillar 5: Enable the digital/elastic workforce (field, office, programmes)

Net zero will be enabled by new business models centred on digital ecosystems and the cloud. To realise this vision, organisations will need new skills in communications and data infrastructure, analytics and data science.

Radical innovation and systemic transformation is best supported by highly agile, dynamic teams that specialise in digital and sustainability solutions.

*That is, lifetime costs divided by energy produced.

The role of digitalisation in reducing emissions

As implied in the previous section, it would be impossible to envisage, let alone deliver, the "green industrial revolution" without digital technology. That's because the task of reducing emissions relies on system modelling, simulation, design, deployment, control, monitoring, measurement and much else that's enabled digitally.

For its part, the government strongly promotes the role of data and digital in both the Ten Point Plan and the Industrial Decarbonisation Strategy:

Developing disruptive technologies such as artificial intelligence for energy is a key priority... Digital twins can be used to identify potential issues within the system and address them before they occur... The adoption of digitalisation technologies could reduce carbon dioxide emissions by 4.5 percent while increasing manufacturing growth between 1.5 percent and 3 percent a year.[20]

The power of cloud-based connectivity to support industry solutions is well recognised. Networked artificial intelligence (AI) systems, internet of things (IoT) devices, digital twins and smart-grid solutions can optimise and enhance existing infrastructure, while providing detailed insights into processes. Connected data can also help inform infrastructure and system design.

Take the example of a digital twin. Once the physical assets of an industrial production facility – complete with process equipment, instrumentation, controls and production processes – are "fed into" the twin, multiple scenarios can be played out and analysed, with minimal upfront investment and risk.

In both simulated and real-world manufacturing scenarios, data can be made available to designers, planners, engineers and operational researchers who have a stake in reducing system emissions. And at industrial plants, IoT devices placed around facilities can feed in data via the cloud to enhance a digital twin's real-time operational model and enable AI-powered process analytics that help cut carbon.

3.0
Maximising project ROI

New integrated business models drive ROI

When it comes to maximising return on investment (ROI) in industrial clusters, a simple rule of thumb often applies: The greater the integration, the greater the value.

Integration can come in many forms, including business partnerships, synchronised systems and open data. All are relevant, but a powerful driver of new integrated business models is the alignment of tech and business goals.

The net zero agenda has put energy sector businesses under pressure to solve multiple use cases at scale and at speed. Devising, funding and implementing emissions-reduction solutions can be complex, and with unusually long project timescales and large upfront CapEx outlays, it's crucial to get them right first time.

Digital twin allow complex projects to be modelled ahead of any concrete being poured to understand the options and trade-offs, considering both the physical infrastructure and the associated commercial flows. By optimising ahead of building and reflecting in the relevant commercial and business models, ROI can be maximised.

This calls for broad expertise that can grasp business objectives, integrate suitable technologies and enable candidate solutions to be modelled, evaluated and tested.

Shared assets and ROI
A key insight for industrial clusters is that shared infrastructure, integrated value chains and open data combine to generate value.

Suppose, for example, that your business plans to build a combined-cycle gas turbine (CCGT) power plant that produces carbon dioxide. You'll need infrastructure to pipe the carbon dioxide into offshore saline aquifers. Clearly, if you team up with a local oil refinery and steel producer that connect their carbon dioxide to your pipeline, you can share the fixed infrastructure costs and make the project more cost-efficient.

You can also share the IoT pipeline-monitoring sensors, the data they generate, the cloud platform that receives the data and regulates the system, and the cost of any predictive maintenance repairs.

So, through an integrated, digitalised system-approach to lowering emissions, your ROI can benefit from lower infrastructure CapEx and lower ongoing OpEx.*

Creating new value through integration
The integration of solutions such as electrification and renewable heat, hydrogen and CCUS can help drive system efficiency and circularity.

As we've seen, the Zero Carbon Humber project will also integrate offshore wind power into hydrogen production.[21] The positive impacts of this whole-system approach radiate outwards, helping to decarbonise the regional gas grid, supply hydrogen transport fuelling hubs and create the world's first sustainable maritime refuelling port. It can even provide carbon dioxide storage services to other regional industrial clusters.

The value delivered across the system is multiplied because of its integration with digital twins, which provides the decision support capability to maximise ROI across infrastructure and commercial design.

*The sharing of assets will also bring risks that need to be managed. We explore this topic in section 4.0, "Mitigating project risk".

Driving efficiency through digital technology and innovation

Digitalisation and industrial process optimisation often go hand in hand, and as we've seen, the Industrial Decarbonisation Strategy commits to developing industrial digital technologies to maximise efficiency improvements, including digital twin technology (Action 6.3).

Digital twins can support project optimisation during concept, design and build. But the value doesn't stop there. The same data and infrastructure can go on to drive further value, post-commissioning, by powering ongoing operational efficiency.

The twin's optimisation capabilities range from maximising efficiency through how processes are run to maximising system uptime and predicting maintenance needs – as renewables company Ørsted does in its Zero Carbon Humber-linked offshore wind farms.

These optimisation efficiencies can enable infrastructure assets to work harder and for longer, reducing their total lifetime cost.

Driving efficiency through optimisation

"Digital transformation has become a byword for greater efficiencies... But digital optimisation might offer a more pragmatic approach, using innovative technologies and processes to optimise what already exists in an affordable way."

Rik Irons-Mclean
Strategy Director - WW Energy & Sustainability Industry Enablement Lead

Using digital to increase ROI

"Our objective is to be more cost-effective, for our assets to have longer lives, and for those assets to be more reliable. That is where digital partnerships with organisations like Accenture and Microsoft have the potential to be hugely influential."

Rachel McEwen
Chief Sustainability Officer, SSE plc

Leveraging the power of open data

As Accenture and Microsoft join forces to help accelerate the UK's transition to net zero, we are urging the energy sector to embrace open data as part of a trusted data environment. As mentioned in section 2.2, this is one of the key principles in the five-pillar decarbonisation model.

So what exactly is open data, and why advocate it?

Data is considered "open" when it's available for everyone to access, use and share. This in turn is made possible by open standards – agreed conventions or practices that help users engage with the data.[22]

When an organisation creates or adopts an open data standard, it can ensure consistency and predictability for data users. The data also becomes easier to compare and link up, which encourages interoperability between systems and ways of working – a powerful asset in business partnerships.

Of course, not all data can be open therefore it is important to consider the role of open data within a trusted data environment, where sensitive data can be shared with under agreement, for defined purposes aligned to robust governance and security.

In addition, as data becomes easier to access, open innovation often follows. New ways of working help accelerate development processes, enabling smarter solutions and reducing costs.

Partnering with the Open Data Initiative

At Zero Carbon Humber, Accenture and Microsoft are partnering with the Open Data Initiative (ODI) to power their digital test-bed accelerator with open data

Our data governance approach ensures that data availability, usage, integrity and security are managed in line with our shared standards and policies. Meanwhile, a strong enterprise data architecture helps us break down data silos and enable maximum value to be driven from the data.

This is all the more important when partners are involved in complex cross-sector projects, such as ZCH. It's important that enterprise systems are able to run data securely and transoperably through the cloud, because this provides consistent and accessible information to support evidence-based decision-making and better outcomes for stakeholders, including ROI.

Open data is the digital counterpart of our "systemic efficiency and circularity" low-emissions principle (see 1.3 "Decarbonising industrial clusters: Four options"). By supporting integration, it provides system-wide benefits, such as safer, low-risk implementations, stronger partnerships and lower costs. It has proved invaluable to projects such as Suzhou Industrial Park, where an open data platform has also turned energy IoT data into a valuable public resource.

Companies in the UK, too, are increasingly championing the value of open data. For example, Ofgem's Final Determination on RIIO-T2 included the principle of "presumed open", and National Grid ESO has set up an open data portal that enables access to 60 datasets.[23]

Building the open data ecosystem

"Industry has a major role to play in leading and contributing to solving the major social, economic or environmental challenges we face today. In order to address these challenges, it is crucial that organisations work together to improve access to and interoperability of data; to make data available as openly as possible to people who need it to make better decisions, while protecting privacy, commercial confidentiality and national security.

More and more we see organisations working together to explore new data access models, developing data standards and shared infrastructure, and forming data access initiatives to stimulate and steward the flow of data. This is why the ODI is committed to working with governments and organisations to build a more open and trustworthy data ecosystem, where such collaborations can flourish."

Olivier Thereaux
Head of Research and Development, Open Data Initiative

Sharing data to optimise supply chains

Sharing data across the supply chain is also a growing trend, though unfounded concerns can make companies reluctant to practise it. They may be unaware that increased data access can create value by enabling new business models, increasing efficiency and reducing costs.

By sharing data at ZCH, project partners can better understand and accelerate complex materials supply chains while cutting costs and even learning best practices from each other. Shared data can also underpin joint planning solutions and new design approaches.

To give an example from aerospace manufacturing, Airbus launched an initiative in 2019 to share engineering data for its aeroplane concepts with supply-chain partners.[24] Its new data-sharing platform enabled aeroplane designs to be completed faster – some processes were shortened from several weeks to mere hours – and more accurately.

The outcome included new technology innovations, more engaged employees and significant ROI. Optimised supply chains also enabled the company to reduce its carbon footprint.

Sharing data for shared success

The ODI has previously used its data-sharing and-using expertise in the engineering sector, which plays a key role in industries such as infrastructure development, manufacturing, energy and utilities.

It's manifesto for sharing engineering data has been endorsed by 17 organisations, including the Health and Safety Executive, the Royal Academy of Engineering and Energy Systems Catapult.

This helped build a global engineering "safety evidence base" for the public good and opened up new opportunities for the industry.[25]

Trusted data for digital twins

Used as combined forecasting and simulation tools, digital twins can help industrial clusters rapidly and safely assess different scenarios and options – including no-build and whole system solutions.

Whether at system planning or operational stage, twins are at their most powerful when working in an open-data environment, as this provides the opportunity for them to access and present the fullest, most nuanced picture possible. With this potential in mind, work is currently under way to create a National Digital Twin (NDT), supported by open data, within the context of a Trusted Data Environment, to help expedite the route to net zero.

It's not too grandiose to imagine a future in which a vast network of digital twins, created by multiple energy companies, openly share operational data to yield a whole-system view of generation and consumption. This real-time, connected vision could be a huge asset for both decarbonisation planning and energy management.

"The digital testbed offers a fantastic opportunity to link hydrogen supply and demand digital twin models with manufacturing supply chain databases. This innovation platform will use Zero Carbon Humber as the pilot to accelerate the scaling up of Hydrogen and CCUS sectors which will afford great opportunities to the UK as a whole."

Ben Morgan
Research Director, AMRC

Welcoming culture change

If the drive towards net zero demands new business models, how can industrial cluster-focused businesses best prepare for the future economy?

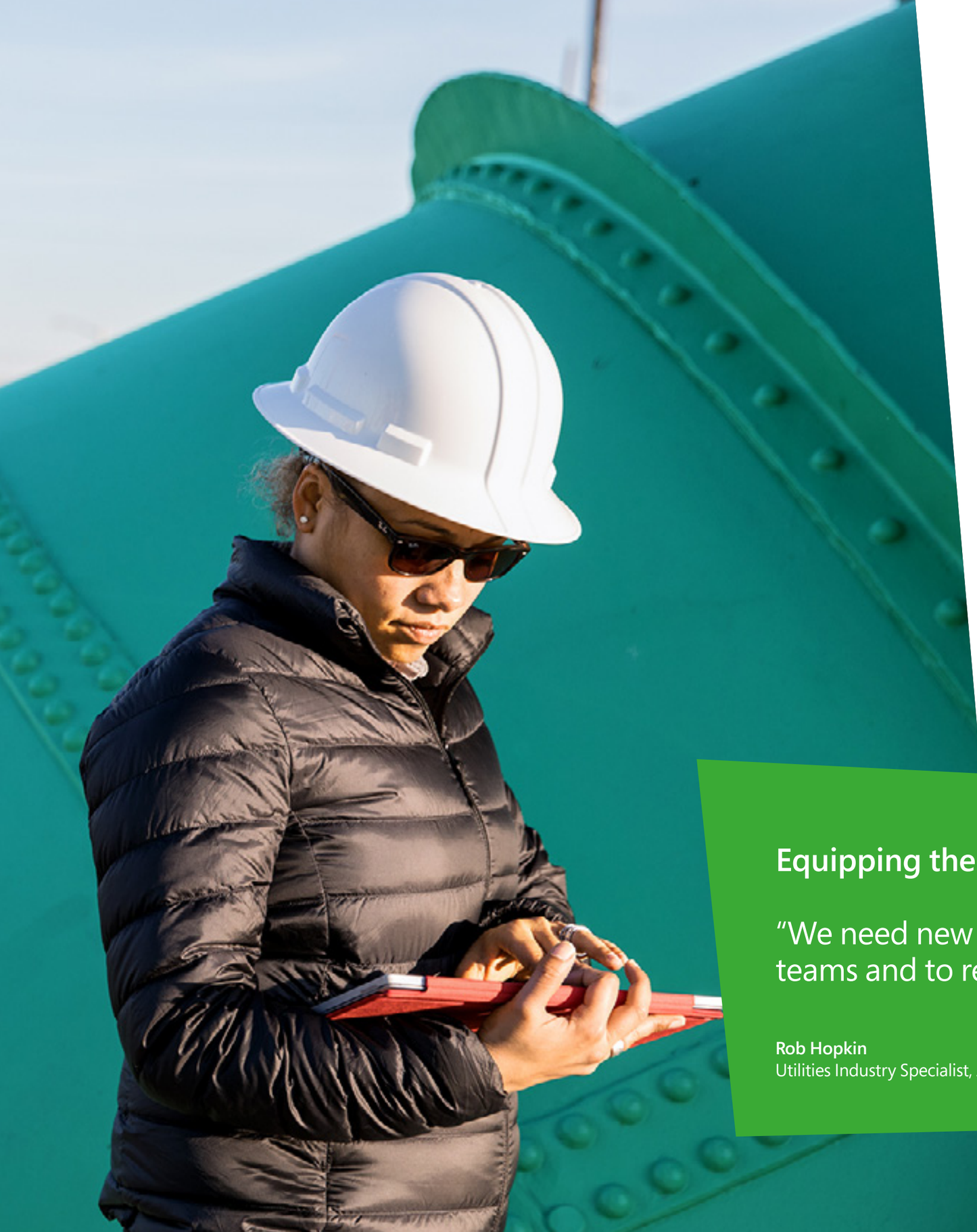
Two key steps, we believe, are to harness the collective intelligence of diverse teams and drive digital skills across the workforce

1. **Nurture diverse teams:** Research shows that organisational gender and ethnic/cultural diversity, especially in executive teams, correlates with financial performance.[26] Strikingly, more diverse companies also better attract talent and improve their decision-making, employee satisfaction and customer focus.

2. **Drive digital skills:** By acquiring digital skills, such as data literacy, digital research, digital innovation and media literacy, workers are more likely to thrive in the post-Covid economy. Research shows that these skills also hold the key to 2.4 percent minimum of a company's bottom line.[27]

More digitally literate and diverse teams will help accelerate the innovation and infrastructure transformation that the UK needs. To achieve the ambitious goals set by government, we need both the advanced technologies that can support innovation and the skills that will make the best of them.

But this isn't just about using existing tech. Employees will also need productive skills that allow them to create new digital tools and systems. This may range from streamlining an industrial process using no-code/low-code apps and analysing system data, to developing AI and algorithms for machine learning.



Innovation, culture and flexible problem-solving

The final pillar in our five-step decarbonisation model (see section 2.2) speaks of "Enabling the digital/elastic workforce (field, office, programmes)". Why is this important?

As we've reiterated, industry partnerships are often the best way to devise, fund and deliver complex emissions-reduction solutions. However, multi-stakeholder partnerships can bring challenges.

For example, partnership teams may be geographically distributed, with sharply different areas of expertise, styles of communication and ways of working. Employees and teams will therefore need to be "digital/elastic" – that is, versatile, agile and mobile. They'll be ready to collaborate from anywhere, working across platforms and systems, and confidently bridging "fields, offices and programmes".

The old, static organisational structures, often defined by a physical office, will be replaced by fluid, dynamic, digitally enabled teams focussed on continuous learning and business outcomes.

Equipping the net zero economy workforce

"We need new skills and new blends of skills, new multi-disciplinary teams and to retrain existing talent."

Rob Hopkin
Utilities Industry Specialist, Accenture UK

4.0
Mitigating project risk

Making risk management a priority

Risk management is a key concern for businesses working to decarbonise and deliver on the potential of industrial clusters. That's partly because these projects are typically large-scale and complex , with high upfront CapEx and long lead-times to positive cash flows.

Other risks arise from the inevitably uncharted nature of many net zero projects. These include:

- The need to build and operate new technologies, which drives construction and operational risk
- Shared infrastructure risk
- "Stranded investment" risk on (potentially) oversized assets
- Pricing and revenue uncertainties, including the challenge of maximising revenue over long asset lifetimes

Despite the challenges, the vast growth in UK offshore wind development tells us that policy and innovation can combine to help fund, develop and operate expensive and hard-to-build assets with uncertain future cash-flows.

The government recognises it has a role to play, too. Its Industrial Decarbonisation Challenge[28] was designed to help offset businesses' capital exposure and reduce risk. In March 2021, UK Research and Innovation (UKRI) awarded £171M across nine projects[29], and the government has pledged to support low-carbon manufacturers after industry has decarbonised so they won't be undercut by cheaper, high-carbon alternatives.[30]

Other initiatives also help the low-carbon electricity sector manage risk and develop the market. Here are two examples:

- **Renewable Obligation Certificates** (ROCs) are issued to suppliers for the eligible renewable electricity they produce each year. Suppliers that fall short can instead pay into a cash fund, which is then given to those that met their obligations. This scheme supports around 30 percent of the electricity supplied in the UK, helping to build the market for renewable electricity.[31]

- **Contracts for Difference** (CFDs) pay eligible renewable-electricity developers a flat rate for electricity they produce over a set period. This rate takes into account low-carbon technology investment costs and the market price for electricity. The scheme protects developers from unpredictable wholesale prices and shields consumers from increased electricity costs.[33]

Three ways for business to reduce cluster project risk

Project partners working in industrial clusters can take key steps in the areas of **co-operation**, **investment** and **integration** to help avoid and reduce risk.

Co-operation

Our experience shows that creating cluster-wide consortiums can effectively distribute risk. This is not just a matter of financial risk. When decision-making groups are given clear responsibilities and project partners have strong reputations, ambition and willingness to invest, the probability of successful collaboration is increased.

Investment

External funding from public-private partnerships will reduce capital outlay for clusters and help de-risk investment. Accenture and Microsoft recommend developing business models that reduce dependence on specific policies and improve commercial feasibility.

Integration

Project partners can benefit by investing in process integration as part of a long-term strategy for operating in a particular cluster. To offset the risks associated with integration, they can then develop commercial models that have flexible arrangements which reduce process rigidity.

Mitigating risk through digitalisation

Although industrial cluster decarbonisation projects are often extremely expensive, with long project timescales (Zero Carbon Humber will run for 20 years), Accenture and Microsoft believe digital and data can help safely accelerate them.

Our approach is built on the 'measure twice, cut once' principle, familiar to DIY practitioners. Put simply, the more planning and prep done upfront – in measuring, calculating, specifying and so on – the more time, money and hassle saved later.

The same principle applies to cluster decarbonisation projects. Digital 'plan/model/simulate' scenarios can ensure the design of costly infrastructure is accurately scoped and specified before build.

If initial designs for industrial cluster super-projects aren't right, downstream costs will escalate. Digital helps by minimising upfront investments, ironing out complexity and helping businesses fine-tune sizing in advance. Data is the basis of this capability, with data analytics providing the predictive power to inform decisions.

Minimising risk at ZCH with digital twins

Microsoft, Accenture and AMRC are supporting the ZCH partnership in developing the foundation for a digital test-bed for Zero Carbon Humber, starting with a digital twin of the hydrogen infrastructure and local market. We will apply our “measure twice, cut once” principle (see section 4.2, “Mitigating risk through digitalisation”). The twin will demonstrate the value potential of a digitally enabled industrial cluster from inception to decommission.

The joint team will digitally model the hydrogen value chain, using real and synthetic data, from the production of blue and green hydrogen through to storage, transportation and consumption across the cluster and beyond. The twin will enable the modelling of decarbonisation pathways and scenarios to understand risk, carbon abatement potential, hydrogen market evolution and the development of the UK’s hydrogen supply chain.

The solution will be built in the cloud and will apply open data principles and cross-sector digital twin data standards. It will be adaptable and extensible to evolve with ZCH and to ensure applicability to other clusters in the UK and globally. Specifically the twin will model:

- Hydrogen supply and demand based upon current and forecast consumption
- Physical hydrogen infrastructure and input costs for both blue and green hydrogen
- Production costs and end-user prices
- Carbon abatement potential through the move to hydrogen
- Economic value creation and the stimulation of the UK’s hydrogen supply chain

Our intention is that the twin will be an invaluable decision-support tool to those envisioning, shaping and building clusters from policy makers through to investors and operators. Clusters are an inherently collaborative endeavour. Digital twins are a powerful collaboration tool for collective innovation, decision-making and execution. The test-bed will put in place the foundations for new ways of working that will power cluster decarbonisation.

6.0

Achieving your sustainability goals in partnership

This paper has looked at innovative ways of tackling industrial emissions at scale, including potential challenges, approaches and solutions.

Yet if you're a business development manager in the energy sector, you may be asking: why should I explore these topics? Isn't it enough to have to raise project funding, meet the latest sustainability KPIs and stay ahead of industry regulations – not to mention the impact of the pandemic and Brexit?

We recognise the stresses you face, including the pressure to contemplate new business models with multiple stakeholders, in complex and uncharted waters.

As partners on current industrial decarbonisation projects, we also recognise your sector expertise. Today's industrial terrain no longer favours siloed thinking around innovation. Our experience suggests that companies drive better outcomes by working with specialist business and technology transformation partners to extend and embed their own domain expertise.

Many industry partners focus on reducing emissions with specific technologies or in specific sectors. In contrast, the Accenture-Microsoft partnership delivers an integrated approach across sectors. It's one reason why we design, build, deploy and advocate interoperable business technologies, data-consolidating digital twins and open data platforms.

We believe our digital and implementation knowhow can help industrial clusters deliver on their net zero goals at lower cost – while mitigating risk, safely accelerating deployment, and nurturing new capabilities for the future.

The power of integration

"The answer to all the technological, market and regulatory challenges that result [from decarbonising the energy system] can't possibly come from a single organisation or sector. Partnerships, like the one between Microsoft and Accenture, are essential in bringing together an electricity utility like SSE with business and digital technology transformation specialists."

Rachel McEwen
Chief Sustainability Officer, SSE Renewables

We understand that every industry organisation is at a different point on the road to net zero.

If you'd like to discuss your needs, we're ready to talk things through and share some thoughts on how we can support you on your journey.

7.0
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