

FLEXIS

SMART ENERGY FOR OUR FUTURE
YNNI CALL AR GYFER EIN DYFODOL

Advisory Board Report

May 2022



UNDEB EWROPEAIDD
EUROPEAN UNION



Llywodraeth Cymru
Welsh Government

**Cronfa Datblygu
Rhanbarthol Ewrop
European Regional
Development Fund**

**CARDIFF
UNIVERSITY**

**PRIFYSGOL
CAERDYDD**



**Swansea University
Prifysgol Abertawe**

**University of
South Wales
Prifysgol
De Cymru**

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Foreword



Prof Hywel Thomas



It is my pleasure to welcome you to the third Advisory Board meeting of the FLEXIS Extension. We are now some 15 months into the two-year extension and as such, well into the second half of the delivery phase of the project. It's a particular pleasure of course to welcome you to our first "face to face" meeting since the pandemic.

I would like first of all to welcome three new member to the Board, namely Nicola Todd from National Grid, Henry James from Wales&West Utilities, and David Jukes from Costain Ltd. Further details of Nicola's, Henry's, and David's backgrounds are included in this report, and I am sure you can see that their experience will add enormously to the work of the Board. We have benefitted significantly from the contributions of the previous members from National Grid, Wales&West Utilities, and Costain.

This meeting is dedicated to presentations and discussions of a number of projects. During the first session of the day we will consider the Wales Net Zero Programme, including the outcome of the Deep Dive into Renewable Energy; the South Wales Industrial Transition from Carbon Hub (SWITCH) and the data work being carried out. The second session is devoted to a discussion related to the Cardiff Capital Region.

In December 2021, the Welsh Government published a report summarising the recommendations of the "Deep Dive into Renewable Energy" exercise led by the Deputy Minister for Climate Change, Lee Waters.

The work of the Deep Dive Group originated from the Welsh Government's earlier work on Net Zero Wales published before COP26. The aim of this work was to identify barriers to significantly scaling up renewable energy in Wales, and identify steps to overcome the barriers. The group looked at short-, medium-, and long-term steps with a particular focus on retaining wealth and ownership in Wales. The vision of the group is for Wales to generate renewable energy to at least fully meet Welsh energy needs and utilise surplus generation to tackle nature and climate emergencies.

The South Wales Industrial Transition from Carbon Hub (SWITCH) is the successor programme to FLEXIS, currently under development. It brings together FLEXIS expertise with other major projects such as SPECIFIC. Through international standard decarbonisation research and innovation, SWITCH will deliver novel low carbon and net zero products, thus generating and supporting high value, highly skilled jobs.

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.

Principal Investigators

Prof Hywel Thomas

Lead Principal Investigator and PI of Sustainable Earth Energy

Cardiff University

Prof Dave Worsley

Mobile Energy Stored as Heat Research Programme (MESH)

Swansea University

Dr Aleksandra Koj

Project Manager

Cardiff University

Prof Manu Haddad

Alternative environmentally-friendly gas for electrical networks insulation

Cardiff University

Prof Nick Jenkins

Network and grid integration of renewables; low carbon energy infrastructure in Wales

Cardiff University

Prof Nick Pidgeon and Prof Karen Henwood

Public response to energy systems technologies

Cardiff University

Prof Alan Guwy

CymruH2Wales2 Hydrogen and fuel cells

University of South Wales

Prof Paul Meredith

Semiconductors for Clean Energy System and Efficient Electronics

Swansea University

Prof Phil Bowen

SMART-POWER: enabling integrated energy systems

Cardiff University

Partners



Advisory Board

Dr Mike Colechin (Chair)

Director of Cultivate Innovation Ltd

Prof Paul Beasley

Head of R & D UK at Siemens

Paul Brodrick

Business Development
Director at Siemens plc

Eric Brown

Chief Technology Officer at
Energy Systems Catapult

Martin Brunnock

Communication and Public
Affairs Director at Tata Steel UK

Ben Burggraaf

Energy Operations Manager
at Dwr Cymru Welsh Water

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

Steve Edwards

Commercial Director at Milford
Haven Port Authority

Francis Griffiths

CEO, Maiple Ltd

Robert Harper

Gallium Nitride Programme
Manager, Compound
Semiconductor Centre

Chris Harris

Visiting Industrial Fellow
at Bath University

Richie Hart

Process Technology Manager at
Tata Steel UK

Roger Hey

Future Networks Manager at
Western Power Distribution

Henry James

Net Zero Project Manager
(Industrial Clusters) at
Wales&West Utilities

Karen Jones

The Chief Executive of Neath Port
Talbot County Borough Council

David Jukes

Programme Director at Costain

Dr Martin Kenny

Sustainability Director for Tarmac

Prof Ron Loveland

Energy Advisor to the
Welsh Government

Dr John Newton

REFHYNE Project Manager
at ITM Power

Tony Parton

Managing Director of CR Plus

Nicola Pearce

Corporate Director of Environment
and Regeneration at Neath Port
Talbot County Borough Council

Steven Phillips

Independent Consultant

Martyn Popham

Managing Director at Cenin Group

Dave A Roberts

Technical Director, EA Technology

Prof David Slater

Honorary Professor, School of
Engineering, Cardiff University

Mahesh Sooriyabandara

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

Dr Chris Williams

Head of Industrial Decarbonisation
at Industry Wales

Nicola Todd

Head of Strategy and
Innovation at National Grid

New Members

FLEXIS extends a warm welcome to the following new members of the advisory board:



Nicola Todd

Nicola joined National Grid in 2013 on their Graduate programme following completion of her Masters Degree in Electrical and Mechanical Engineering at the University of Strathclyde. She started her career as a Power Systems Engineer undertaking network analysis and design for supply and demand connections to the Electricity Transmission System. Since then she has held multiple roles across National Grid's Electricity Transmission (NGET) business including delivering the legal separation of the Electricity TO and SO businesses, Executive Assistant to the Director of NGET and leading a team of Engineers accountable for the development of strategic

infrastructure projects to facilitate future power flows across the electricity transmission system. In October 2021, Nicola took up the role of Head of Strategy and Innovation for NGET and is accountable for NGET's business, asset and network development strategies to deliver the net zero transition, as well as delivering a portfolio of innovation projects to support our decarbonisation ambitions. Nicola also leads the Deeside Centre for Innovation, the first of its kind in Europe where electricity network assets can be tested under real life conditions, 24 hours a day, seven days a week.



Henry Jamet

Henry James is Wales & West Utilities' Net Zero Project Manager for Industrial Clusters. He is responsible for delivering the company's contribution to industrial cluster projects like the South Wales Industrial Cluster, including infrastructure development and modelling support.

Henry joined Wales & West Utilities as a Graduate Mechanical Engineer where he completed the Graduate Development Programme.

He has since worked to deliver Capital Delivery projects before joining the newly formed Net Zero team in June 2021. Henry now plays a key role in collaborating with industrial gas users to initiate projects which explore how the gas network of the future will decarbonise industry.

New Members



David Jukes

David is a Programme Director for Costain Ltd and the lead for Costain's decarbonisation work in Wales. He heads the Lead Partner role on the Industrial Strategy Challenge Fund (ISCF) Industrial Decarbonisation Challenge (IDC) South Wales Industrial Cluster (SWIC) Deployment project. o Lead COGAP's Lead Partner role on the Industrial Strategy Challenge Fund (ISCF) Industrial Decarbonisation Challenge (IDC) South Wales Industrial Cluster (SWIC) Deployment project.

Other projects under David include the Welsh Local Government Association, Transition and Recovery Support Programme (TaRSP) Framework, set up to help the 22 LA's in Wales comply with the commitments in the Welsh Governments Net Zero Wales Carbon Budget 2. He also leads Costain's involvement in the Ofgem funded Resilience as a Service (RaaS) project.

A Chartered Engineer and Chartered Environmentalist, David joined Costain in April 2000 working in the Highway and Rail Sectors. He is currently working in the Energy Sector following a period working on Nuclear Civil and Defence contracts.

David also holds roles as: Cardiff University School of Engineering, Industry Advisory Group Member, EPSRC funded Decarbonisation of Transport through Electrification (dte. network/) Advisory Board member, Future Generations Leadership Academy, Advisory Board member, Steering Board member of HyCymru / Wales Hydrogen Trade Association, Cardiff Capital Region (CCR) Energy Strategy, Strategic Steering Group member, South West Wales Energy Sub-Group - Advisory Panel member, Welsh Government South Wales Industrial Cluster Steering Group member.

IMPACT

CREATING RESEARCH CAPACITY
AND CUTTING CARBON EMISSIONS



UNDAE EWROPEAID
EUROPEAN UNION



Llywodraeth Cymru
Welsh Government

Cronfa Datblygu
Rhanbarthol Ewrop
European Regional
Development Fund

INVESTMENT

£38,155,033

Generated in **grant income**



120x
research
grants

£31,815,940



40x
industrial
grants

£6,339,093



10x

grants **over £1m**



£2.4m

investment in
**equipment
and technology**

46.1% success
rate

162 grant awards out of 351 bids

PARTNERSHIPS



281

**industrial
collaborations**



181

**academic
collaborations**

PEOPLE



166
employees

119 researchers
recruited



44

Academics on
the project



Professional
associations and
memberships/chairs
of profs connected
to FLEXIS

50+



60+

PhD students
associated
with FLEXIS
research
themes



9 GoWales
work placements

PERFORMANCE

622

papers
published



100+

research projects
underway



263

conferences
attended



New Starters

We're delighted to welcome FLEXIS Communication Officer, Sam Jones, to the team.



Sam Jones

What is your role at FLEXISApp?

My role as the communications officer is to make sure the story of FLEXIS is being told to the public and other stakeholders.

This involves using the website, social media and other publicity channels such as video content to highlight the impact, achievements and ongoing work of the project. I split these responsibilities between the work on the FLEXIS project and FLEXISApp.

What attracted you to this role?

This role appealed to my motivation to use the skills and experience I've developed in communications and digital media in service of something that contributes to my community and my society. FLEXIS is a fantastic expression of this, an example of collaboration and innovation being used to take on the challenges associated with getting Wales to decarbonize and allow us a more sustainable relationship with the environment. It has been very exciting to learn about the developments in technologies, to see the industrial collaborations and have the chance to write about a subject that has an impact on all of us.

What are your interests outside of work?

My main interests outside of work are hillwalking, trying new craft beers and playing and producing music. I recently got my hands on a new Fender Nashville Telecaster which I often pick up and noodle on while on my lunch break while we've been working from home!

New Starters

We're delighted to welcome Project Development Officer (WP1), Sian Allister, to the team.



Sian Allister

What is your role at FLEXISApp?

I'm a project development officer for the FLEXIS Integrated Energy Supply Systems work package and am responsible for providing full project support for all project activities within this work package. The research undertaken in this work package investigates how low carbon and flexible energy solutions can be developed to be used by businesses and within people's homes.

Working closely with Professor Nick Jenkins and the team in CIREGS, I help to develop and manage research within the work package, monitor the budgets and provide financial support to work package members, recruit staff, and work with a wide range of stakeholders to ensure key objectives are completed to deadlines. I project manage a number of different projects awarded under the FLEXIS programme.

What attracted you to this role?

It is hugely rewarding to work in such an important area of research, and within a consortium that strives to make an impact in energy systems research in Wales. I have worked in academia for several years in operational management and wanted to take on a new challenge moving into project management, so this role seemed like the perfect opportunity.

Since starting this role, I have enjoyed the chance to work in a new area learning new skills to support my work. I enjoy working with a dynamic team of academics supporting their research, which makes my role interesting and full of variety. I also like multi-tasking which is a key aspect to this role!

What are your interests outside of work?

I love getting out and about and visiting new places with my family and walking my dog. I am especially fond of the Pembrokeshire coastline and enjoy camping trips and walks in that area. I like to cycle (when the weather is good!) and investigate new areas of Cardiff on two wheels.

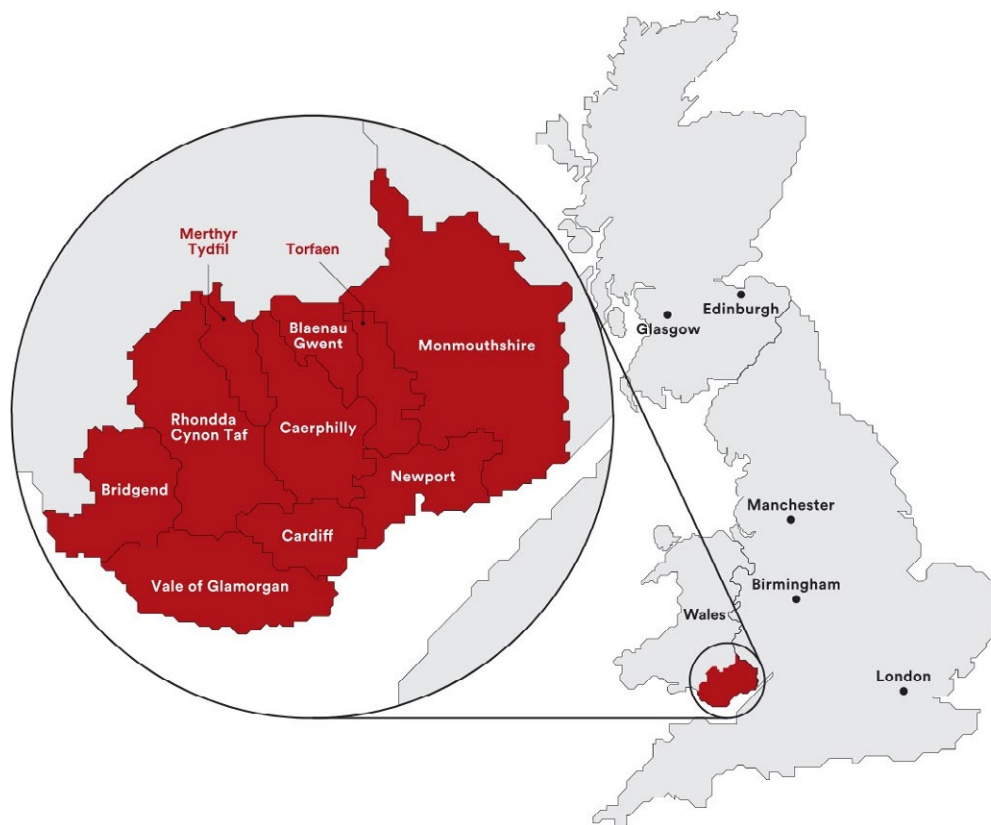
Finding a new coffee stop is always appreciated on these trips. I am also trying to read more and enjoy the challenge of discovering different types of fiction with my book club.

Cardiff Capital Region & FLEXIS



FLEXIS team is delighted to introduce its new strategic partner Cardiff Capital Region.

The Cardiff Capital Region (CCR) represents the 10 Local Authorities making up South East Wales. These comprise Blaenau Gwent, Bridgend, Caerphilly, Cardiff, Merthyr Tydfil, Monmouthshire, Newport, Rhondda Cynon Taf, Torfaen, and Vale of Glamorgan. It has a population of 1.5 million which equates to almost half the total population of Wales. It is a diverse region comprising the two cities of Cardiff and Newport, a range of market towns, the industrial heartland of the South Wales Valleys, rural communities and a coastal belt.



The region is economically highly significant for Wales accounting for approximately 50% of the total economic output of the Welsh economy thus the success of the CCR economy is a major factor behind the economic performance of Wales as a whole. Drawing on its industrial heritage, it has a number of anchor manufacturing businesses in aerospace, defence and automotive. It is home to 50,000 local businesses.

It also has growing diversity in its business base with emerging, competitive business clusters in areas such as cyber, compound semi-conductors, life sciences and the creative industries. It is home to three universities, and is well skilled with a high proportion of the population with qualifications of degree level or equivalent. It has a vibrant capital city at its heart

with excellent cultural and sporting facilities, is characterised by a diverse environment of coastline, forest and parks, and has very high reported levels of quality of life and wellbeing.

The Cardiff Capital Region City Deal (CCRC), which commenced in 2016, is a £1.3bn programme agreed between, and funded by, the UK Government, the Welsh Government and the ten local authorities in South East Wales. The CCRC is designed to build on the region's sectoral strengths, its high skill base and three successful universities and accelerate economic growth and productivity through a series of considered targeted investments in skills, infrastructure, innovation-led scalable projects and priority industry sectors and businesses.

Comprising a dedicated team, headed up by Director Kellie Beirne, and a ring-fenced 1.3bn investment fund, it is one of the CCR's primary mechanisms for implementing its growth ambitions and strategic priorities.

Over its lifetime of 20 years the desired outcomes from the CCR's programmes of intervention (£734m of which is ring-fenced for Metro developments with the remaining £495m available through a wider investment fund) are to have delivered 25,000 new jobs, generated an additional £4bn of private sector investment into the region and increased GVA by 5%.

The approach being followed to the deployment of the £495m Wider Investment Fund is a complete departure from the silod infrastructure and sectoral programmes of the past. Against a set of guiding principles that include taking an evergreen approach to our investment funds and co-investment, the aim of our investments is to improve both;

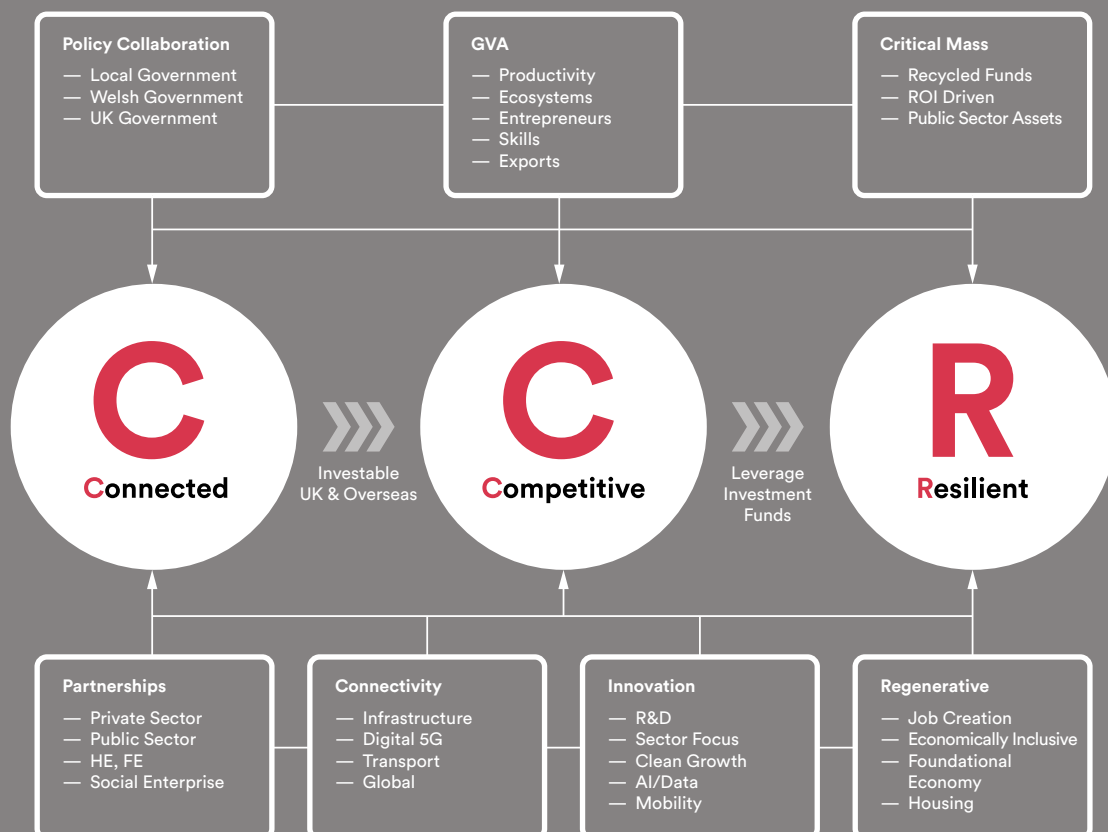
- the business environment within the CCR, creating rich ecosystems that stretch and support the development of key sectors in the economy.
- our comparative performance against other cities and regions within the UK and internationally.

Our ultimate goal is to aim to make the CCR the most investible region within the UK.

Goals, Key Areas Focus, and Priority Sectors

Three main goals of the Cardiff Capital Region are:

- **Connected:** A connector of people, their ambitions and the opportunities to fulfil their true potential. Nurturing the best conditions for business success and community cohesion, through targeted investment in world class digital communications. Creating cutting edge integrated transport infrastructure, connecting affordable and accessible spaces to live, work and play.
- **Competitive:** A catalyst for continuity investment, bringing key industry clusters to life. A trusted partner enabling companies to innovate and realise their full potential. A shaper of economically significant hubs, producing multiplier effects that fuel local and regional supply chains as well as the broader foundational economy.
- **Resilient:** A focus for creating the conditions where our businesses and our people are best equipped to embrace the future. A keystone presence helping the region adapt, improvise and overcome periods of economic turbulence or social unrest.



The areas of interest enabling capability essential to achieving CCR's ambition include:

- **Skills:** To compete effectively in today's global economy confidence in a highly skilled, adaptable and dependable workforce is essential.
- **Digital:** The provision of high class digital services is a stimulant for innovation and the creation of new business streams, leading in turn to economic growth, social inclusion and cohesion.
- **Site and Property:** Good housing is one of the key determinants of quality of life, yet for many in the Cardiff Capital Region a good quality, modern home is an unmet need.
- **Innovation:** Innovation is the cornerstone of sustained economic growth and prosperity. According to McKinsey, 84% of executives say that their future success is dependent on innovation.



Cardiff Capital Region also recognised eight priority sectors, in which the region has comparative strengths and competitive advantages.

- **Compound Semiconductors:** Compound Semiconductors provide the underpinning technology behind most of today's high-tech products and services including smartphones, sensors, and fibre-optic communications.
- **Fintech:** Wales has the fastest growing digital economy outside of London, and the growth of the financial and professional sector in Wales has led to a thriving Fintech industry.
- **Cybersecurity and Analytics:** Cybersecurity is a core pillar of Welsh Government's international strategy, and one of the Capital Region's priority sectors for economic growth.
- **Artificial Intelligence:** AI in many ways underpins the transformative work that is taking place in many of the other priority sectors.
- **Creative Economy:** The Cardiff Capital region is acknowledged as one of the UK's largest media production centres outside of London.
- **Life Sciences:** The life sciences sector is a huge one, but Cardiff Capital Region is focusing specifically on medical diagnostics and devices.
- **Transport Engineering:** Better public transport underpins sustainable economic growth and also offers real benefits for people.
- **Energy and Environment:** Creating the conditions for a transition to a carbon neutral economy and society in the CCR, using low carbon energy are considered a key enabler of economic regeneration and fundamental to improving the health and wellbeing of our communities.

South Wales Metro

One of the CCR's plans envisions the creation of the South Wales Metro, an integrated public transport network that will make it easier for people to travel across the Cardiff Capital Region, transforming rail and bus services. Metro is all about making it more convenient to use public transport so that it's easier to get to work or school, to get to your hospital appointment or to simply get out and about in the evenings and weekends.

The infrastructure development necessary to cater for the new faster, greener trains will include electrifying about 170km of track, creating new stations, upgrading most stations and associated signalling and upgrading the Core Valleys Lines to Aberdare, Coryton, Merthyr Tydfil, Rhymney and Treherbert.

Such extensive infrastructure development is a long and complex process and is expected to take about 5 years but when it is finished passengers should be able to get from the Heads of the Valleys into Cardiff in just 50 minutes. Such vastly improved connectivity across the region will enable more jobs, more investment and a better standard of living for all.

The programme is funded through contributions from Welsh Government, UK Government, EU funds and a ring-fenced contribution of £734m from the CCR City Deal. The programme is being managed by Transport for Wales and selected contractors.

Metro Stations



Nid yw Traffidieth Cymru yn atebol am unrhyw wall neu hysgiadau yn y myfyrddi a gyhoeddi. Mae Traffidieth Cymru yn oeddi'r hawl i newid y gwasgwerau a'r cyfnewtiraau yn y cael iou harrinellu. Transport for Wales accepts no liability for any errors or omissions in the information published. Transport for Wales reserves the right to make changes to the services and facilities outlined.

Aberthaw Power Station

The Cardiff Capital Region (CCR) has purchased Aberthaw Power Station, one of South Wales' best known landmarks, to develop and reposition it as an exemplar for green energy production in the region.

It has acquired the 489-acre site, which contains the decommissioned coal-fired power station on the Vale of Glamorgan coast, from the current owners RWE, with the potential to create thousands of jobs.

Following approval to purchase from the CCR's Regional Cabinet, CCR plans to remediate, redevelop and reposition the site, maximising its long-term development potential to drive sustainable, clean economic growth across the South-East Wales region.

CCR has committed £36.4m to the project, with an £8m purchase price of the site, and the remaining amount being used for demolition, remediation, and re-development.

The proposed Master Plan for the redevelopment of the Aberthaw site, which we acknowledge will take several years to come to fruition given the nature of and complexities involved in the transitioning process, will seek to:

- **Support** the production of renewable and green energy projects
- **Provide** an accompanying battery storage facility to support the green energy projects
- **Produce** a zero-carbon manufacturing cluster which will include green hydrogen production facilities
- **Provide** a green energy innovation centre to promote innovation, growth, knowledge and community interaction with the zero-carbon future of Wales
- **Be responsible** for the development and maintenance of a bio-diverse ecology park which will include a visitor centre, providing amenities to the local community
- **Create** the correct conditions to support industrial de-carbonisation and future giga-plant facilities



Figure 1 - The Master Plan for the Redevelopment of the Aberthaw Power Station site. (Created by and Copyright of Reef Group). Please note that this is intended to be illustrative only to bring our future intent to life and is not a blueprint.

The Master Plan aligns with the objectives of the CCR Economic and Industrial Plan and the CCR Energy Strategy and will contribute towards the objectives of the UK and Welsh Government 2050's net zero targets. It will also provide the region with highly skilled job creation - with the potential to create thousands of direct, indirect and induced jobs, along with local supply chain and upskilling benefits.

CCR will maintain a strong commitment to engage and involve local community stakeholders in order to develop an open, inclusive and participative ethos as soon as the commercially sensitive considerations have been addressed.

There are areas of the site which require ongoing custodianship, in respect of nature, biodiversity and managing the overall ecology of the site, which will be best achieved in partnership with community.

CCR's redevelopment plan will commit to safeguarding and developing the Nature Reserve, working with colleagues in the Vale of Glamorgan Council to ensure effective plans are put in place.

In the interim, whilst plans are worked through, commitment is given to ensure this ecologically valuable component of the site is protected and, wherever possible, further enhanced and augmented.

The location of the site allows for strong strategic links with other major assets, including Bro Tathan Business Park, Cardiff Airport, and the overarching St Athan Enterprise Zone - one of the few sites in the UK capable of accommodating large-scale lithium-ion battery production.

This project will enhance and strengthen the Vale of Glamorgan and the region, as a major regional enterprise hub. In so doing it will deliver multiple benefits to South-east Wales communities and offers the potential to shape and create new markets in key industrial sectors of the future.

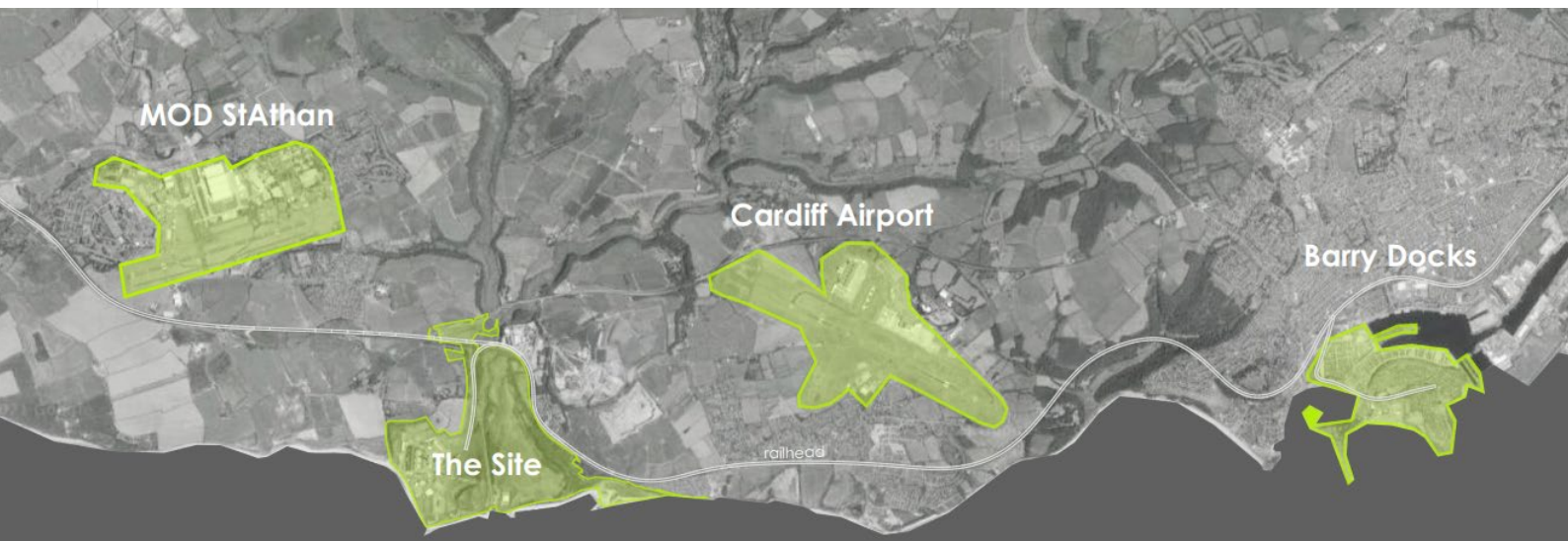


Figure 2 - The Wider Area around the Aberthaw Power Station Site showing strategic links with key sites in the Vale of Glamorgan (Created by and Copyright of Reef Group).



Figure 3 - The Current Aberthaw Power Station Site.

Next steps and strategic plans for 2021-2025

Moving out from the pandemic, Cardiff Capital Region has ambitious plans for 2021-2025. 'Five for Five' plan recognises the five key priority areas that will be the hallmarks of CCR's evolution over the next five years. Those pillars will be central to building sustainable inclusive growth by taking the programme beyond City Deal and creating a robust platform for developing compatible initiatives that create a wider and more holistic City Agenda, based on:

1. Building Back Better

'Building Back Better' means restructuring the economy to create a new resilience. This will be done through delivering on the COVID-19 10-point priority-set, creating a Future Skills Hub, implementing a Strategic Premises Fund, ESG, Ethical and Place-based investments, and finally managing climate crisis and decarbonization.

2. Becoming a City Region

CCR plans on building on their unique experience of regional public investment in order to bring access to the full range of funds, investments and opportunities that are available. This will be achieved by shaping and owning the CCR Corporate Joint Committee (CJC), becoming a Testbed region through a new institutional capacity, playing part in delivering Regional Investment for Wales, cementing commitment through a Regional Economic Framework, developing policy and economic insight partnerships, and engaging in international partnerships (including Horizon Europe).

3. Scaling Up

'Scaling-up' is at the heart of the City Deal, in the commitment to building capacity across our region through delivery of our Wider Investment Fund projects. The first four years of the CCR has been spent 'starting-up', but subsequent to the launch of the Investment and Intervention framework, Cardiff Capital Region has quickly developed a pipeline that now includes 11 approved projects with more at an advanced stage of development. The approved projects which are at varying stages of delivery include:

- CCR Graduate Scheme
- CSC Foundry
- CSconnected
- Metro Plus
- Metro Central
- Creo Medical
- Homes for all the Region
- Challenge Fund
- Zip World Outdoor Adventure Project
- Pharmatelligence
- Strategic Premises Fund

Beyond this approved delivery pipeline, there is also a number of other projects in development – including the pioneering cluster projects for CCR Creative Industries, Cyber Wales and Fintech Wales plus new funds for Innovation growth.

4. Levelling Up

Considering the regional disparities in the United Kingdom around everything from productivity to R&D output (and the probability of COVID-19 exacerbating these existing inequalities), the ambition of the CCR is to put in a place a clear vision for 'Levelling-up' in South East Wales. Cardiff Capital Region will achieve it through publishing a CCR Investment Prospectus – "Prosperity for our Place", defining the infrastructure policy position and investment requirements, becoming more mission-driven and challenge-led, and finally leveraging the data and digital credentials of the region.

5. Developing Economic Clusters

The UK Government has set a target for 2.4% of national spend to be invested in research and development by 2027. CCR possesses proven strengths in innovation and so is determined to contribute to the UK R&D Roadmap. The set out strategy aimed at contribution to the R&D include establishing the CCR Clusters Framework that will identify priority clusters and mapping the stage of each cluster or prospective cluster; creating a CCR Innovation Investment Fund (currently in development), which will be around £100m (inclusive of co-investment) and will underpin the clusters' framework as well as other innovative proposals aligned to meeting grand challenges; making CCR the 'go to' place for challenge-led development, engaging closely with the Western Gateway partnership, engaging in new international trade relationships and research arrangements, and finally supporting foundational economy renewal.



Point of View



Prof Hywel R Thomas

The FLEXIS team is delighted to welcome the opportunity to work with the Cardiff Capital Region. This exciting new partnership marks an important moment in the life of the project and as we look towards a FLEXIS/SWITCH future, this collaboration will be of major importance.

We hope that this partnership will be carried into the future, becoming a foundation for the collaborations between the CCR and the projects as well as organisations which will continue FLEXIS legacy.



Kellie Beirne

Environmental challenges threaten the health, prosperity, and resilience of the Cardiff Capital Region. The urgent need for intervention at pace and scale, as well as collective action, to address the challenges presented by climate change is evident.

Our goal is to achieve net zero by 2050 and to realise this ambition will require a significant transformation of the energy system and fundamental changes to the use and generation of energy in the Cardiff Capital Region.

The scale and complexity of this negates traditional policy approaches or working in organisational silos. We believe that a key enabler for regional success is a whole system response and collaborations across boundaries between academia, industry, communities and local government.

This partnership with FLEXIS will be a central feature of our approach going forward, building our capacity for research and innovation across the region and providing a key building block for enabling the delivery of public sector innovation and economic value.

We are extremely excited about the future relationship with FLEXIS and the sustainable future it will help build for the region.

Deep Dive into Renewable Energy

In December 2021, the Welsh Government published a report summarising the recommendations of the “Deep Dive into Renewable Energy” exercise led by the Deputy Minister for Climate Change, Lee Waters. We are pleased to acknowledge that the Chair of the FLEXIS Advisory Board, Dr Mike Colechin (Cultivate Innovation Ltd) and Dr Chris Williams (South Wales Industrial Cluster), were part of the core group of involved in the work.

The other members of the core group were:

- **Dr Jenifer Baxter**
Protium Green Solutions
- **Pete Capener**
Bath and West Community Energy
- **Dr Jeffrey Hardy**
Imperial College London
- **Andrew Jeffreys**
Director Welsh Treasury, Welsh Government
- **Sarah Jennings**
Natural Resources Wales
- **Anthony Kyriakides**
Energy Saving Trust
- **Hywel Lloyd**
Institute of Welsh Affairs
- **Dan McCallum**
Awel coop
- **Sarah Merrick**
Ripple Energy
- **Guy Newey**
Energy Systems Catapult
- **Robert Procter**
Community Energy Wales
- **Dr Nina Skorupska**
Renewable Energy Association
- **Beth Warnock**
Energy Systems Catapult
- **Dr Mike Jenkins**
Local Government
- **Rhys Wyn Jones**
Renewables UK Cymru

The work of the Deep Dive Group originated from the Welsh Government’s earlier work on Net Zero Wales published before COP26. The aim of this work was to identify barriers to significantly scaling up renewable energy in Wales, and identify steps to overcome the barriers. The group looked at short-, medium-, and long-term steps with a particular focus on retaining wealth and ownership in Wales.

The vision of the group is for Wales to generate renewable energy to at least fully meet Welsh energy needs and utilise surplus generation to tackle nature and climate emergencies. Wales is supposed to accelerate actions to reduce energy demand and maximise local ownership retaining economic and social benefits in Wales.

The recommendations of the group are reproduced below:

Recommendations:

- 1.** Our Vision is for Wales to generate renewable energy to at least fully meet our energy needs and utilise surplus generation to tackle the nature and climate emergencies. We will accelerate actions to reduce energy demand and maximise local ownership retaining economic and social benefits in Wales.
- 2.** We will scale up local energy plans to create a national energy plan by 2024, mapping out future energy demand and supply for all parts of Wales to identify gaps to enable us to plan for a system that is flexible and smart - matching local renewable energy generation with energy demand.
- 3.** Our Net Zero Wales public engagement and behaviour change plans will help citizens to take action to reduce demand, improve energy efficiency and use energy in a way which supports our vision.
- 4.** We want to see an easy to access advice service set up to help people improve the energy efficiency and smart performance of their homes and businesses as well as a ready supply of trusted suppliers and installers of low carbon heating systems in Wales. We will scope additional actions as we develop our future Warm Homes Programme and Heat Strategy.

Grid

Recommendations:

- 5.** We will step up our engagement with Ofgem to set out Wales' investment needs, with a focus on retaining value within Wales. We will set up a joint-working group to look at options for supporting new, flexible grid connections for renewables and energy storage solutions.
- 6.** Building on the Future Energy Grid Project, we will press Ofgem to create a Wales Energy System Architect to oversee:
 - a.** Demand side flexibility, domestic, non-domestic and dedicated, including energy storage
 - b.** The mapping of fuel (& transport) poor households against Distribution Network Operators (DNO) current & predicted constraint management zones (where demand side response/flexibility has greatest system value) with a view to socialised deployment of low carbon flexibility technologies to these homes and households
 - c.** Smart solutions for transmission and distribution including the use of Artificial Intelligence (AI) to maximise the use of the existing network. Including development of requirements, funding and opening up to the market for innovation. Engagement and inputs required from across industry.
 - d.** Supporting business cases for whole system planning and bring together of plans across South, Mid and North Wales
 - e.** Competition for network build to decrease costs and accelerate build times
 - f.** Development of a detailed whole system plan covering transmission and distribution
 - g.** Celtic Sea offshore network design and onshore reinforcements.

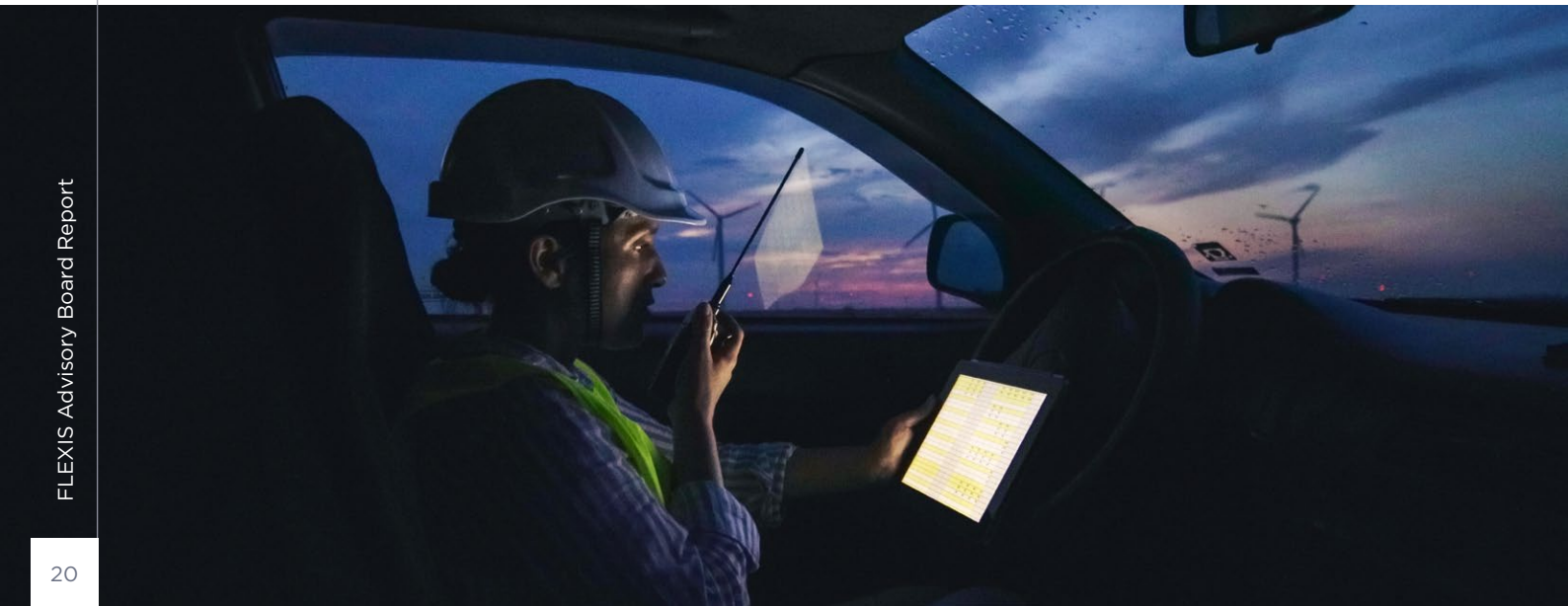
Consenting, licensing and supporting advisory arrangements

Recommendations:

- 7.** We will undertake a review of consenting and supporting evidence and advice, to ensure a timely and proportionate process including:
 - a.** An end-to-end review of the marine licensing, consenting and supporting advisory processes to remove barriers, drawing on the work of existing groups
 - b.** A review of resource needs and options for consenting and advisory processes to keep pace with the growth in renewables, including an urgent review of resource needs and options for NRW's Offshore Renewable Energy Programme
 - c.** Identifying priority marine and terrestrial evidence gaps and mechanisms to fill them, to expedite the application process
 - d.** Reviewing and mapping the process for land based renewables installations to obtain an environmental permit, with a focus on emerging technologies
 - e.** Identifying options for releasing capacity and redirecting resource to agreed priority areas

We will report our findings during summer 2022, except for point b. which we will report on in spring 2022.

- 8.** We will, with NRW and key stakeholders, identify marine 'strategic resource areas' by 2023 and provide guidance to signpost appropriate and inappropriate areas for development of different renewable energy technologies. Our marine planning, licensing and marine conservation policies will work together to provide a pathway for marine renewable developments.
- 9.** While we pursue the devolution of the Crown Estate we will streamline the process for developing the Celtic Sea renewable energy projects including delegating offshore advisory powers from the Joint Nature Conservation Committee (JNCC) to NRW.



Finance

Recommendations:

- 10.** We will set up an expert group to explore ways of drawing down additional investment in renewable energy generation in Wales. We will prioritise local and community ownership to maximise local economic and social value.
- 11.** We will seek to create an alliance with devolved Governments to ensure the UK Government's Contract for Difference (CfD) process evolves appropriately to:
 - a.** reflect the primacy of supply chain development and
 - b.** to achieve a coherent and balanced development pathway for early commercial and emerging technologies.
- 12.** We will look at the options to support local and community renewable energy generation through Non-Domestic Rates.
- 13.** A working group will be set up to review options for how procurement can support the acceleration of renewable energy generation in Wales to maximise local economic and social value to include but not limited to:
 - a.** Improve procurement policy to incorporate social value including exploring with commercial developers how they can best meet local need.
 - b.** Options for utilising the buying power of the public sector in Wales to support reliable routes to market for community and public sector energy projects, including through long term Power Purchase Agreements.
 - c.** How advice and support services can better assist community energy developers access market opportunities.
 - d.** How to better engage the community energy sector in the Wales funding Programme.
 - e.** How best practice can be disseminated including feeding into the Welsh Governments best practice group or the Procurement Centre for Excellence if established.

Opportunities to scale up Community and Local Energy in Wales

Recommendations:

- 14.** We will scale up resources to support community and local renewable energy in Wales including:
 - a.** From the Welsh Government Energy Service with staff and financial support to ensure coverage for community owned heat, energy efficiency and transport project development (with continuation for renewable electricity) and support for shared ownership
 - b.** Action from government to encourage private developers to include options for shared local and community ownership including through tenders issued on public land.
 - c.** Welsh Government funding to build additional capacity in community enterprises to help them start to scale their work and mentor smaller organisations, to create a larger, sustainable sector.
- 15.** We will ensure that community owned sector is involved and gains input into Ynni Cymru considering the following 3 options:
 - a.** The community energy sector has a stake in the publicly owned developer
 - b.** WG invest in an existing community energy organisation to deliver this work e.g., YnNi Teg, Egni or a Coop of Energy Coops
 - c.** WG invest in both the publicly owned energy developer and a community owned energy developer = two bodies with resource to develop projects.
- 16.** We will improve access to the public estate for the community energy sector via (a) community enterprises have rights to first proposal if not developed by a public body (b) structuring tendering processes to favour socially minded projects / community schemes.
- 17.** We will finalise and publicise the guidance on shared ownership, including what meets the definition of 'shared ownership', and work closely with private developers to maximise impact. We will publish the guidance in spring 2022.

Opportunities to maximise Economic and social value in Wales

Recommendations:

18. We will work with the UK Government to bring new investment to ports in Wales. We will work with ports in Wales to identify opportunities for specialisation and collaboration, and to make Welsh ports investment ready. We call on The Crown Estate and UK Government to maximise the value of supply chain and infrastructure development opportunities in Wales from their leasing rounds.

19. As we develop a net zero skills action plan by spring 2022 we will support greater industry collaboration to maximise supply chain opportunities in Wales.

20. Working with industry, we will scope a programme of work to maximise the installation of renewables, flexibility and storage on business and industrial sites. The programme will explore mechanisms to support and de-risk investment.

Innovation

Recommendation:

21. We will call on Ofgem to develop a Welsh regulatory derogation to enable energy business model innovation in support of the wider recommendations of the Renewable Energy Deep Dive. The objectives of the derogation should include:

- a.** Accelerate the scale-up of renewable energy in Wales
- b.** Enable energy business model innovation
- c.** Realise the benefits and wider co-benefits of renewable energy (from a Welsh and energy systems perspective)
- d.** Unlock energy system value, such as that from demand flexibility customers and consumers peer to peer trading and local electricity supply
- e.** Better engage and protect the interests of Welsh citizens.”

As Wales looks into the future, the Welsh Government, as well as the Deep Dive group, recognise the role that innovation will continue to play in driving forward new renewable technologies and smart solutions to manage demand in a flexible way. In the written statement, Lee Waters stated that the support for innovation in Wales must continue, focussing on our strengths and acting to address specific challenges where innovation will help provide solutions.

More information about the Deep Dive into Renewable Energy and the group’s recommendations can be found on <https://gov.wales/written-statement-outcome-deep-dive-renewable-energy>



NOW SWITCH progress and challenges

The Net Zero Wales launch (NOW) was held in October 2021 with comprehensive support from the SWITCH partners including hosting the launch event itself. In March 2022 HEFCW released some initial funds to support the NOW research initiative and it is recognised that one of the first programmes to come forward will be NOW SWITCH. **The Universities of Swansea (SU), Cardiff (CU) and South Wales (USW)** are partnering on this ambitious programme to support decarbonisation and transitioning to net zero for industry, transport and buildings. Our plans are based around a central Theme Zero that will support interconnects between the core teams at FLEXIS and SPECIFIC®. These two major projects combining forces to be a catalyst for change.

The plan is to nucleate innovation, demonstration and deployment for the **decarbonisation of the industrial base and communities** in South Wales **removing over 16Mt per annum UK emissions**. This will also deliver novel low carbon and net zero products for key manufacturing sectors, delivering sustainable economic growth, to generate and support more than **11000 high value high skilled jobs** and support **global impact** through international decarbonisation research and innovation missions in particular with existing partnerships in India.

The **NPT demonstration area** initiated through FLEXIS is being transformed through a mixture of public sector (Swansea Bay City Deal (SBCD)) and private sector investment supporting **World Leading Facilities**. The Baglan **Technology Centre** opens in May 2022 and is an exemplar building for the future with solar generation on all facades and the roof space supporting a substantial investment (SBCD) in the hydrogen generating capacity at the USW **Hydrogen Centre**. An additional exemplar steel intensive building has already had site preparation completed and this unique **SWITCH Harbourside** facility will not only showcase current and future steel construction products but house the current Steel and Metals Institute and an additional £5M new equipment supporting decarbonisation research.

These add to existing and substantial assets over and about the SU Bay Campus including the CU **Gas Turbine Research Centre (GTRC)**, the SU SPECIFIC® Innovation and Knowledge Centre pilot production line and the **Solar Heat Energy Demonstrator (SHED)** next to GTRC. In addition, as part of the FLEXIS supported i-SPACE project a substantial investment is expected in a world first scrap sorting facility aimed at positioning the region at the centre of the circular metals economy.



Figure 1 - Flexis App and SPECIFIC® are jointly supporting the development of heat storage media (salt in matrix) for storing excess solar energy and waste industrial heat respectively.

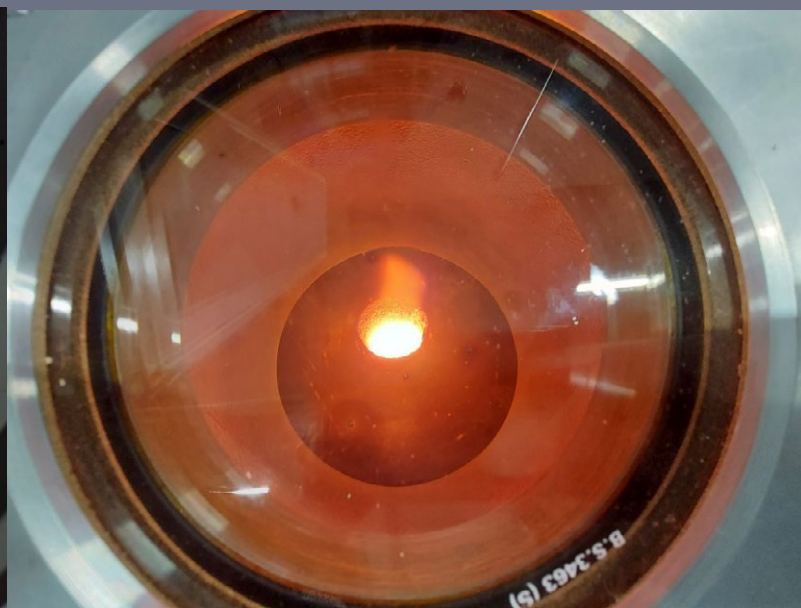
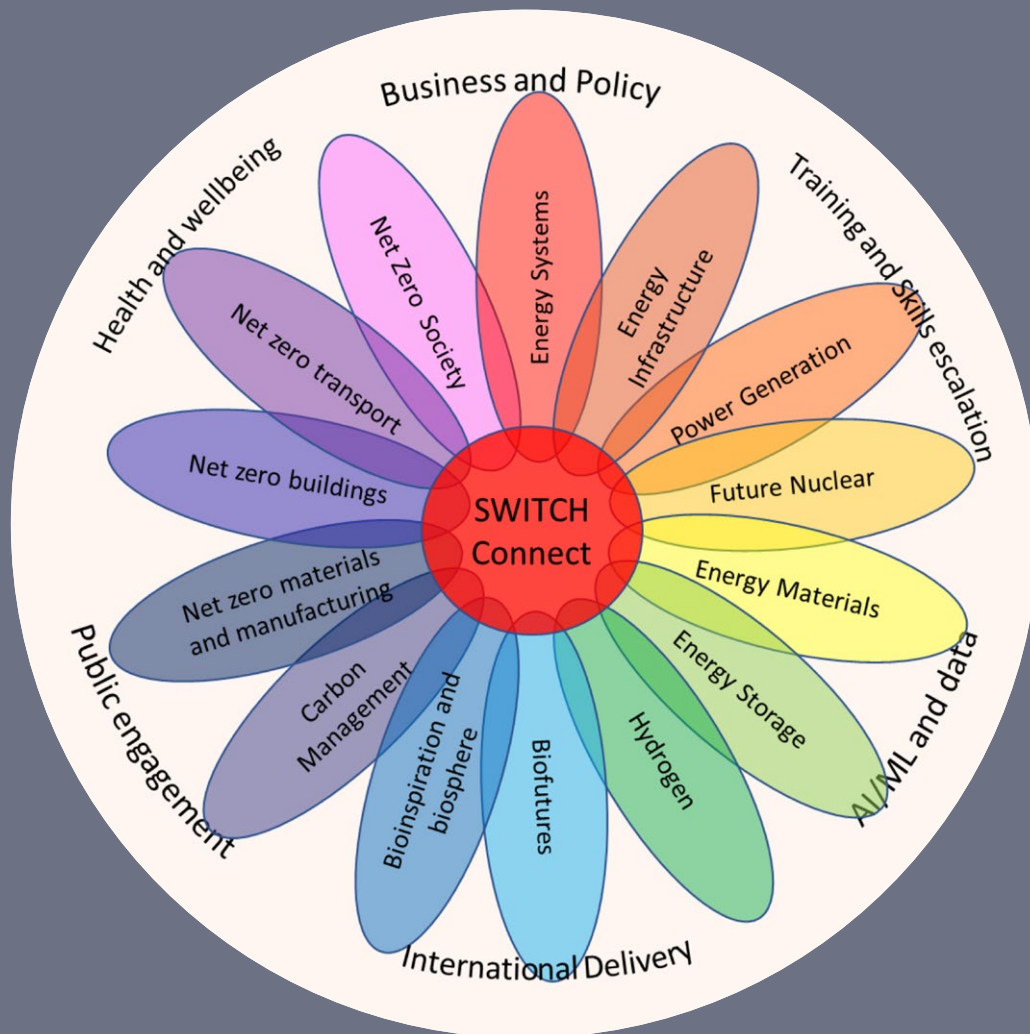


Figure 2 - The first metal melt on a new HEFCW funded vacuum induction metal melter which will be at the heart of the steel industry net zero challenge



Further investments locally include the completion of the Semi-conductor Institute **CISM** on the Bay Campus (£30M) and up to £15M private sector investment in the **Gateway to Zero**, a solar powered transport charging hub (for battery and hydrogen electric vehicles which will also showcase homes for the future (linked to the **Homes as Powerstations** (SBCD) initiative) and have an additional offsite meeting space for SWITCH partners assembled from the physical deconstruction and rebuilding of the award winning SPECIFIC Active Classroom®.

Accelerating Research and Innovation: The SWITCH Connect hub links to 14 detailed Themes underpinning societal and industrial net zero ambitions. The themes are interconnected to support a systems approach to decarbonisation. Much of the research builds on teams already in place as part of **FLEXIS**, **SPECIFIC®** or other initiatives such as the **SUSTAIN** Manufacturing hub. This means that the delivery of the SWITCH mission can commence immediately with expert teams and engaged industrial partners ensuring rapid progress.

The partnership approach is essential with TRL 1-9 activity occurring simultaneously in an innovation ecosystem designed to accelerate delivery of net zero targets. In addition, whilst work will clearly focus on Welsh targets the team will explore both national and international collaborations which can support rapid knowledge transformation to deliver Global change.

Net Zero Skills and talent: SWITCH on Skills will build on an existing training and skills escalator model which is aimed at delivering net zero skills at all levels from public engagement and school interactions, apprenticeships, work-based learning, and full/part time degrees/doctorates. This is timely with the first PhD graduate from the precursor **METaL programme** in 2022 who started their journey with no formal qualifications. SWITCH on Skills will be a core element of the just transition and open up training, re-training and awareness of the opportunities from the next stage of the region's industrial transformation whilst supporting the wider aspirations of the **South Wales Industrial Cluster (SWIC)**.

Funding for SWITCH components. The search continues! With ca **£57M SBCD** investment in the NPT low carbon capital projects and additional **£15-£20M Private Sector** investment in the Gateway to Zero transport hub and novel decarbonisation equipment for the SWITCH mission the capital elements for success are in place. With 12 months to go to support transitioning critical teams from EU funding a **'layered' approach** to funding is being adopted in the absence of significant levelling up or 'strength in places' opportunities.

UKRI (EPSRC and IUK) sources, supported with industrial leverage are enabling a variety of the SWITCH topic areas to gain traction and **longer-term** support.

This includes Prosperity Partnership and Manufacturing Hub applications to EPSRC, preparations for new **UKRI Doctoral Training Centres** and active engagement with initiatives such as the IDRIC programme (EPSRC) and the IETF (IUK). In addition, as a result of a UKRI review we are hopeful that the core **Innovation and Knowledge Centre** team at SPECIFIC® will be able to gain support for a further five years to 2029 which can further support the Theme Zero. This is also supported by new FLEXIS App initiatives around the circular economy, green agriculture and conversion of CO2 into chemical precursors which we hope will seed ambitious long-term collaborative work via H2020 and UKRI.

A host landing page has been created www.switch-connect.co.uk



Figure 3



Figure 4



Figure 5



Figure 6

Figure 3 - Two Active® Homes constructed at Coed Darcy by Coastal Housing in partnership with Daiwa House Europe and SPECIFIC® which combine solar power storage and heating and have no gas connection. Steel intensive factory built with 6 day onsite assembly.

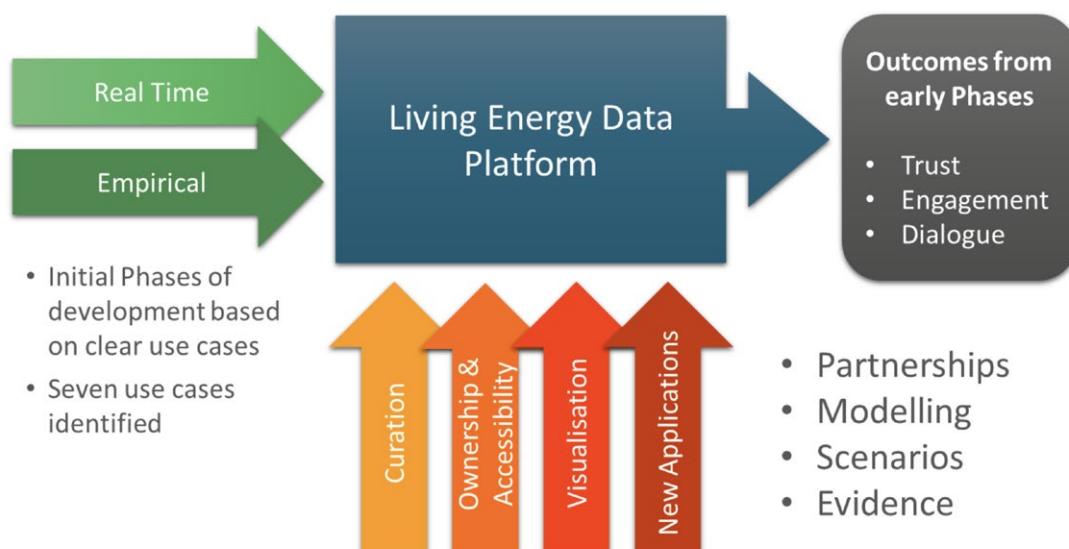
Figure 4 - First Minister and Minister for Climate Change Julie James MS examining a RotaHeat energy capture system at the Margam SHED.

Figure 5 - SPECIFIC® perovskite PV panels on display and for testing in Indian climate at Jamshedpur Steel Plant for Tata Founders Day.

Figure 6 - Net Zero Wales Launch; Prof Trystan Watson and Dr Jo Clarke demonstrating robust flexible self-adhesive PV from BIPVco Newport

FLEXIS: Living Energy Data Platform

In early 2020, the FAB took a deep-dive look at the potential for delivering value from the data coming out of the projects in the FLEXIS Demonstration Area, in and around Neath Port Talbot. This led to the development of the concept of a 'Living Energy Data Platform' for FLEXIS. This would seek to open channels for real time and empirical data collection and storage, addressing issues like curation, ownership and accessibility, and data visualisation in ways that create knowledge and provide evidence that ultimately builds trust and engagement between project partners and other stakeholders.



FLEXIS Living Energy Data Platform - a concept that builds relationships and creates knowledge.

Data Sprint Projects

To turn this concept into reality, a number of 'sprint' projects have been conceived as part of a phased approach to realising this vision. These were intended to be short-duration projects designed to establish the feasibility of specific data applications; agree data access, collection and curation methodologies; develop modelling capabilities and evidence based on the data; and ultimately assist in the definition of low carbon options for the region.

In total, nine use cases have been identified that have the potential to become sprint projects, ranging from optimisation of energy costs in public buildings through to utilising air quality data to inform low carbon investments. Although events of the last two years have stalled progress on most of these, with the support of EA Technology, NPT Council and WPD, we are now managing to move a number of them forward. In particular, we are making good progress with projects designed to explore the benefits of high fidelity monitoring of secondary electricity sub-stations in the region using EA Technology's VisNet monitoring system.

Data Issues

The concept of a 'Living Energy Data Platform' is working. It is opening up dialogue and delivering collaborative responses to the urgent challenge of 'net zero' within the FLEXIS Demonstration Area. However, to date it is has not delivered a lot of data. While this has at least in part been due to the impact of the pandemic, it has also provided a practical illustration of a number of well recognised issues when seeking to create value from data:

- **Data ownership** - where potential data sources are identified, ownership is often not clear and can be complex
- **Access** - where data ownership issues are easily addressed, the data is not always readily available in a format that can be easily accessed and transferred between partners
- **Resources** - data processing, at least in the initial stages of a project, can be resource intensive, requiring significant time commitments from all partners, particularly those providing the data
- **Value attribution** - messages about the potential value in data creates barriers to data sharing, as parties are unwilling to release data which may subsequently be commercially valuable to them
- **Data security** - concerns about how data will be stored, anonymised, accessed and used, often articulated as 'GDPR issues' any of these issues can, of course, be addressed with clear project specification and appropriate legal agreements. However, putting such agreements in place takes time and resource and often involves complex negotiations between multiple parties. For projects that are already struggling to secure funding and appropriate resources this can be the 'final straw'.

Outcomes, Lessons Learned, Concerns

Data is often presented as a 'low hanging fruit' an enabler that unlocks the ability for us to respond with an appropriate level of urgency to the challenge of delivering net zero and minimising climate change.

In this practical example we are not finding this to be the case. There are many reasons for this and there is no question that working on these issues is opening up channels of communication and starting to deliver the sort of collaboration needed more broadly to deliver the urgent changes required.

However, the data is still not flowing in anything like the quantities hoped for, and there is a lot more work to do before we realise the benefits promised. Work and alignment need to take place at a range of levels - governmental (UK and Regional), organisational, between collaborative partners and within academia - to accelerate progress towards effectively using energy system data for delivering net zero and minimising climate change.

There is the need to adopt a systematic and co-ordinated approach at project level which will identify challenges and assist in removing barriers, ensuring the required rate of progression.

Future Work

FLEXIS 'sprint' projects that are still under development include:

- Use of available data to optimise energy costs in public sector buildings
- Advanced energy data monitoring of the electricity distribution network
- Delivering a net zero 'route map' for Neath Port Talbot
- System modelling for a 'Smart Low Carbon Town'



FLEXIS App

Collaborate | Commercialise | Decarbonise
Cydwethio | Masnacheiddio | Datgarboneiddio

FLEXISApp is a £4M WEFO funded research, development and innovation programme that is focussing on industrial decarbonisation and economic growth.

FLEXISApp is the commercial development route for the research programme undertaken in South Wales via the FLEXIS research programme.

Like FLEXIS, FLEXISApp brings together academia (Swansea University, University of South Wales and Cardiff University), local government and industry to develop innovative energy technologies to achieve net zero targets by 2050. The project supports several Welsh Government and UK initiatives including 'Science for Wales', 'Innovation Wales' and the UK's Clean Growth Strategy.

FLEXISApp projects drive net zero solutions via strong industrial partnerships with companies that use FLEXIS' world-leading research and resources in energy systems.



Current FLEXISApp Projects

Centre of Expertise (Cardiff University)

The objective is to establish a Centre of Excellence focussed on the development of AI based algorithms for energy efficiency and optimisation of multi-vector energy systems for use in commercial applications within the region, across Wales, the UK and global markets. The project is partnered with Maiple Limited.

Gateway to Zero (Swansea University)

G20 is the nucleating point for research, innovation, development and deployment in collaboration with academic, public sector and industry partners; to demonstrate, test and deploy large scale decarbonisation of commercial, private and public sector road transport. The refuelling of vehicles and testing of new applications will use renewable energy generated by Amazon. Consumer facing activities will be developed and operated by GRIDSERVE, underpinning support by research, innovation and training by collaborative partners.

H2ACE (University of South Wales)

Whereas several industries combust the intermediate syngas produced in their current processes, there is an opportunity to extract hydrogen and provide separated hydrogen and CO₂ streams. This project is based around the investigation of enhanced Water Gas Shift processes, with selective adsorption from a range of syngas feeds, including steelworks arising gases. Conversion and re-use technologies could be an alternative to carbon capture and storage approaches.

Innovative Steel Processing Accelerating the Circular Economy (Swansea University)

This project is to develop a business case, demonstrate the long-term viability and understanding of market needs in an aligned collaborative approach for the South-Wales Circular-Metals Recycling and Processing Institute. This will be a key R, D and I asset to the region for both industrial and innovation partners in terms of developing the future of material recycling and reducing the projected losses of non-reclaimed valuable, precious and rare elements from industry and the economy.

Mobile Energy Storage as Heat (Swansea University)

MESH will investigate and optimise the capture, storage and release of heat from industrial waste air streams using thermochemical storage (TCS) materials originally developed for capture of solar energy as part of the SPECIFIC project and subsequently use the acquired data to model the viability of the reuse of the captured heat from a technological, environmental and economic viewpoint.

Sustainable Fertiliser for Decarbonisation (University of South Wales)

This project will optimise and increase the commercial potential of an advanced soil conditioner (ASC) through a mixture of laboratory, container and field-scale trials. ASC is a valid NPK fertiliser replacement, so could reduce consumption and dependence on natural gas for fertiliser and food production. The ASC can potentially enable significant energy and carbon savings for wastewater treatment processes due to not causing excess leaching into soil and groundwater.

VFA-Sense (University of South Wales)

This project seeks to increase the energy yield from anaerobic digesters, reducing the overall water sector GHG and PM10 emissions. This will be achieved by the deployment of a novel on-line volatile fatty acid (VFA) instrument to control and improve process stability resulting in increased energy yield and reduced GHG emissions.

Partners



FLEXIS

SMART ENERGY FOR OUR FUTURE
YNNI CALL AR GYFER EIN DYFODOL