



# FLEXIS

SMART ENERGY FOR OUR FUTURE  
YNNI CALL AR GYFER EIN DYFODOL

May 2019  
Advisory Board Report



UNODD EWROPAID  
EUROPEAN UNION



Llywodraeth Cymru  
Welsh Government

**Cronfa Datblygu  
Rhanbarthol Ewrop  
European Regional  
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UNIVERSITY**  
**PRIFYSGOL  
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**Swansea University  
Prifysgol Abertawe**

**University of  
South Wales  
Prifysgol  
De Cymru**

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# Foreword



FLEXIS is moving strongly into the second half of development, with a particular focus on the demonstration area.

We are delighted to welcome our latest recruit – our new demonstration area Project Manager, Rhys Bowley. A Cardiff University graduate, Rhys has spent the past seven years at National Instruments and is relocating from Austin, Texas, to Wales to lead FLEXIS' demonstration area work on a full-time basis. We hope Rhys will join us in June.

The FLEXIS and Neath Port Talbot County Borough Council (CBC) Memorandum of Understanding (MOU) laying out the development of energy systems research, innovation and commercialisation activities within the demonstration area, was signed at the end of 2018. It lays out eight traction projects the Council would like FLEXIS to consider, as well as a list of proposed projects from the FLEXIS Principal Investigators and their teams. Further details are provided on p10 and a number of very positive discussions are underway.

FLEXISapp is also moving on apace with a final version of the Business Plan recently submitted to the Welsh European Funding Office. FLEXISapp is the Energy System (FLEXIS) Commercialisation Demonstrator that will develop and test individual, innovative energy technology in-situ in a whole multi-vector energy systems environment, within the demonstration area.

In December 2018, FLEXIS formed part of the official UK delegation at the 24th Conference of the Parties to the United Nations Framework Convention on Climate Change in Katowice, Poland. We co-hosted a workshop 'De-risking Decarbonisation of Industry-Intensive European Regions' with the Central Mining Institute, a leading Polish R&D organisation and a strategic EU FLEXIS partner. Our presence at COP24 resulted in shared knowledge and stakeholder co-operation, raised awareness with the UK Government's Department for International Trade and deepened our relationship with the Royal Society.

A further collaboration with the Royal Society took place in March 2019 with a Net Zero Carbon Wales 2040 workshop at their Low Carbon Wales Creating Connections event, hosted in conjunction with The Learned Society of Wales.

The FLEXIS team would like to thank Martin Brunnock for his excellent contribution to the FLEXIS Advisory Board and wish him well in his new role as Hub Director, Tata Steel in Europe. We welcome on board our new Tata representative - Phil Clements, Director of Technical, Tata Steel UK as well as two other new Advisory Board members: Chris Harris, Head of Regulation at NPower and Francis Griffiths, CEO of Maiple.

Finally, we extend our warmest congratulations to Prof Alan Guwy following his election as a Fellow by The Learned Society of Wales.

**Prof Hywel Thomas**

# Who's who

FLEXIS is made up of approximately 100 academics, researchers and administrative staff from three of Wales' leading universities - Cardiff, Swansea and the University of South Wales.

**Prof Hywel Thomas**

Lead Principal Investigator and PI of Sustainable Earth Energy

**Dr Aleksandra Koj**

Project Manager

## Principal Investigators

**Prof Nick Jenkins**

Network & grid integration of renewables;  
low carbon energy infrastructure in Wales  
Cardiff University

**Prof Alan Guwy**

CymruH2Wales2 - hydrogen and fuel cells  
University of South Wales

**Prof Phil Bowen**

SMART-POWER: enabling integrated energy systems  
Cardiff University

**Prof Andrew Barron**

Energy safety research  
Swansea University

**Prof Manu Haddad**

Alternative environmentally-friendly gas for electrical networks insulation  
Cardiff University

**Profs Nick Pidgeon & Karen Henwood**

Public response to energy systems technologies  
Cardiff University

## Partners



# Advisory Board

**John Scott (Chair)**

Director, Chiltern Power Ltd

**Prof Paul Beasley**

Head of R & D UK at Siemens

**Ben Burggraaf**

Energy Operations Manager at  
Dwr Cymru Welsh Water

**Dr Phil Clements**

Director of Technical, Tata Steel UK

**Dr Mike Colechin**

Director of Cultivate Innovation Ltd

**Prof Bill David**

Professor of Chemistry at  
the University of Oxford

**Ceri Davies**

Executive Director – Knowledge  
Strategy and Planning at  
Cyfoeth Naturiol Cymru /  
National Resources Wales

**Steven Edwards**

Director of Regulation & Commercial  
at Wales & West Utilities

**Robert Harper**

Gallium Nitride Programme Manager,  
Compound Semiconductor Centre

**Chris Harris**

Head of Regulation, NPower

**Roger Hey**

Future Networks Manager at  
Western Power Distribution

**Francis Griffiths**

CEO, Maiple Ltd

**Prof Ron Loveland**

Energy Advisor to the  
Welsh Government

**Dr John Newton**

Managing Director at ITM Motive

**Dr Iliana Portugues**

Head of Innovation for National Grid  
Electricity Transmission Owner

**Stephen Phillips**

Chief Executive at Neath Port  
Talbot County Borough Council

**Dave A Roberts**

Director of Smart Interventions,  
EA Technology

**Prof David Slater**

Honorary Professor, School of  
Engineering, Cardiff University

**Nick Smailes**

Head of Business Development  
at Energy Systems Catapult

**Mahesh Sooriyabandara**

Associate Managing Director at  
Toshiba Telecommunications  
Research Laboratory, Toshiba  
Research Europe Ltd

**Dr Mark Winskel**

Chancellor's Research Fellow  
on Energy Innovation, Science  
Technology and Innovation Studies,  
University of Edinburgh

**James Yu**

Future Networks Manager at  
SP Energy Networks

## FLEXIS in figures

Since our launch in 2016, FLEXIS has achieved the following highlights:

# £13,028,693

VALUE OF GRANTS AWARDED

68/86  
RESEARCHERS RECRUITED

# 106

GRANTS WON

# 186

CONFERENCES

# 454

SCIENTIFIC PAPERS  
PUBLISHED

# 50+

EVENTS

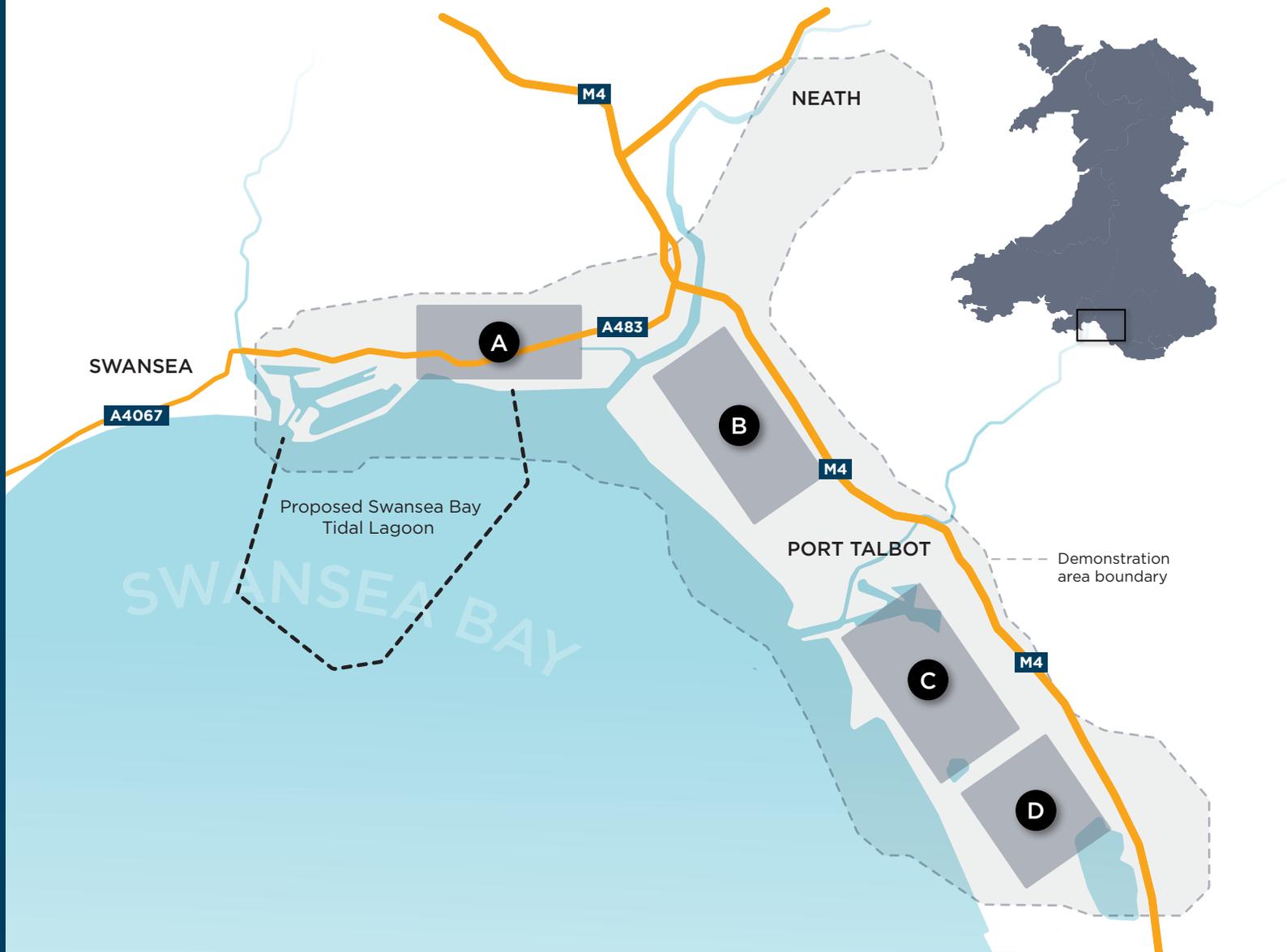
# 62

# 400

SOCIAL MEDIA  
FOLLOWERS

COLLABORATIONS WITH  
ENTERPRISES

# The FLEXIS demonstration area



- A** • Swansea University Bay Campus
- Water treatment works

- B** • Hydrogen Centre
- Council offices
- Paper mill
- Energy Park
- Gas fired power station
- Schools / Hospital
- Solar technology provider
- SPECIFIC Buildings as Power Stations

- C** • Tata Steel Port Talbot
- Cement works
- Water treatment plant with electrical generator

- D** • Gas Turbine Research Centre (Cardiff University)
- Biomass power station
- Gas & electricity networks
- Industrial gas & equipment supplier

# Demonstration area: Project Manager profile

We're delighted to welcome Rhys Bowley to the team.

## Why are you interested in the role?



Even though I'm an engineer and technical at heart, the social awareness and engagement with society highlighted as part of the FLEXIS project was a major selling point for me. Especially now that governments around the world are beginning to formally recognise a state of climate emergency, I wanted to work on a project that had realistic and meaningful benefits in the near-term, rather than something that might be decades away from commercialisation.

## Tell us about your engineering experience.

My seven years working at National Instruments (half in Austin, Texas and half in England before that) have been incredibly fun and rewarding. I'm really lucky to have experienced the full breadth of different research projects the company is involved with, through energy, automotive, aerospace, semiconductor, biomedical and 5G. Travelling the world with a major corporation has been an eye-opening experience and left me wanting to learn as much as possible about different places, people and cultures.

## What are your interests outside of work?

Aside from eating (too much) curry, my spare time is filled mostly with a mix of interests and playing computer / board games with friends. The biggest hobby right now is an obsession with rock climbing and I'm looking forward to making the most of the summer in the Brecon Beacons and across the South Wales coast.



# Demonstration area: setting things in motion

By Christopher Jones, Neath Port Talbot County Borough Council (CBC) Energy Manager and FLEXIS Technical Representative

We're delighted that the FLEXIS Programme has chosen to support Neath Port Talbot CBC, which will increase momentum for moving towards decarbonising the Council's service delivery and work activity, bringing valuable expertise and resource. For formal approval of the collaborative partnerships we signed a Memorandum of Understanding with FLEXIS at the end of 2018, which outlines traction projects we've formulated for consideration and development to assist our move towards a smart, low carbon and prosperous future:

1. Smart Low Carbon Town - Port Talbot (Smart Local Energy Systems)
2. Electrical Grid Constraints
3. Swansea Bay Technology Centre / USW Hydrogen Centre
4. Low Emission Vehicles / Electrical Charging
5. Cefn Coed Colliery Museum
6. Mine Water Heat Recovery
7. Real-time Energy Modelling
8. Air Quality

We're now working on the progression and development of these projects with a view to creating a programme plan for their effective implementation, inclusive of the submission of funding bids and creation of collaborative partnerships with other organisations.

A dedicated Neath Port Talbot CBC / FLEXIS project team is starting to materialise and will take further shape with the arrival of the FLEXIS demonstration area Project Manager who will be the lead for delivering the traction projects.

Progress on our real-time energy monitoring and modelling project is well underway with the FLEXIS Integrated Energy Supply Systems team already using our local authority energy data. We have had extensive input from the University of South Wales' Hydrogen team about using hydrogen generated from excess electricity to power vehicles from our new £7m Swansea Bay Technology Centre in Baglan Bay Energy Park. Significant progress has been made in relation to the Community Focused - Area Wide Air Quality Monitoring Programme with the project team currently writing the business case proposal. This project will also form part of the Smart Low Carbon Town initiative.

# Demonstration area: potential projects

Much effort and discussion has gone into scoping out potential FLEXIS demonstration area projects, which have formed the basis of the FLEXIS – Neath Port Talbot County Borough Council MOU.

## Integrated Energy Supply Systems

An energy audit of the demonstration area showing energy flows as a single node and the gas and electricity networks currently serving the area is being conducted, with the data stored in a secure database.

Using historical data at 30-minute resolution for electricity and hourly (calculated) resolution for heat, the team is in the process of acquiring gas data from Wales & West Utilities.

Potential projects include:

- Investigating peer-to-peer energy trading between large energy plants, exploring use of blockchain and other distributed ledger technologies.
- Providing flexibility to the power system from multiple energy sources, in particular, district heating, to investigate a solution to decarbonising heat.
- Integrating gas networks – looking at how to use gas networks to accommodate gases generated by Tata Steel’s Port Talbot Steelworks and other renewable gases.
- Investigating the flexibility of provision from multi-energy systems to assist the National Grid and Distribution Network Operator (DNO) in managing their networks.
- Looking at opportunities regarding community energy, especially local, integrated multi-vector systems and peer-to-peer at a domestic level.

## Flexible Power Plant

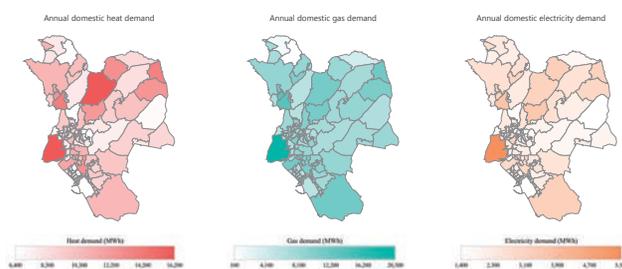
Potential projects include:

- Investigating safe limits of hydrogen and higher hydrocarbons in the gas grid. The variability of gas in the national grid will increase considerably in the future. The team could work with industry to establish safe operational levels of hydrogen or higher-hydrocarbons in liquified natural gas to ensure optimised efficiency of heat and power plant due to gas-grid variability. Cardiff University’s Gas Turbine Research Centre (GTRC) can employ advanced optical diagnostics to appraise and optimise the performance of commercial and developmental burners for flame stability and harmful emissions production.
- Designing and developing novel power-generation components utilising Additive Layer Manufacturing (ALM). ALM has the potential to revolutionise the heat, power and propulsion sectors through its capability to expand the potential of manufacturing complex, materials and structures. New designs and direct appraisal of performance can be undertaken through the controlled, optical facilities at GTRC, which would cut development costs and timescales, leading to a paradigm shift in new gas turbine technologies. Current partners include HIETA and Renishaw.

## Energy Storage to Power

Potential projects include:

- Developing an integrated wind-power to ammonia storage to power, demonstrator, building on the success of the world-first green energy pilot developed with Siemens and Oxford University at the Rutherford Appleton Laboratory in Harwell, Oxfordshire in 2018. This could use excess renewable supply and/or waste ammonia from Tata Steel’s Port Talbot Steelworks as an energy storage medium in the Neath Port Talbot region. The current 20kW demonstrator power output would need to be increased by 1-2 orders of magnitude, possibly demonstrating operation with alternative technologies such as gas turbines, thereby increasing the range of application. This would require industrial partners, alongside the redesign of engine components, with the possible use of additive manufacture technologies to develop new, ammonia-specific burners.
- Utilising hydrogen for fossil-fuel replacement in industrial and/or domestic heat. A demonstration project could be developed from the current desktop Hy4Heat industrial review. This would map tolerable H2 levels in process gas and natural gas supply in conjunction with scenario modelling to predict likely ranges in concentration.



Intensity maps showing annual demand for heat, gas and electricity in Neath Port Talbot CBC



At the £1.5m world-first green ammonia demonstrator in Harwell

## Carbon Capture and Storage - Integrated Power & Alternative Fuels

Potential projects include:

- Reducing or eliminating flaring at Tata Steel's Port Talbot Steelworks. Taking a current FLEXIS - Tata Steel Port Talbot project further to assess the increased use of BOS and blast furnace gas enrichment for process utilisation rather than flaring. A wider range of by-product gases can be utilised to fuel process operations at the Tata power station, which would lead to improved efficiency, a lower carbon footprint and the reduced production of harmful emissions.
- New international explosive area classification standards for storage and transportation of high-flashpoint fuels and their mitigation. Ongoing work at the Gas Turbine Research Centre (GTRC) aims to develop practical guidelines applicable to all power and industrial process plants.
- Developing European standards for environmental emissions (NO<sub>x</sub>, CO, PM) and performance of aero-engines using alternative fuels. GTRC has designed and built the EU reference systems for particulate (PM) emissions from aircraft with funding from EASA and Rolls-Royce. Ongoing and future studies will assess the emission performance of aero-engines utilising various alternative fuels.
- Novel industrial carbon capture and storage (CCS) cycles. This is aimed at long term future ultra-low carbon ironmaking as an alternative to the blast furnace.
- Enhancing performance of carbon capture technology in industry and power sectors.



Cardiff University's Gas Turbine Research Centre (GTRC)

## Hydrogen Energy Storage

Potential projects include:

- Working with Neath Port Talbot CBC on the development of the new Swansea Bay Technology Centre at Baglan Energy Park (see p9).
- A novel wind turbine, PV integrated energy supply and balancing system demonstration. The proposal is to demonstrate the novel, robust and efficient CrossFlow Energy wind turbine, together with local PV and a hydrogen energy balancing system in Port Talbot. This combination would be demonstrated for immediate industrial use, but is also relevant to industry, power and water provision for remote communities, military compounds and for disaster relief.
- In response to UK Government programmes, the University of South Wales (USW), Cardiff University, Tata Steel Port Talbot and Wales and West Utilities are developing proposals for the use of hydrogen for domestic, commercial and industrial heat in Margam. This has the potential to be a major demonstration as hydrogen for heat in the UK.
- A new demonstration facility for testing new fuel cell stack configurations for automotive and stationary power application, integrated with existing hydrogen systems at the USW Hydrogen Centre, Baglan.
- Assisting with the Y Bryn project which seeks to use the Penhydd and Bryn forest blocks for renewable energy generation with potential hydrogen linkage.

## Sustainable Production and Purification of Hydrogen, Syngas, BioH<sub>2</sub>, BioCH<sub>4</sub>

Potential projects include:

- Renewable hydrogen and oxygen product off-take with potential supply for Welsh Water, for waste minimisation and displacement of diesel fuels for transport.
- Expansion of a small pilot plant for biological production of green chemicals from CO and CO<sub>2</sub> which is currently being developed to utilise these gases from steelmaking.
- A hydrogen purification / recovery test facility using gas arising from steelworks – a demonstrator which aims to enhance and capture hydrogen available in gas arising from steelworks, particularly coke-oven gas and blast furnace gas.
- Extending the range of feedstocks for an integrated biorefinery for the production of biohydrogen and either platform chemicals or biomethane, using a small pilot at the University of South Wales.
- A further potential development, subject to funding, would be a pilot to investigate the water gas shift of blast furnace gas to enhance hydrogen production and convert CO to CO<sub>2</sub> enabling carbon capture and storage. This would be of significant impact to the region.



Site of the new Swansea Bay Technology Centre

# Demonstration area: potential projects

## Hydrogen and Syngas: Efficient Use

Potential projects include:

- The University of South Wales (USW) are working with the Welsh Government and Neath Port Talbot CBC on the development of the Centre of Rail Excellence in the Dulais Valley on the Neath Port Talbot – Dulais border. USW have advised on the potential to deploy hydrogen train refuelling on the site in order to test new fuel cell rolling stock, thereby creating a unique facility in the UK.
- USW is also in discussion with Transport for Wales to consider future deployment of fuel cell trains as a lower carbon alternative to overhead electrification.
- Power generation and heat recovery from biomass with advanced CO<sub>2</sub> thermodynamic power cycles. USW are installing a small-scale biomass power generation demonstrator with advanced CO<sub>2</sub> supercritical/transcritical power cycles at the Baglan Hydrogen Centre.
- A high pressure hydrogen component development and test rig, part-funded by Innovate UK, which will enable demonstration of the safety and functionality of high pressure hydrogen components with industry partners.



Hydrogen Centre (University of South Wales)

## Smart Thermal Energy Grid

Potential projects include:

- Based on the successful demonstration of the viability of using mine water as a local heat source at Llwyn-Lanc Uchaf farm in Crynant village, Cardiff University's Sustainable Earth Energy team is working with Neath Port Talbot CBC to scale up the experience and evidence base data from a single building into a community-scale, district heating scheme. The demonstrator currently comprises a 30kW heat pump and two 65m boreholes which meet all of the heating and hot water demands of a large farmhouse, farm workshops and adjoining physiotherapy centre in the Dulais Valley.
- Sharing the practical experience and skillset gained while working on Bridgend's Upper Llynfi Valley Heat Network Project funded by the Heat Networks Delivery Unit and the Intelligent Bridgend Energy Systems Design (funded by Innovate UK's Industrial Strategy Challenge Fund).
- Contributing to the development and design of the integration of the energy vectors (heat, power and transport) to make the renewable energy system more efficient and economical.
- Working with industrial partners to explore and demonstrate the use of heat pump technology more innovatively within the FLEXIS demonstration area to de-risk the decarbonisation of heat energy. The work has particular focus on a multi-faceted and integrated approach to energy that encompasses renewable generation, energy efficiency and the electrification of heat.



Crynant mine water site

## Unconventional Gas

The geochemistry and hydrogeology of the South Wales coalfield within the demonstration area have been investigated representing the baseline data for any future industrial exploration or development activities. This expanded current knowledge of the local geology of the area, hydrogeology and surface environments.

Potential projects include:

- Providing further understanding of the gas and water migration in the coal seams for potential coal bed methane (CBM) extraction in a reliable and sustainable way from coal deposits, potentially in the vicinity of the Tata Steel Port Talbot site. The results would be used to improve the efficiency of the steel-making processes by considering the utilisation of the gases extracted and their integration into the overall process, with potential savings available for both fuel cost and emissions.
- Demonstrating the potential of utilising the existing coal resources within the demonstration area through underground coal gasification (UCG) technology. A bespoke high pressure Simultaneous Thermal Analysis (STA) system can provide gasification-related energy and environmental data demonstrating the relevance of ex-coal mining regions for application of low emission, clean, coal energy technologies. Findings from MEGAPlus - a Research Fund for Coal and Steel (RFCS)-funded project (£2.9m) - to evaluate the use of deep-lying European coal deposits for utilisation of CBM-UCG technologies with Tata Steel UK can be used in the potential demonstration projects.

## Carbon Sequestration in Coal and Soil

Potential projects include:

- Pilot testing of CO<sub>2</sub> sequestration in coal to establish the storage potential of the region's remaining coal deposits. This project is seen as particularly relevant to South Wales and other similar regions around the world that lack easy access to the more conventional CO<sub>2</sub> storage reservoirs. It is proposed that coal seam storage can at least reduce the amount that needs to be shipped and so contribute to the plans of the emergent South Wales carbon capture, utilisation and storage (CCUS) cluster.
- A field trial using perennial grass and fungal mycelium to estimate soil carbon sequestration potential and enhance the storage of recalcitrant carbon in short rotation energy cropping. A site of non-arable or abandoned land within the FLEXIS demonstration area is preferred to broaden the scope of the project towards soil regeneration and to collocate the trial with energy and CO<sub>2</sub> intensive industry.

## Geoinformatics and Environmental Monitoring

Potential projects include:

- An agreement in principal is in place with Neath Port Talbot CBC to gain access to their spatial data repository. There are approximately 1000 different GIS layers in this resource covering a wide range of domains. The Cardiff University-based Sustainable Earth Energy team plans to mine this big spatial data with the aim of uncovering useful information to help the Council make informed decisions. This evidence-based, decision-making can be used to map the future energy outlook, environmental improvement, business generation, job creation and socio-economic uplift of the area.
- Assisting with other geoinformatics studies across the demonstration area including baseline monitoring, resource mapping and spatial planning of future smart energy infrastructure.
- 3D GIS modelling with mixed reality to visualise future energy infrastructure within the demonstration area for public outreach and acceptance.

## Carbon Capture and Utilisation

Potential projects include:

Swansea University's Energy Safety Research Institute (ESRI) is working with Apache Corporation to assist in the development of a Pressure Swing Adsorption (PSA) System called BECAUSE (Bespoke Carbon Separation). The system will be flexible to allow testing of a wide range of emissions, a range of adsorbents, and process conditions.

Potential projects include:

- BECAUSE will be provided as a resource to all industries with Wales, including within the demonstration area. Each industry can share their low, high and average emissions from any source, and BECAUSE determines the optimum conditions and range required to separate the CO<sub>2</sub> (and other desired gases) from the particular flue stream. This data will be provided to the industry to keep as their own IP. The industry can then use this bespoke IP to design individual systems for their own needs. This will save time and investment in refining systems to meet industry needs without significant post-installation development, therefore saving costs in the implementation of carbon capture.



Swansea University's Energy Safety Research Unit (ESRI)

# Demonstration area: potential projects

## Energy Vectoring Through Hydrogen

A catalyst able to convert CO<sub>2</sub> to ethylene, a precursor to many large-scale products like plastics, surfactants, detergents has been developed by Swansea University's Energy Safety Research Institute (ESRI). Work is underway to improve the performance and scale of this catalyst in parallel to designing electrolysers to optimise ethylene production, including other chemicals.

Potential projects include:

- The scaling up of the catalysts through new collaborations with partners with expertise in industrial electrolysis, such as Siemens and De Nora, in the demonstration area.

The goal is to integrate new CO<sub>2</sub> conversion technologies expanding the CO<sub>2</sub> utilisation capabilities of the area beyond the biorefinery approach.

## Environmentally-Friendly Electrical Power Plant & Insulation

Potential projects include:

- A demonstrator in the form of a video or graphics showing changes that could be brought in by gas insulated systems. These will include gas insulated substations to replace existing air insulated substations which require large land footprint and gas insulated lines to replace overhead lines and cables in specific areas to minimise visual impact. The added environmental benefit of using new environmentally-friendly gases and their application could be described, with the potential to link in future to a laboratory and substation setup.

## Social Acceptability and Responsible Development of Energy Systems

The Cardiff University-based social science team is undertaking original, empirical research in three areas linked to specific demonstration projects in Neath Port Talbot and other parts of the West Wales priority area.

Current project:

- Communities, Energy Controversies and Risk Governance. Community workshops are underway in Neath Port Talbot, working in collaboration with Tata Steel Port Talbot and Neath Port Talbot CBC, with involvement from the Energy Saving Trust and National Energy Action.

Outcomes:

1. Identify potential areas of controversy and possible unintended consequences of proposed energy technology developments in the Neath Port Talbot demonstrator area.
2. Provide a nuanced understanding of what issues, whether energy-related or not, matter to people within Neath Port Talbot (e.g. air quality and other environmental concerns, community resources, local employment etc.).
3. Identify key priorities for future energy research, or how subsequent developments in the demonstrator area might be enhanced in ways that benefit local people, through social intelligence gained from the workshops.



Prototype of a textured insulator



The St Paul's Centre, Port Talbot, one of the venues of the FLEXIS community workshops

## Smart Energy Management

Potential projects include:

- Power quality monitoring of the demonstration area to assess the level of harmonics and other disturbances such as voltage fluctuations. Power quality meters could be installed at different voltage levels and various locations across the transmission and distribution system to monitor different types of customers (industrial, residential and commercial). Power quality measurements will result in a better understanding of the quality of electricity supply in the region, and if issues are identified, this could lead to other projects investigating mitigating solutions.
- A study of the impact of renewables in the demonstration area.
- Deployment of energy storage in the demonstration area. Currently, the South Wales export capacity at peak generation is curtailed due to transmission limits. Therefore, one aspect to investigate could be optimal sizing and placement of energy storage to minimize the cost, size and impact on power systems operation. This would tie in well with other FLEXIS work investigating energy storage.
- Energy storage in the form of using batteries from EV as 'distributed storage'. The feasibility of this option depends on the number of EVs expected to be used in the demonstration area.



Tata Steel's Port Talbot Steelworks

# Demonstration area: community workshops and office space

## FLEXIS runs workshops with Port Talbot community

The FLEXIS Social Science team have started running a series of linked interviews and workshops aimed at providing social intelligence on how future changes to energy infrastructures in Port Talbot might impact on communities.

Facilitated by members of the Social Acceptability and Responsible Development of Energy Systems work stream, the workshops will use four possible

‘whole energy system’ future scenarios to stimulate discussion with members of the public.

They will explore with participants how everyday life may change with a decarbonised system and document their findings.

The results will be fed back to other FLEXIS colleagues, in all likelihood in the form of responsible innovation, intended to help demonstrator projects

avoid risks and enhance the value to project stakeholders including the wider community.

## FLEXIS heads west

Our new office space in Baglan Bay Innovation Centre is up and running. As well as being home to demonstration area staff, the space has hot-desking and meeting room facilities for any team members requiring short stints in Port Talbot.

Facing the University of South Wales’ Hydrogen Centre, we’re sure that this location will prove useful for our demonstration area work.

Address: Room 28A, 3rd Floor, Baglan Bay Innovation Centre, Baglan Energy Park, Central Avenue, Port Talbot, SA12 7AX.



Prof Karen Henwood and Dr Christopher Groves at the first Energy Futures workshop



Baglan Bay Innovation Centre, Port Talbot

# FLEXIS inspires South Wales Industrial Cluster

At FLEXIS' inception, Chris Williams of Tata Steel Port Talbot was seconded to the project. Through Chris' involvement in devising the FLEXIS demonstration area and the project's regional modelling approach, Chris began to visualise how FLEXIS could help Tata's Port Talbot plant with de-risking decarbonisation.

Exploration into hydrogen, carbon capture and utilisation and waste heat recovery as well as the possibility of working with other industries around Wales gave rise to the idea that industry can be part of the solution and not just part of the problem.

Chris said: "Following this I got involved in the Royal Society's sustainability programme, initially for exploring the use of CO<sub>2</sub>. Through those events we started to become involved in the UK Government's Clean Growth programme."

The UK Government's Clean Growth Strategy identified the need for the creation of industrial clusters, which group together significant CO<sub>2</sub> emitters, particularly for industries such as steel, cement, oil and chemicals which face challenges in decarbonising.

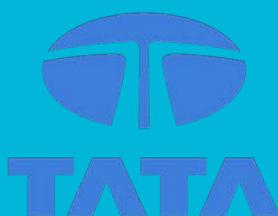
Industrial clusters already existed in St. Fergus and Grangemouth in Scotland, and in Teesside, Humberside and Merseyside in England, each with a different focus – for example, the Scottish cluster has the key North Sea gas terminal and potential access point for CO<sub>2</sub> storage.

Chris seized the opportunity to start a South Wales cluster, canvassing opinion from different companies and extolling the benefits of one voice for industry as well as the potential UK Government funding opportunities for developing energy efficiency and decarbonisation. At the kick-off meeting held in January 2019, representatives of 28 companies attended from the industrial, energy and academic sectors. Natural Resources Wales and the National Farmers Union Cymru have since also entered the mix.

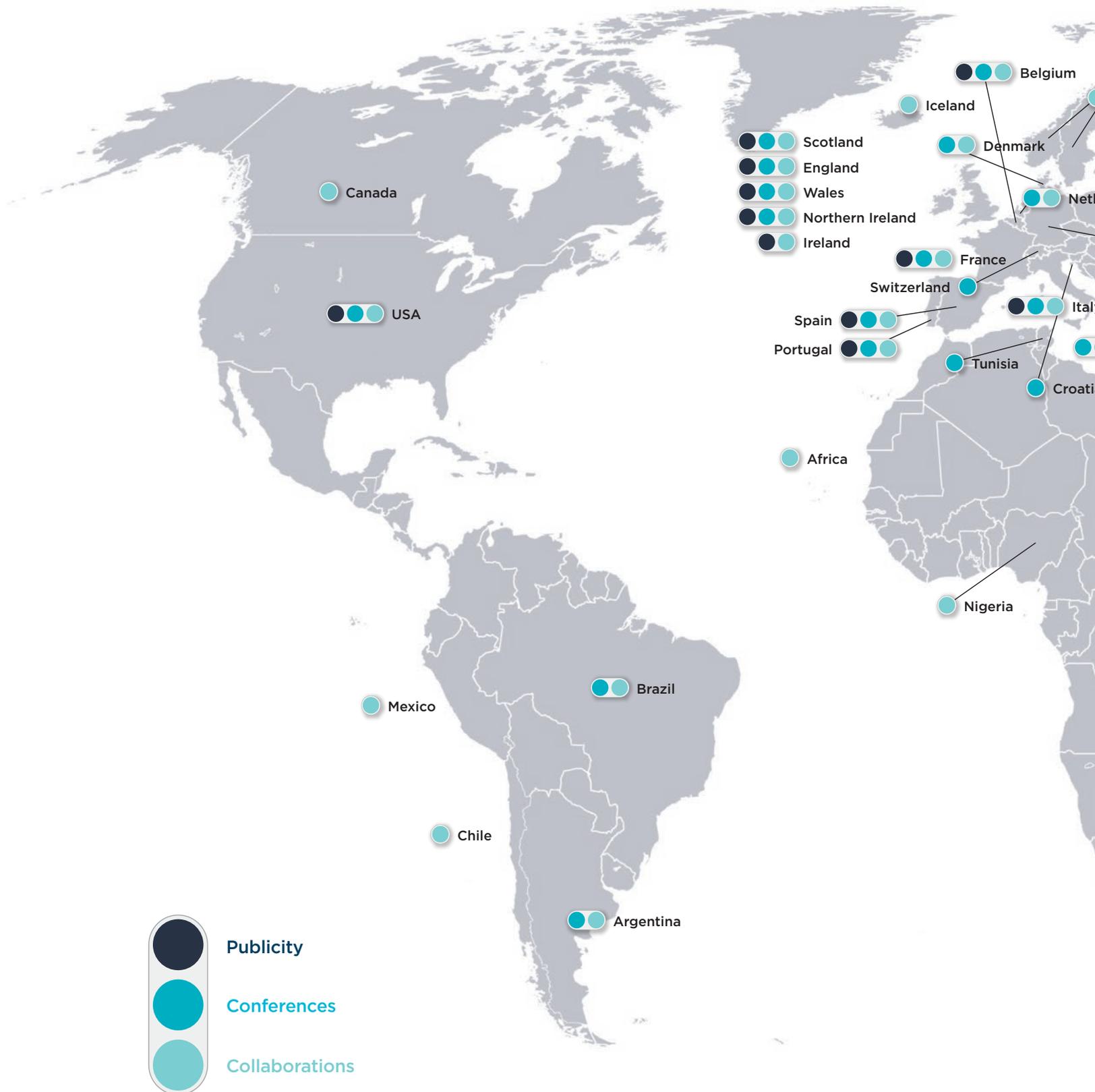
In support of the Cluster, National Grid have sponsored an overview report by consulting firm Progressive Energy, which will start to explore what South Wales could look like in 2050 in a decarbonised world. The report will feed into their distribution networks planning.

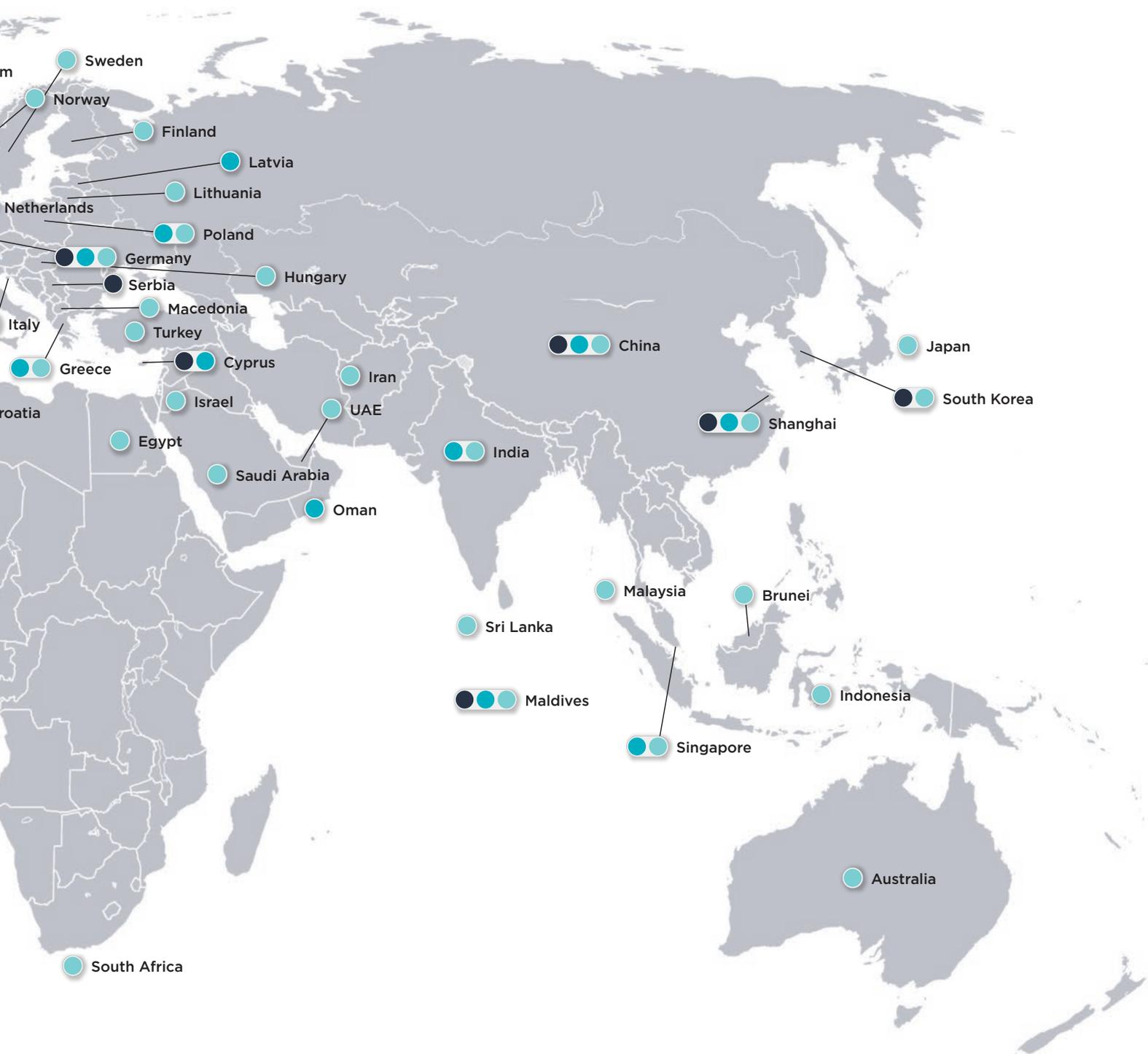
With the objective "to develop a world-leading, truly sustainable Industrial Cluster befitting the societal needs of 2050 and beyond", the South Wales Cluster is now in talks with the North West Cluster to offer the UK Government an attractive and speedy option for reducing CO<sub>2</sub> emissions.

Chris says that momentum is picking up through work with the Welsh Government on their decarbonisation programmes. The next step is to define a vision for the Cluster before developing its roadmap, demonstrators, incentives and policies to make that vision a reality.



# International engagement





## News of note

FLEXIS formed part of the official UK delegation and hosted a workshop on 'Derisking Decarbonisation of Industry-Intensive European Regions' at the 24th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP24) in Katowice, Poland, in December 2018.

A £1.5m world-first green energy system using ammonia as an energy storage system opened in July 2018. FLEXIS researchers worked alongside Siemens, Oxford University and the Science and Technology Facilities Council to create the brand new system which generates power when required, while storing energy in the form of ammonia when demand for, or price of, electricity is low.

Through FLEXIS, Cardiff University's Gas Turbine Research Centre will play a major role in an EPSRC Centre for Doctoral Training in Resilient Decarbonised Fuel Energy Systems in partnership with the universities of Nottingham and Sheffield.

Prof Alan Guwy, Professor of Energy and Environment and Head of the Sustainable Environment Research Centre at the University of South Wales, has been elected as a Fellow of the Learned Society of Wales for his contribution to the world of learning as a researcher, academic and professional.



24th Conference of the Parties to the United Nations Framework Convention on Climate Change



Launch of the green ammonia power demonstrator at the Rutherford Appleton

## Our stakeholders include:

3M	Electronic Systems Design Centre (ESDC), Swansea University	Loughborough University	Swansea Bay City Deal
ABB Group	Energy Systems Catapult	Low Carbon Swansea Bay	Swansea University
Akzo Nobel	Energy Saving Trust	Materials Processing Institute	Tampere University of Technology
Airbus	Engineering and Physical Sciences Research Council (EPSRC)	Minister of State for Climate Change and Industry	Tata Steel UK
Amazon	Energy Technologies Institute (ETI)	National Grid	Tecnalía
Bangor University	Future Generations Commissioner for Wales	National Physical Laboratory (NPL)	The Behavioural Insights Team
BIS Group	Global Challenges Research Fund (GCRF)	Neath Port Talbot County Borough Council	Tianjin University
Bridgend County Borough Council	General Electric (GE)	Natural Environment Research Council (NERC)	Tidal Lagoon Power
BP	Gexcon AS	Newcastle University	Torfaen County Borough Council
Calon Energy Baglan Bay Power Station	Grid Solutions	Port of Milford Haven	Toshiba
Carbon Conversations	GW4 Alliance (Bath, Bristol, Cardiff & Exeter Universities)	Port Talbot Waterfront Enterprise Zone	TNEI
Cardiff County Borough Council	Honeywell	Power Networks Research Academy (PNRA)	UCL (University College London)
CCS (Carbon Capture & Storage Association)	Indian Institute of Technology Roorkee	Ofgem (GB Electricity Distribution Network)	UKCCS Research Centre
Celsa Steel UK	Initiative for Managing Policymaker-Academic Cooperation and Transfer (IMPACTT), Swansea University	Queen's University Belfast	UK Energy Research Centre (UKERC)
Centre for Radiation, Chemicals and Environmental Hazards (CRCE), Public Health England	Imperial College	REHAU	UK Power Networks
CIIIA (Centro de Investigacion e Innovacion en Ingenieria Aeronautica), UANL (Mexico)	Innovate UK	Renishaw	UK Research and Innovation
Climate Change, Environment and Rural Affairs Committee, National Assembly for Wales	Institute of Electrical and Electronics Engineers (IEEE)	Rhondda Cynon Taf County Borough Council	Uniper SE
Compound Semiconductor Centre	Institute of Welsh Affairs	Ricardo plc	University of Bath
Cranfield University	Council on Large Electric Systems (CIGRE)	RICE	University of Bristol
Cyfoeth Naturiol Cymru / Natural Resources Wales	Integral	Riversimple	University of Edinburgh
Department for Environment, Food & Rural Affairs (UK Government)	Intellectual Property Office	RMIT University	University of Leeds
Department for Business, Energy & Industrial Strategy (UK Government)	International Energy Agency (IEA)	Rolls-Royce	University of Manchester
Department for Transport (UK Government)	ITM Power	Royal Society	University of Nottingham
DNV GL	Jaguar Land Rover	RRI Tools	University of Reading
Dwr Cymru Welsh Water	Khalifa University	RWE nPower	University of Sheffield
EA Technology	Kingsmill Industries (UK) Ltd	Schneider Electric	University of Southampton
EERA (European Energy Research Alliance)	KU Leuven	SSE plc	University of Strathclyde
eCORP International, LLC	Lancaster University	SP Energy Networks	University of Warwick
Ecole Centrale de Lyon	Life Sciences Hub Wales	SER Cymru II	Virgin Atlantic
	Liverpool John Moores University	Severn Trent Water	Wales Council for Voluntary Action (WCVA)
	Local Partnerships LLP	Shell	Wales and West Utilities
		Siemens	WEFO (EU funds in Wales)
		SINTEF	Welsh Government
		SPECIFIC Buildings as Power Stations	Westminster Energy, Environment and Transport Forum
		SP Energy Networks	Western Power Distribution
		Stainless Metalcraft Ltd	WRAP Cymru
		Supergen Bioenergy	ZF



