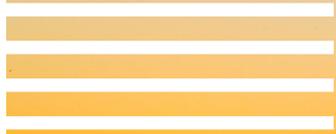


NET ZERO BY 2040



A Year in the Life of the South Wales Industrial
Cluster (SWIC) Deployment Project

Produced by the SWIC Deployment Partners

June 2022



**CLWSTWR DIWYDIANNOL
DE CYMRU**
SOUTH WALES
INDUSTRIAL CLUSTER



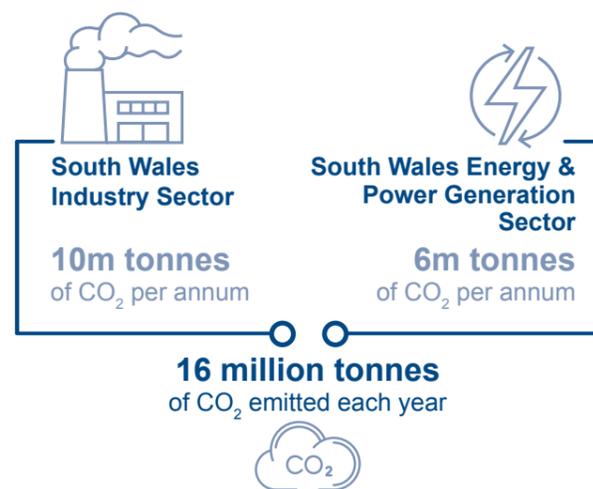


Why South Wales

Throughout the Industrial Revolution, Wales powered the world with coal mined from the valleys and shipped through the ports of Cardiff and Barry. But the world is now seeking new, cleaner sources of power and Wales can be at the forefront of this new Industrial revolution. To meet this challenge, industry, power companies, academics and government are working together as part of the South Wales Industrial Cluster (SWIC), driving inward investment to create and protect jobs as part of a new low-carbon economy.

South Wales is currently the second-highest industrial and energy generation emitter of carbon dioxide in the UK, producing over 16m tonnes of CO₂e per annum. These activities are also a significant part of our economy:

- 30% of the UK's electrical power is generated in Wales
- The port of Milford Haven is capable of handling 30% of the UK's liquid natural gas
- Industry and power generation employ over 100,000 people in Wales – that's 7% of the Welsh workforce
- 'Green jobs' will bring new opportunities and new employers to the UK – with the skills and facilities on offer, South Wales can fulfil many of these opportunities.



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For further information about the SWIC Deployment Project, please contact
David Jukes (david.jukes@costain.com) or
Sarah Bowles (sarah.bowles@costain.com)

Introducing the SWIC projects

The South Wales Industrial Cluster was formed in 2019, to help plan and shape a route to net zero for industries in South Wales. Within SWIC, there are two main projects – the Cluster Plan and the Deployment Project.

- The Cluster Plan involves 30 partners, exploring the feasibility of decarbonisation proposals and development of a circular, restorative economy
- The Deployment Project involves 17 partners working on feasibility studies for specific projects that will reduce emissions.

The Deployment Project is split into multiple work packages, designed to better determine the pathway to 2030 and then beyond to Net Zero by 2050. They address technology challenges, to understand what part these technologies will play in delivering Net Zero for the region.

“The South Wales cluster is unique in its approach. Whereby we’re collectively working together to understand the vision and opportunity. From this position we will be better informed to take projects forward to final investment decision.”

Tata Steel

SWIC Deployment Project in numbers

UKRI UK Research and Innovation
Funding awarded in March 2021 by UKRI's Industrial Decarbonisation Challenge, with Match Funding from industrial partners

Total Contract Value is £37.6m – £20m grant, £17m match funding from partners

Duration of the Deployment Project is 36 months, finishing February 2024

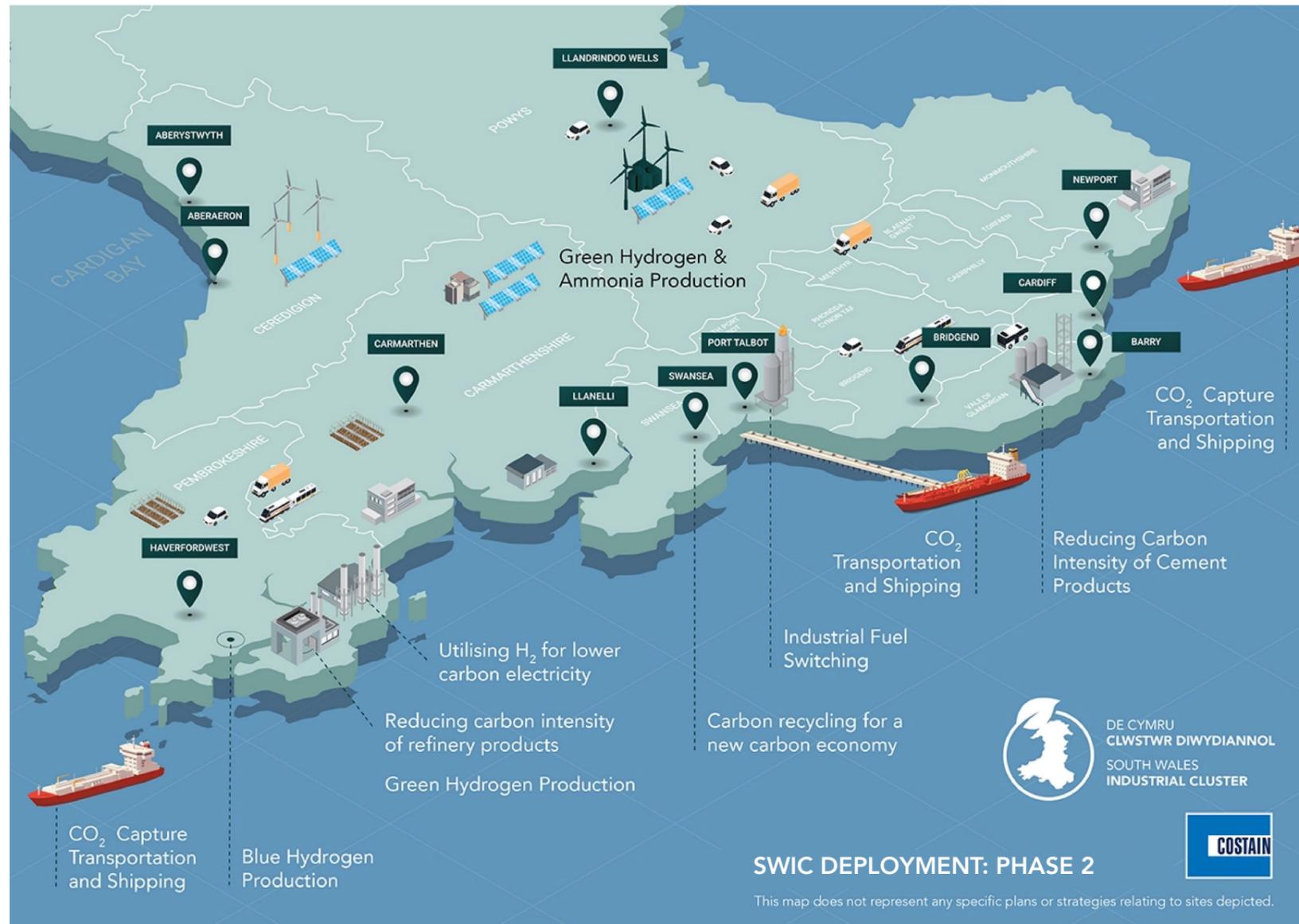
The project involves feasibility and engineering design studies, which will inform financial investment decisions – the first project should be completed 'on-the-ground' in 2025

If all 35 individual Deployment Projects are fully implemented, this would require an investment of over £3.5bn in South Wales.





SWIC Deployment Partners



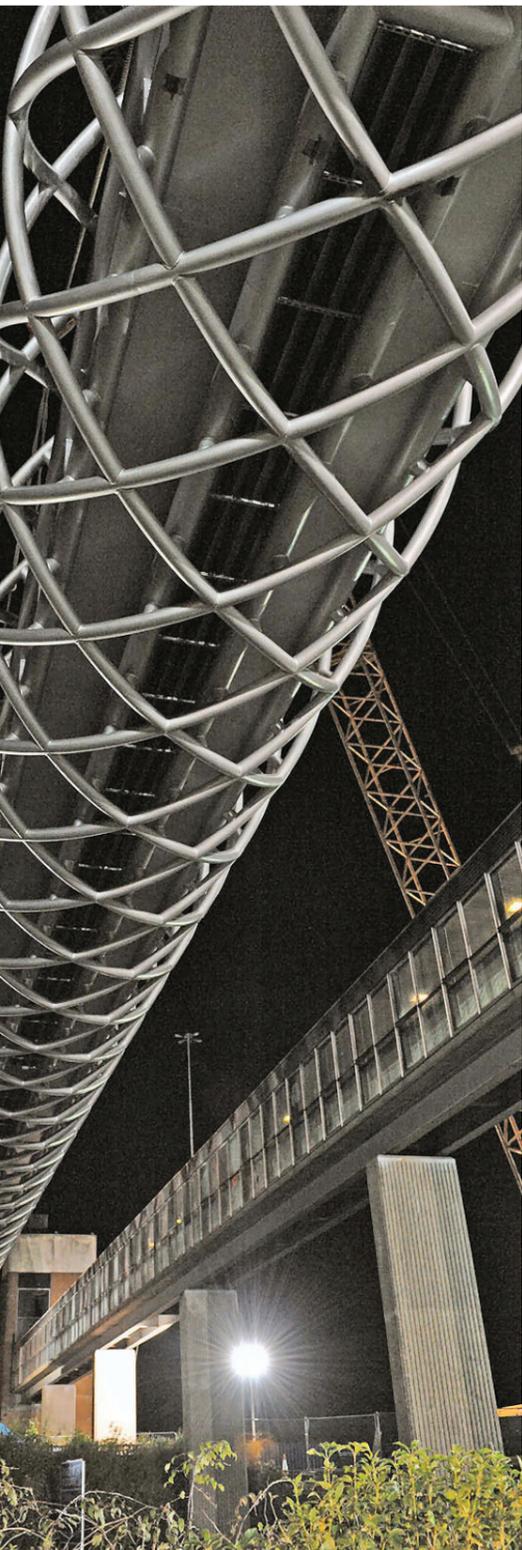
Costain has a 150-year heritage in engineering and construction having delivered many successful civil engineering projects in Wales. Bringing together capability and experience, we deliver sustainable and practical solutions to some of the most complex challenges across energy, water, transportation and defence. In 2020 Costain was appointed Lead Partner for the South Wales Industrial Cluster Deployment Project taking a key role in developing plans that will help to establish the world's first net zero carbon industrial cluster by 2040.

Lead partner role

To achieve the best outcomes, Costain's role is to join the dots between the 17 partners highlighting, opportunities. These include emissions captured by others to produce a sustainable aviation fuel, or prioritizing infrastructure investments, such as shipping, that would be unviable for one company working alone, but may be cost-effective if they are also used by others. Costain also engages with UK Research and Innovation who are funding the SWIC Deployment Project, plus UK and Welsh Government ministers, local authorities, academics, other regions and professional groups, as well as keeping the citizens of Wales informed.

It's no mean feat for 17 major companies, each with their own corporate processes and identities, to integrate and work effectively, but in our first year, we have established our communication, decision-making and reporting processes. This was achieved whilst working through the COVID-19 pandemic and managing the public interest brought by the COP26 climate change conference in Glasgow.

A highlight of the first year has been establishing the Future Leaders Group (FLG), including talented people nominated by the partners. The FLG holds the senior leaders to account – after all, it will be their responsibility to manage the outcomes of decisions taken today.



TATA STEEL

Tata Steel is the largest steelmaker in the UK with primary steelmaking at Port Talbot in South Wales supporting manufacturing and distribution operations at sites across Wales, England and Northern Ireland as well as Norway and Sweden. Tata Steel employs more than 8,000 people and has an annual crude steel capacity of 5 million tonnes. The company supplies high-quality steel products to demanding markets, including construction and infrastructure, automotive, packaging and engineering. Tata Steel in the UK has the ambition to produce net-zero steel by 2050 at the latest and to have reduced 30% of CO₂ emissions by 2030.



Key success factors for Tata Steel

Key to the success of the SWIC Deployment Project for Tata Steel is the development of external low-carbon enabling infrastructure. This is beyond Tata Steel core expertise so this project provides a collaborative opportunity, for shared learning to understand what can be achieved in the region.

Opportunities include shared assets and alignment to other low-carbon plans which could potentially drive down costs and help achieve emission reduction within the region at pace.

Key technologies to support the ambitions are carbon capture, hydrogen (fuel switching) and electrification. A year into the Deployment Project and there is a better understanding of the role of the technology choices, the impacts and the potential costs.

With this knowledge, Tata Steel will be in a stronger position to deliver a low-carbon steel product to customers to decarbonise the product chain and ultimately build the low-carbon infrastructure, necessary to drive the low-carbon transition for the UK.



RWE

RWE has a clear ambition – to be carbon neutral by 2040. The company is a world leader in renewables, a market leader in the development of offshore wind and a key driver of the global energy transition. In turn, Pembroke is looking to continue its transformation as part of a decarbonisation hub under the title of the Pembroke Net Zero Centre (PNZC), which brings together all areas of the company’s decarbonisation expertise. Located all in one place, it demonstrates RWE’s commitment to the decarbonisation of Wales and the UK.

PNZC will develop and implement three distinctive pillars: 1) Decarbonisation of Pembroke Power Station, including CCS and initial Hydrogen feasibility studies; 2) Green Hydrogen production, including feasibility studies for an initial 100-300MW ‘pathfinder’ electrolyser on the Pembroke site and also looking at GW-scale opportunities in the longer-term; 3) Floating Offshore Wind development in the Celtic Sea.

As a proud and supportive member of South Wales Industrial Cluster (SWIC) it is working with local partners on solutions to develop hydrogen infrastructure and support the decarbonisation of Welsh industry. The first phase of these projects has just been completed and has been partly funded by SWIC. It included the investigations into the feasibility of installing a 100 megawatt (MW) electrolyser to produce green hydrogen from local and grid connected renewable energy. The project has the potential to grow to several gigawatts (GW) in scale, be linked to floating offshore wind in the Celtic Sea, and become one of the UK’s largest green hydrogen plants in development.





LanzaTech

LanzaTech, a carbon recycling and sustainable fuels company, joined SWIC in June 2021. The company is working on the UK's first commercial-scale Alcohol-to-Jet (ATJ) facility in Port Talbot, which could be operational by 2025. The plant will produce 100 million litres per year of Sustainable Aviation Fuel (SAF), which will be blended with conventional fossil kerosene to produce jet fuel for commercial aviation. This blend is fully approved for use in commercial aviation today, and would be enough to supply up to 1% of the UK's jet fuel demand, driving decarbonisation of the UK's aviation industry. The production process is outlined in the graphic below.

The ethanol feedstock for the Alcohol-to-Jet plant could come from existing waste-based ethanol sources or be produced locally from industrial waste gases using LanzaTech's gas fermentation technology. This approach will offer a further decarbonisation option to SWIC emitters alongside traditional capture and storage solutions.

In the year since joining SWIC, LanzaTech has made significant progress to advance this exciting project. A final site has been selected, engineering design of the facility has started, and the planning and permitting process is underway.

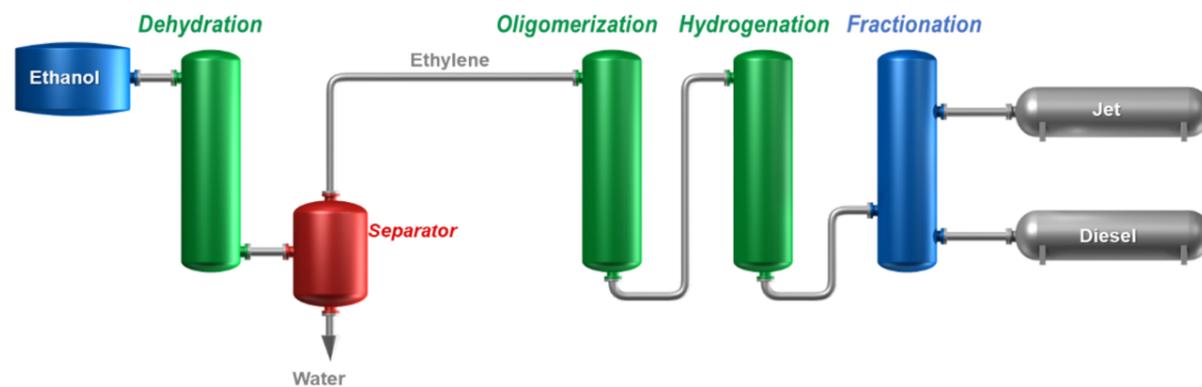


Figure 1: LanzaJet™ Alcohol-to-Jet process

Being a member of SWIC has allowed LanzaTech to engage quickly with like-minded partners to work together on project concepts for significant decarbonisation of existing industry in South Wales and to drive demand for green hydrogen projects.

For example, CO₂ and hydrogen from current and future SWIC partner facilities can be utilised locally in LanzaTech's gas fermentation technology to produce ethanol for SAF production in the above Port Talbot ATJ plant, or can be converted into CarbonSmart ethanol to produce more sustainable consumer products, such as plastics, cleaning products and textiles.



Tarmac is the UK's leading sustainable building materials and construction solutions business. Its innovative products and solutions not only safely deliver the infrastructure needed to grow the UK economy today but also help to create a more sustainable built environment for the country's long-term future.

Sustainability is at the core of Tarmac's business and is deeply embedded in its culture with ambitious commitments and targets based around three key themes – people, planet, and solutions.

The Aberthaw Cement Plant opened in 1912 and is located in an area of rich limestone geology. The cement produced from Aberthaw is used both regionally and nationally to make essential construction materials, such as ready mix concrete, which is used to create the homes, schools, hospitals, workplaces, transport, clean water and renewable energy on which we all rely.

As part of ongoing sustainability commitments, Tarmac continue to actively research and explore further opportunities to reduce energy and carbon.

Joining SWIC gives the opportunity to work alongside regional experts to build on existing developments and identify new ways of further cutting energy and carbon. SWIC also allows collaboration with other industries in South Wales in delivering proactive plans for the decarbonisation of the region.



University of South Wales

The University of South Wales (USW) was established by the merger of the University of Glamorgan and the University of Wales Newport in 2013. The University now has 23,000 current students and maintains a strong commitment to sustainability has a world-leading research through the Sustainable Environment Research Centre (SERC) – SERC was a founding member of SWIC.

Working with industry partners, USW’s role in the SWIC Deployment Project covers three key areas:

- To identify the Research and Development requirements that will support decarbonisation projects and achieve net-zero operation, linking industry with the regional, national and international expert research groups, including the national Industrial Decarbonisation Research and Innovation Centre (IDRIC).
- To identify the future skills and training required to achieve decarbonisation. This includes undergraduate and postgraduate training (working with regional University partners), apprenticeships (with regional FE colleges), as well as upskilling/CPD training and the Welsh Government’s Skills, Higher Education and Lifelong Learning team.
- To share knowledge – USW actively contributes to UK and Welsh Government Advisory Councils and expert working groups as well providing advice to the local authorities in the SWIC.

By co-ordinating regional engagement with IDRIC, ten new research projects have been initiated that are directly relevant to the R&D needs identified by SWIC. These cover a range of detailed technical advancements that all support industrial decarbonisation in South Wales.

Guided by SWIC, USW has now created the South Wales Industrial Transition from Carbon Hub (SWITCH) – this will help to co-ordinate major R&D projects such as FLEXIS, RICE, SPECIFIC and SUSTAIN, as well as future R&D programmes. SWITCH involves the universities of Swansea, Cardiff and South Wales, with additional support from national and international research organisations, all guided by the needs of industry. SWITCH has secured £20m of new funding to create a new R&D facility at Port Talbot Harbourside – this will host industry-based decarbonisation experimental research.



SIMEC ATLANTIS ENERGY

Built in the late 1950’s, the Uskmouth Power Station has provided employment and economic benefit for Newport and its communities for many years. However, coal-fired power stations no longer meet society’s needs and Simec Atlantis Energy, as the developer, owner and operator of Uskmouth, are planning a world-first, ground-breaking plant conversion.

The Uskmouth conversion project aims to convert a coal fired power station to generate electricity in an economically viable and sustainable way through the combustion of waste derived fuel pellets, manufactured to a rigorous specification that is purchased as a fuel. These fuel pellets displace the need for primary fossil fuels and virgin biomass to provide baseload electricity on the road to decarbonisation.

Uskmouth can act as a blueprint to improve the environmental performance and utilise the existing infrastructure of coal fired power stations in the UK and Europe to provide electricity on the pathway to decarbonisation. It has ambitions to become Wales’ largest net negative carbon emission facility using Carbon Capture and Storage and Usage combined with the Uskmouth conversion project.

The Uskmouth Sustainable Energy Park aims to enable the development of new innovative decarbonising technologies, alongside the ongoing development of the Uskmouth Conversion Project. The Sustainable Energy Park will create jobs, and bring investment to the local economy and beyond.

Simec Atlantis Energy is investigating Carbon Capture Storage and Carbon Capture Usage solutions for the Uskmouth Conversion Project and considering various decarbonising technologies including: novel algal production with Remediate, a new process which, in addition to capturing the emissions, could generate high-value by-products such as pigments, nutrients and supplements, as well as more conventional amine based technology.



Engaging with SWIC partners to become an anchor site for smaller CO₂ producers, by ensuring the business case for CO₂ infrastructure in the area.





Wales & West Utilities (WWU) look after the pipes that bring gas to heat homes and power businesses and heavy industry across Wales and South West England. From Wrexham to Redruth, 7.5m people rely on WWU to keep the gas flowing safely. As well as homes and businesses, 48 flexible power stations connected to the network support renewable energy, keeping the lights on when the wind doesn't blow, and the sun doesn't shine.

Between 2021 and 2026 WWU is investing £400m into the network to make sure it is ready to transport green gases like hydrogen and biomethane.

Working with SWIC and other industry stakeholders, including local, Welsh and UK Government, WWU can help demonstrate the role hydrogen can play in decarbonising home heating and heavy industry.



WWU and SWIC are:

- Assessing the potential of alternative forms of hydrogen distribution and storage such as Liquid Organic Hydrogen Carriers (LOHC) and Ammonia to help support the transition from natural gas to hydrogen
- Identifying and evaluating supply and demand scenarios for hydrogen in South Wales, and the pipeline infrastructure needed to transport gas energy vectors (natural gas, biomethane, hydrogen and hydrogen blends)
- Assessing future demand in the case of 100% hydrogen, and future requirements for storage (including line pack, tank, and salt cavern storage)

In the first year, WWU has explored the hydrogen demand across South Wales, considering a variety of future uses and what this means for the network. This in turn has enabled exploration into a number of possible pathways to begin connecting hydrogen supply with industrial demand, highlighting low-regret opportunities such as repurposing existing infrastructure. The next focus will be on the opportunity for the construction of new hydrogen infrastructure to convert homes to hydrogen for heating once a hydrogen backbone supplying heavy industry has been established.



Shell UK joined the SWIC Deployment Project in 2021. Through Shell UK's Carbon Capture and Storage and Renewable and Energy Solutions businesses, they are evaluating two different workstreams:

- Provision of carbon capture, transport and storage solutions
- Generation, supply and marketing of blue hydrogen

CCUS – SWIC has provided an excellent platform for integration with South Wales' extensive and diverse manufacturing and industrial businesses and, through this collaboration, Shell has identified several options which are now undergoing further analysis. The SWIC region has several potential CO₂ export locations, strategically positioned and capable of expansion if other local CO₂ emitters seek to decarbonise their operations. Further work is now required to refine these details, including analysis of:

- Technical aspects of vessel approach/maneuvering
- Location for jetty loading and unloading
- Layout of export infrastructure within the port facility
- Port access/port stay
- Risk management and CAPEX/OPEX requirements.

Once complete, this integrated CO₂ export and shipping approach, developed around the needs of South Wales, is expected to stimulate economic growth through a competitive, standardised shipping market.

Hydrogen – Building on the CO₂ evacuation concepts, South Wales, in particular Milford Haven, is well-suited to an LNG-H₂-CO₂ concept. The concept brings efficient, at-scale production of blue hydrogen, located right next to the UK's biggest marine energy-handling facility at Milford Haven.

The hydrogen produced has several economic exploitation options, including a range of industrial customers and/or export through the existing gas infrastructure operated by National Grid and Wales & West Utilities. These options will each be evaluated in a series of business cases, allowing investment decisions to be taken. This blue hydrogen initiative could pave the way for a wider transition to hydrogen within SWIC and beyond.





Progressive Energy's mission is to deliver significant reductions in the UK CO₂ emissions through development of zero and low carbon projects.

Founded in 1998, the team translate innovative technologies, such as hydrogen and carbon capture, utilisation and storage (CCUS), into concepts and ideas all the way through to their Deployment to make a material difference to climate change.

Progressive Energy originated and lead the development of the HyNet decarbonisation cluster and are a founder member of SWIC.

Within SWIC, Progressive Energy are charged with developing a vision for CO₂ aggregation and terminals across South East Wales, serving sites with CO₂ capture from Port Talbot to Newport.

Within the Deployment Project, they are developing the CO₂ pipeline, terminal and shipping specifications and designs to inform the delivery of these projects over time. In addition, Progressive Energy are working with Wales & West Utilities to support the identification of sites for hydrogen production, required pipeline systems and storage solutions.

To date, the team has have developed costing models for CO₂ capture, transport and terminalling, identified appropriate sites for CO₂ terminals and associated pipeline routes as well as a basis of design for a scalable, modular CO₂ export terminal.



Associated British Ports (ABP) is the UK's leading and best-connected port owner and operator, with a network of 21 ports (including five

ports in South Wales) handling around a quarter of the UK's seaborne trade. ABP ports play an essential role at the heart of the UK economy, supporting around 120,000 jobs and contributing £7.5 billion to the economy every year.

Within SWIC, ABP is working with other partners on a feasibility study for the development of CO₂ export terminals within the ports of Port Talbot and Newport. These terminals would enable CO₂ captured within the cluster to be loaded to vessels for shipping to remote storage locations for sequestration. CO₂ shipping will be a key enabler for SWIC and for those other clusters in the southern UK that are without direct pipeline access to offshore geological storage – shipping is also therefore critical to achieving Net Zero in South Wales.

The project has completed extensive stakeholder engagement with the upstream emitters of CO₂, including their requirements in terms of quantities, states and shipping profiles. ABP are also working closely with Shell who are leading a SWIC workstream on CO₂ shipping.



Port of Milford Haven

The Port of Milford Haven is the UK's largest energy port handling approximately 20% of the UK's energy requirements. The Port, along with the energy facilities around the Milford Haven Waterway, directly supports over 5,000 Welsh jobs, with many more indirectly supported through the supply chain. Our Port is also home to an increasing number of organisations from across the globe who are spearheading new research, development and manufacturing in marine energy power generation.

Fuelled by its vision to play a key role in building the Haven's prosperity. The Port of Milford Haven is fully supportive of the next generation of energy opportunities such as hydrogen, carbon capture and marine renewables as well as the health of the regional economy giving access to rewarding careers, creating a rich culture, making a positive contribution to our natural environment, investing in a greener future for our children and strengthening our communities.

The Port of Milford Haven joined SWIC to provide advice and guidance to all partners on port operations, logistics, maneuvering, capacity and berthing.

Alongside its work within SWIC they are also collaborating with other Pembrokeshire partners – the Haven Waterway Future Energy Cluster - to deliver an accelerated low carbon future for the Haven Waterway.



Capital Law

Capital Law was founded in 2006 and have a team of 100 qualified lawyers and consultants advising clients in the public and private sector, on all areas of commercial law, from our offices in Cardiff, London and Paris. The Construction, Energy, and Projects team has been providing expert legal support to the Deployment Project since the inception of Phase 1, in April 2020.

Due to the number of partners involved in the Deployment Project, Innovate UK required an agreement from the partners to show their commitment to working collaboratively. Capital Law were responsible for preparing and implementing this Collaboration Agreement which enabled the Project to take place – this work was vital to maintain trust between partners.

Since the commencement of the Project, Capital Law has led on the work package which aims to provide innovative legal guidance and support to the Project. Part of this work involved supporting Costain as Project Lead, with setting up the governance structure of the Project and preparing Terms of Reference.



As the only law firm to be a member of the SWIC, Capital Law understand the importance of driving down emissions and ultimately to achieve the vision of a circular economy.



Industry Wales (IW) is an arms-length organisation of Welsh government, formed to provide an active link between industry and government officials. Industry Wales has been supporting development of a formal entity for SWIC, allowing it to become a subscription-based membership organisation.

This new organisation, Net Zero Industry Wales, has recently been announced by the Minister of Economy for Welsh Government and the focus now moves to recruiting a CEO, a chairperson and board of directors and the organisation will be formally launched later in 2022.

As a partner within Deployment Project, Industry Wales is responsible for supporting industrial partners as they develop their routes to NetZero and also for smoothing alignment with the SWIC entity and the Cluster Plan.



Founded in 2005, CR Plus are a sustainable cost reduction, energy efficiency and project engineering consultancy established to support its industrial client base. As leaders of the SWIC Cluster Plan involvement in the SWIC Deployment Project align the two projects.

Links between the Cluster Plan and Deployment Project have also enhanced knowledge sharing – smaller-scale projects within the Cluster have been able to feed-back their learning which has been used to improve larger-scale proposals. All partners, projects and Wales' pursuit of NetZero will benefit from this knowledge-sharing process.

CR Plus led the development of a series of events during SWIC Week One, held in October 2021, and SWIC Week Two, in March 2022. These events highlighted the projects involved in the Cluster Plan and Deployment Project, explaining progress to the industry and communities alike.

In the first year of the SWIC Cluster Plan and the SWIC Deployment Project, CR Plus has attracted over £50 million in investment funding from, among others, the IETF (Industrial Energy Transformation Fund). This funding will provide real examples of how South Wales industry can transition and thrive in the Net Zero Future. The scale of the investment is expected to increase as the pipeline of SWIC projects continues to expand.





Lightsource bp was founded in 2010 and is now a leading Solar PV (photovoltaics) developer. Whilst solar power is often fed into the national electricity grid, Lightsource bp's Innovation team has been looking into using solar-generated electricity to produce Green Hydrogen through the electrolysis of water. Participation in SWIC has allowed them to develop this proposal, extending scope into Electrolysers and H2 storage and distribution. SWIC introduced a range of industries that may be future suppliers or customers for this green hydrogen.

Lightsource bp's feasibility study will assess the business case for a renewable power pilot installation, supplying electricity at 20 to 50 MWe capacity, which will be used to produce hydrogen to meet developing demand by industry and other users.

Work within SWIC will frame the project and associated opportunities and risks, and identify the next steps to progress the project, including funding requirements. The study will consider the green hydrogen hub location, evaluate electrolyser technology and options for other aspects of the project, develop an outline design, estimate capital and operating costs, evaluate project economics, commercial and legal aspects, safety and consenting requirements.



Meet the team

To learn more about how we can help you meet your decarbonisation targets, contact:



Matt Browell-Hook

Energy Sector Director

M: +44 (0)7812 236308

E: matt.browell-hook@costain.com



Dave Richardson

Project Director

M: +44 (0)7876 213483

E: david.richardson@costain.com

To learn more about the South Wales Industrial Cluster, contact:



David Jukes

Programme Development Director
- SWIC Deployment Project

M: +44 (0)7799 435858

E: david.jukes@costain.com



Sarah Bowles

Programme Manager
- SWIC Deployment Project

M: +44 (0)7717 838872

E: sarah.bowles@costain.com



Martyn Garrett

Project Director
- SWIC Deployment Project

M: +44 (0)7795 952833

E: martyn.garrett@costain.com



www.linkedin.com/company/costain



@CostainGroup

WWW.COSTAIN.COM