

Advisory Board Report

November 2020

FLEXIS

SMART ENERGY FOR OUR FUTURE
YNNI CALL AR GYFER EIN DYFODOL



UNDEB EWROPEAIDD
EUROPEAN UNION



Llywodraeth Cymru
Welsh Government

**Cronfa Datblygu
Rhanbarthol Ewrop
European Regional
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**CARDIFF
UNIVERSITY**

**PRIFYSGOL
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**Swansea University
Prifysgol Abertawe**

**University of
South Wales
Prifysgol
De Cymru**

Contents

Foreword	03
Who's Who	04
Advisory Board	05
FLEXIS researchers reaching their full potential	06
The right tool to unlock energy systems thinking, and to save the public sector pound	07
FLEXIS researchers reaching their full potential	08
Comments from the Vice Chancellors	10
Principal Investigators – Point of view	11
Funded Research Projects	12
Investment in technology and equipment	13
Resources from Urban Bio-waste (RES URBIS)	15
Scalable CO2 adsorbents	17
The Active Building Centre Research Programme: Living Well in Low Carbon Homes	18
Comments from our key stakeholders	20
What is FLEXISApp?	22

Foreword



“ Over the last five years, our consortium of strategic partners - Cardiff University, Swansea University, The University of South Wales, Neath Port Talbot Borough Council and Tata Steel UK, has worked together successfully to develop and create an energy systems research capability in Wales.

Part funded by the Welsh European Funding Office (WEFO), the ambitious 5 year, £24M project now approaches its final stages.

As we continue to move forward with the opportunities that FLEXIS has created, I'd like us to take a look back and acknowledge some the successes that we have had.

Since the project began, we have generated over £25M in research income, recruited 95 new researchers into Welsh universities and invested over £2.4M into research equipment and technology to aid current and future research.

To date, we have published 550 papers, shared FLEXIS outputs at 240 conferences and delivered 100+ research projects with government, industry and academia from across the world.

In addition to this, we have collaborated with over 230 industrial partners including Maiple and Tata Steel UK, who we will continue to work in partnership with through FLEXISApp.

Like, **RICE** and the South Wales Industrial Cluster (**SWIC**), FLEXISApp is another research project that was created from FLEXIS and will be a continuation of its legacy.

FLEXISApp will take forward the research and demonstration capacity of FLEXIS and part fund the commercial development of energy technologies, that focus on

industrial decarbonisation and greenhouse gas (GHG) reduction. More information about FLEXISApp is available on page 22.

I would personally like to thank everyone who has been involved with FLEXIS for their expertise, hard work and commitment. This includes not only the academic staff and the Advisory Board members, but also the Management team whose 'behind the scenes' effort ensured the project ran smoothly and efficiently. The cooperative working of all parties has been a key factor in the project's success

Together, we have achieved everything that we set out to do!

We have created significant economic impact through supporting and developing the internationally renowned research in this area and more specifically, through the new technologies and new jobs that have been created. We have successfully developed the much-needed critical mass within the consortium of universities and created the capability to continue using Wales' growing research capacity for energy innovation to develop carbon neutral energy systems across Wales with the potential for global application.

FLEXIS has provided a strong foundation for future energy system developments within Wales to support the world's climate change commitments.

I am proud of what we have achieved to date and what we will achieve in the future because of FLEXIS.

Hywel.

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 Phil Bowen

SMART-POWER: enabling integrated energy systems Cardiff University

Dr Aleksandra Koj

Project Manager Cardiff University

Prof Andrew Barron

Energy safety research Swansea University

Prof Nick Jenkins

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

Prof Manu Haddad

Alternative environmentally-friendly gas for electrical networks insulation Cardiff University

Prof Alan Guwy

CymruH2Wales2 Hydrogen and fuel cells University of South Wales

Profs Nick Pidgeon & Karen Henwood

Public response to energy systems technologies Cardiff University

Partners



Advisory Board

John Scott (Chair)

Independent Consultant

Prof Paul Beasley

Head of R & D UK at Siemens

Ben Burggraaf

Energy Operations Manager at
Dwr Cymru Welsh Water

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

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

REFHYNE Project Manager at ITM Power

Paul Gallagher

Innovation Manager/Engineering
Services Manager for National
Grid Electricity Transmission

Stephen Phillips

Chief Executive at Neath Port Talbot
County Borough Council

Dave A Roberts

Technical Director, 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

James Yu

Future Networks Manager at
SP Energy Networks

Dr Martin Kenny

Sustainability Director for Tarmac

Chris Harris

Head of Regulation and
Compliance at Npower

Dave Richardson

Project Director for Costain

Martyn Popham

Managing Director at Cenin Group

FLEXIS researchers reaching their full potential

Part of our activity at FLEXIS was to drive innovation to create jobs and produce real economic impact. One of our key objectives was to create significant critical mass and attract new researchers to Wales.

Since 2015, we have recruited around 95 researchers and in June 2020 one of these researchers, Louise Hamdy, shared her story for International Women in Engineering Day.



Louise Hamdy

“ Never one to be put into a box, I initially started my undergraduate degree in Biochemistry and graduated with a Masters and PhD in Chemistry. I now work in the College of Engineering at Swansea University for FLEXIS.

Going back to the beginning, I must have been inspired by the countless kids' Usborne science books kicking about my childhood bedroom. I have always been fascinated by science, from stingrays to X-rays and I have always cared deeply about the protection of the natural world.

As my knowledge and understanding grew, so did my awareness of the environmental disasters unfolding – often at the hands of the energy and chemicals industries, but which could be redressed through the chemical sciences.

I headed from Glasgow to the University of Bath for my PhD in Crystallographic Studies of Supramolecular Structures.

Now, working in the interdisciplinary environment of the Energy Safety Research Institute at Swansea University for FLEXIS, I combine my experience in materials chemistry with my drive to help the environment by developing new carbon dioxide adsorbents that can help reduce greenhouse gas emissions and combat global warming.

This post has been the platform of my greatest professional achievements, publishing high impact research and writing in *The Conversation*. This also led to one of my proudest moments, presenting in the Library of the Royal Society of Chemistry's historic Burlington House headquarters in London.

I have also enjoyed taking part in our research group's science outreach project 'Recycling Carbon' and engaging with the public on issues of energy production and the environment.

I think outreach is an extremely important aspect of being a scientist. I really admire the physicist and oceanographer Dr Helen Czerski as she communicates what is often perceived as difficult and abstract science in an exciting and – most importantly – an inclusive way.

To read the full version please click [here](#).

The right tool to unlock energy systems thinking, and to save the public sector pound

Funder



Professor
Nick Jenkins



Professor
Jianzhong Wu



Dr Sathsara
Abeysinghe



Mr Alexandre
Canet



Dr Muditha
Abeysekera

The public sector is the largest buyer of gas and electricity in the UK. Energy managers of public sector organisations such as hospitals, campuses and schools are faced with a significant challenge to optimise the operation of multi energy supply systems (electricity, gas, heating/cooling) amidst the large variations within day and seasonal energy prices.

Before this project, there were no easy to use tools to unlock these possibilities and to support energy managers in making these decisions.

In January 2019, the then FLEXIS Researcher, and now Lecturer, Dr Muditha Abeysekera, secured a £39,507 EPSRC grant via the Centre for Energy Systems Integration (led by Newcastle University), to create a tool to address this challenge.

With support from his FLEXIS colleagues, Professor Nick Jenkins, Professor Jianzhong Wu, Dr Sathsara Abeysinghe and Mr Alexandre Canet, Dr Abeysekera worked in partnership with a range of industry and academia, namely, the Energy Systems Catapult, the UK Governments Crown Commercial Services (Energy), Queen Elizabeth Hospital at King's Lynn and the University of Warwick, to develop a tool to support decision making on the day to day and seasonal operation of on-site energy systems whilst considering the energy price fluctuations and the synergies between multi energy systems.

The decision support tool was demonstrated at Queen Elizabeth Hospital at Kings Lynn. The tool showed that by improving controls of on-site energy assets and optimising the operation of the energy system, the hospital could save around 10% on its energy use, including a 15% reduction in carbon emissions and achieve cost savings of around 17%.

Since then, this research has:

- attracted £90k additional funding from EPSRC to further develop decision support tools in collaboration with project partners
- influenced investments in the building management system at Queen Elizabeth Hospital
- provided technical input to the Energy Systems Catapult's Modern Energy Partners programme
- applicable to UK Governments' Crown Commercial Service customer base
- influenced formal collaborations to commercialise the decision tools in partnership with Energy services company, QiO Technologies

FLEXIS researchers reaching their full potential



Dr. Muditha Abeysekera

“ When I started this research project, I was a FLEXIS funded researcher at Cardiff University. In the space of a year, this research has given me lots of experience and opportunities within the industry and supported me to progress my career and take on a role as a lecturer within the university.

This project extracted learning from academic research to develop a simple methodology to evaluate operation decisions of energy systems and highlight the potential benefits of local multi-vector energy systems for providing local grid services.

It also showed there are major benefits to be captured from fuel arbitrage and energy storage systems; from optimising the interactions with energy suppliers and other neighbouring energy systems, through to the interconnection of energy networks and smarter cost effective energy choices.

This project was a real team effort and I'd like to thank everyone involved for their, guidance, commitment to research and openness to change.

Dr Sathsara Abeysinghe, who was employed to work in this project, also found the collaboration truly rewarding. Dr Abeysinghe who is originally from Sri Lanka specialises in a statistical analysis of energy systems. She gained a PhD degree from Cardiff University and is now working with FLEXIS staff and researchers to advance her research interests. The CESI project provided her with a brilliant opportunity to put her skills to the test and see the results unfolding. The success of this research exceeded Sathsara's expectation. She is now working on the second stage.



Dr. Sathsara Abeysinghe

“ The success of this research grant enabled me to transition from a closely mentored researcher to an independent researcher with my own project. From the beginning of this project, I found myself developing a vast variety of skills in research, organisation and project management within a short period of time, which I am sure will benefit my future career.

As a continuation of the first stage CESI project, in this new project we proposed to bridge the gap between the potential benefits of the theoretical most effective operation of public sector multi energy systems and realising these benefits.

Currently we are developing new control algorithms/strategies to improve the real time operation of the two public sector case study sites including the Queen Elizabeth hospital Kings Lynn.

I have been fortunate to work with a remarkably talented research team and extremely supportive project partners in this project. I am hopeful that this project will be of great success.

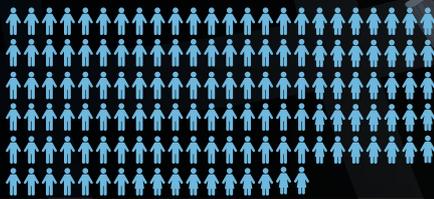
FLEXIS

SMART ENERGY FOR OUR FUTURE
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IMPACT

Creating research capacity and cutting carbon emissions

PEOPLE



135 employees

95 researchers recruited

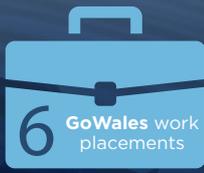


44 Academics on the project



Professional associations and memberships/chairs of profs connected to FLEXIS

50+



6 GoWales work placements



60

PhD students associated with FLEXIS research themes

PERFORMANCE

614 papers published



100+ research projects underway



250 conferences attended



INVESTMENT

£25,884,036

Generated in grant income



92x research grants

£21,035,100



29x industrial grants

£4,848,936



4x grants over £1m

£2.4m



investment in equipment and technology

39%

success rate



146 grant awards out of 372 bid

PARTNERSHIPS

235

industrial collaborations



151

academic collaborations



FLEXIS is part funded by the European Regional Development Fund and wishes to acknowledge the support provided by the Welsh European Funding Office (WEFO).

www.flexis.wales

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Comments from the Vice Chancellors



Julie Lydon
University of South Wales
Vice Chancellor



The FLEXIS team from the Sustainable Environment Research Centre at the University of South Wales have produced internationally leading research solutions that address the critical challenge of future energy systems, using Wales as their living laboratory.

Working across disciplines with key industrial partners, the FLEXIS team have developed novel and creative ways to decarbonise one of the most significant regions in Europe.

FLEXIS has demonstrated how collaboration between academia, industry and government can nurture expertise, knowledge and ideas that provide solutions for a net zero future.

The substantial number of publications and further collaborative projects generated reflects the expertise and capacity that has been developed by the FLEXIS project. I look forward to seeing the FLEXIS team continue their important work.



Professor Colin Riordan
Cardiff University
Vice Chancellor



FLEXIS has enabled a truly multi-disciplinary integrated approach by a team of leading South Wales energy academics, led by Cardiff University, towards a sustainable net zero future.

Focussed on a challenging region of South Wales, FLEXIS tackled the truly 'difficult to decarbonise' sectors of heat, transport and industrial energy, leading to the South Wales Industrial Cluster initiative.

Through establishing the FLEXIS demonstration area, integrated energy systems can now be demonstrated at scale. The role played by societal engagement and risk perception research teams is a particularly attractive feature, essential to addressing such societal grand challenges.

FLEXIS has also developed outstanding early career researchers, as well as a Centre for Doctoral Training to ensure the healthy supply chain of future leaders in this field.



Paul Boyle
Swansea University
Vice Chancellor



The research outputs and industrial traction created by FLEXIS is impressive and I feel the critical element here is how a really strong community has grown, equipped with the talent and skills to help support a regional transformation towards net zero.

This has involved exploring new ways of both heating our homes and travel, as well as imaginative ways of helping industry introduce fundamental changes to their ways of working.

It is an exemplar of interdisciplinary working and we look forward to continuing the journey together to decarbonise Wales, providing an example for the rest of the world to follow.



Swansea University
Prifysgol Abertawe

Principal Investigators – Point of view



Professor Alan Guwy
University of South Wales

“ One of the most promising areas we have developed in FLEXIS is the ability to convert waste gases and biomass into valuable platform chemicals known as volatile fatty acids (VFAs).

This “VFA Factory for Decarbonisation” concept is a variant of anaerobic digestion, but rather than producing methane a green house gas (GHG), VFAs are produced as chemical building blocks that can decarbonise the production of everyday materials such as plastics.

The biological conversion technologies developed in FLEXIS have resulted in a number of EU, and UKRI funded projects which include pilot scale deployment in partnership with industry.



Karen Henwood
Social Science,
Cardiff University

“ FLEXIS is a collaborative network that enables social scientists to work far more effectively with colleagues who are knowledgeable and practical in their ways of dealing with complex technical systems change.



Professor Jianzhong Wu
Cardiff University

“ FLEXIS has provided us with the capacity to carry out further research, this includes additional researchers, test facilities and equipment and close collaboration with government and industry. In particular, partnerships with industry within FLEXIS’ Neath Port Talbot Demonstration area.



Professor Nick Jenkins
Cardiff University

“ One of the outcomes from FLEXIS that I am most proud of is the successful training of young researchers. The problems facing us are immense and can only be addressed by a plentiful supply of talented researchers.



Dr. Charlie Dunnill
Swansea University

“ FLEXIS has enhanced expertise within Welsh universities through recruitment and development. It has invested in infrastructure and research facilities to develop world leading research into reducing CO2 emissions in our atmosphere, which has enabled additional funding and partnership working to develop further research.

Funded Research Projects

121 Funded Research Projects

=£25m+

33 projects x EPSRC

=£10m



34 projects x Private Enterprise

=£5.5m



27 projects x Government

=£2.3m



17 projects x Other UK Research Councils

=£4.2m



10 projects x EU Funding bodies

=£3m



Investment in technology and equipment

FLEXIS was designed to develop an energy systems research capability in Wales which will build on the world class capability that already exists in Welsh universities.

Part of that capability is having access to world leading technology and equipment to allow researchers within our partner universities to advance their research and the research of future generations. To date, the project has invested £2.4M into equipment and technology.



Phantom V1212 High-speed camera



AC Transformer

Gas Turbine Research Centre

Equipment purchased:

- Phantom V1212 High-speed camera
- SIL40HG50 High-speed image intensifier
- Litron LDY30-527 High-speed laser (for particle image velocimetry)

Purpose:

To understand the thermochemical response of the flame in significantly more detail. When combined together this equipment measures the dynamic response of the flame which relates to flame stability, intermediate chemical radicals producing light and how that effects the produced emissions and acoustic signature of gasses

This equipment will be used across the majority, if not all **future projects** at the Gas Turbine Research Centre as they continue to explore net zero solutions for combustion systems with traditional and alternative fuels.

Lightning Lab

Equipment purchased:

- AC Transformer
- DC Supply

Purpose:

This specialist equipment allows the team to carry out full scale systems research as opposed to the test cells that were previously available and to test certain components such as HVDC insulators as part of current and future research.

The team will continue to use this equipment as they further explore SF6 leakage, alternative gas characterisation and throughout other relevant project with National Grid and Allied insulators.

Investment in technology and equipment



GasClam



Linseis HP-STA

Geoenvironmental Research Centre

Equipment purchased:

- GasClam – in-borehole gas monitoring system
- Linseis High Pressure Simultaneous Thermal Analysis System

Purpose:

The GasClam is the first unmanned in-borehole gas monitoring technology that can collect data continuously. This equipment is unique in its ability to collect long-term, real-trend ground-gas data (methane, carbon dioxide, oxygen, hydrogen sulphide, carbon monoxide and total VOCs) and provide environmental monitoring to better inform research.

The Linseis High Pressure Simultaneous Thermal Analysis System is used to characterise the thermal properties of coal and rock samples in the aspects of unconventional gas technologies.

One of its key features is the ability to conduct adsorption/desorption of gas on solids by mass change at different temperature and pressure to replicate the process of geological carbon sequestration (CCS).

Resources from Urban Bio-waste

Funders



EN Horizon 2020 Work Programme
2016 - 2017 CIRC-05-2016:
Unlocking the potential of urban organic waste
Research and Innovation Actions (RIA)



Dr Jaime Massanet-Nicolau



Dr Rhys Jones



Professor Alan Guwy



RESURBIS Team

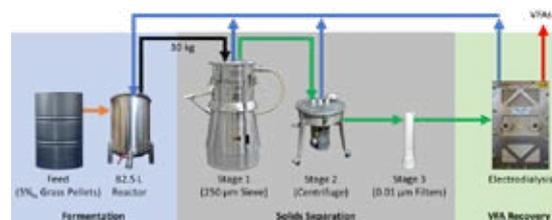
RES URBI is a three year European commission research and innovation project that started on January 1st 2017. It is an international project made of 20 partners from eight countries to look at the conversion of urban biowastes into value biobased products such as bioplastics. A priority of the European commission.

Biowastes include, sewage sludge, food waste and park waste. Bioplastics are a material or product derived from biomass (plants).

One of these partners was our very own University of South Wales who received a £212,000 Horizon 2020 grant to look at the decarbonisation of polymer production.

Through a partnership project involving Welsh Water, Tata Steel UK and many international SMEs and universities, USW and its FLEXIS researchers successfully led the work on the conversion of these urban biowastes into carboxylic acids, commonly known as volatile fatty acids (VFAs), the building block chemicals that can be used to produce many products for the chemical industry, such as films and coatings for product packaging and structural plastics for things like furniture and consumer electronics.

This was done by developing an advanced form of anaerobic digestion integrated with novel separation technologies.



(illustration of the conversion and separation process that applies to most biomass streams.)



Resources from Urban Bio-waste

Funders



This project has since led onto a new concept which the team is calling 'VFA Factory for Decarbonisation.' Lead by Prof. Guwy, the VFA Factory is a variant of anaerobic digestion in which, rather than methane being produced, carboxylates such as acetate, butyrate and propionate are produced and separated.

Incorporating carbon into these compounds, instead of fuels like methane, helps to decarbonise energy generation.

This is a potential game changer for the water and waste industries, transforming waste treatment plants into industrial decarbonisation biorefineries.

Advances in the FLEXIS work has stimulated further research through funded projects including a Marie Curie Co-Funded PhD, a Newton Fellowship, RICE and a new proposal to IDRIC and FLEXISApp.

The VFA factory concept has grown to include several new core technologies for different wastes streams, such as BIO-ACE for biomass and H2-ACE and CO-ACE for waste gases streams such as those produced in steel manufacturing.

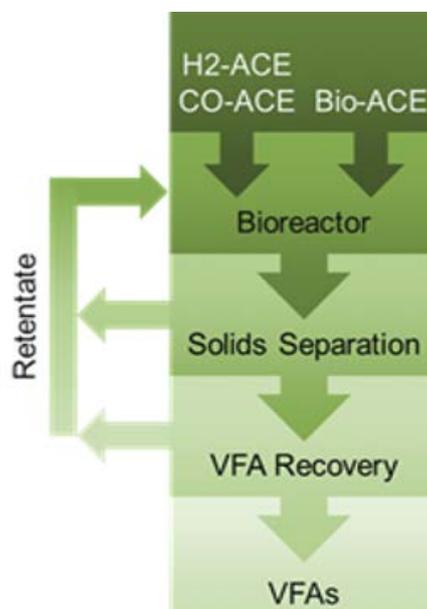
The team has developed, at lab scale, a process that successfully converts sewage biosolids, grass and municipal food wastes into valuable VFAs in continuous operation.

These green platform chemicals, which have much higher market value than biogas, will significantly reduce greenhouse emissions helping to make wastewater treatment net zero.

Professor Alan Guwy adds

“ Tata Steel, Welsh Water and other industries within the South Wales Industrial Cluster (SWIC) are significant emitters of greenhouse gases (GHGs) including CO₂, CO and CH₄. These industries are actively seeking to decarbonize these emissions. The economic costs of decarbonization are reduced if carbon is converted to valuable platform chemicals such as volatile fatty acids (VFAs), instead of being captured for disposal or converted into GHGs such as CH₄.

There is a large market for VFAs valued at over €1.5 billion growing at 15% p.a. The USW team has demonstrated the feasibility of these processes, but challenges remain concerning intensification and scaleup to accommodate large carbon emissions from industry alongside technical challenges, resistance to change must be addressed by showing how these processes can be incorporated into industries that typically have long development and investment cycles.



Scalable CO2 adsorbents

Funder



Llywodraeth Cymru
Welsh Government

The project 'Scalable CO2 adsorbents' targeted the development of new materials for CO2 capture from industrial flue gases and air. Industrial CO2 emissions from the burning of fossil fuels are increasing worldwide, and the accumulating concentration of CO2 in the atmosphere is the primary cause of climate change.

Effective CO2 adsorbents can reduce the amount of CO2 in the atmosphere, therefore, research in this area is highly important. The UK continues to use fossil fuels to meet current energy demand, therefore, carbon capture technologies are fundamental for enabling the transition to net zero carbon emissions, targeted for 2050.

The initial aim of this project was to design a new and highly efficient CO2 adsorbent using economical and widely available starting materials.

The research was led by **Dr Enrico Andreoli**, Associate Professor and Head of the Carbon Capture & Utilisation Research Group at the Energy Safety Research Institute, Swansea University. Lab work, analysis and the writing-up of the research was performed by **Dr Louise Hamdy**, FLEXIS research officer and Dr Athanasios Koutsianos, (then) PhD candidate.

The contribution of FLEXIS was fundamental to the success of this project in that it not only funded Dr Louise Hamdy's post-doctoral position, but it enabled the purchase of laboratory supplies and advanced new analytical instruments.

These included the ReactIR iC IR 7.0 and the iSorb HP1 High Pressure Gas Sorption Analyzer – a versatile piece of equipment and the first to be purchased in the UK.

ESRI colleagues and Marie Curie Research Fellows* Dr Marco Taddei and Dr Russell J. Wakeham contributed to the success of the project by offering some specialist support and new synthetic perspectives.



Dr Enrico Andreoli



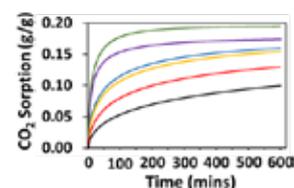
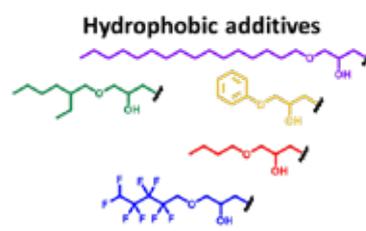
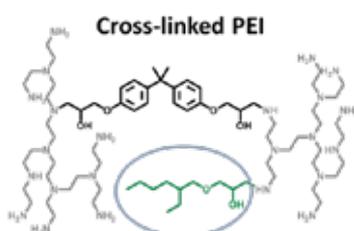
Dr Louise Hamdy

Other aspects of the research were conducted in close collaboration with several academic and international partners – including a commercial enterprise who also work on CO2 adsorbents. As the project advanced beyond the establishment of high performing materials and into the scaling-up stages, Abel Gougsa, MSc student at Swansea University was also brought on board, helping to boost sample preparation and develop the highest performing adsorbent of the project.

FLEXIS funding made possible the discovery of new high capacity, highly selective, robust and economical CO2 adsorbents, significantly advancing current knowledge in an exciting new branch of these materials and paving the way for their application in industrial settings. It has also funded Dr Enrico Andreoli and Dr Louise Hamdy to attend conferences# and events, to share their findings with the wider community. At these, they have met leading figures, such as science communication expert Dr Michael Dahlstrom. They have been inspired to better publicise their research, to inform others as to the dangers of climate change, and of the exciting solutions that FLEXIS are working on to reduce CO2 emissions as we move forward to a net zero future.

More information on this project can be found here:

- [Paper](#)
- [The Conversation](#)



*Supported under the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement no 663830 #namely, American Chemical Society 2018 Midwest Regional Meeting, special symposium on Carbon Capture, Utilization and Storage

The Active Building Centre Research Programme: Living Well in Low Carbon Homes

Funder



Professor Karen
Henwood



Professor Nick
Pidgeon



Dr Kate
O'Sullivan



Dr Fiona
Shirani

The **Active Building Centre (ABC)** is a £36million investment and is part of the **UKRI Transforming Construction Challenge Fund**. Its vision is to transform the UK construction and energy sectors through the deployment of active buildings.

Being sustainable, energy efficient and digitally intelligent, active buildings should significantly contribute to UK national net zero targets as well as international and global agreements to address climate change. The research programme is researching and developing innovative tools and technologies towards this vision.

The role of buildings within the energy system is changing. Active homes combine in-building energy generation, storage and advanced energy management systems. Integrating such homes into UK energy infrastructure offers one potential means for addressing the net zero challenge in relation to the UK's energy inefficient building stocks. However, active homes are more than a material building, or a simple extension of energy infrastructure.

They are also homes and as such, are laden with meaning and value for the people who will live there. Active homes will offer not only better energy management for householders, but will also change the expected privacy of a home as well communications within and between the home and wider neighbourhood. As many active homes may require new occupant behaviours to achieve their intended low/zero carbon and grid flexibility objectives, it is essential that social science insights are gained as to how such a home is both understood and lived in by occupants, both now and as active homes are developed into the future.

Who is involved in the Active Building Centre project?

The ABC Research Programme is led by Swansea University and brings together expertise from across industry and academia. The academic consortium consists of 10 UK universities working within 10 work packages researching innovative technologies; data and monitoring; socioeconomics and user engagement; and modelling and tools.

FLEXIS' social science investigators Professor Karen Henwood and Professor Nick Pidgeon from Cardiff University are leading the 'Living Well in Low Carbon Homes' work package of the Active Building Centre. Working in a carefully selected set of South Wales case sites, the research seeks to explore the experiences of active home residents prior to and at several points after moving into their active homes. The study builds upon methods and approaches developed in the FLEXIS social sciences programme.



Internal visual control panels to manage heating and air ventilation, and 13.5kWh battery storage capacity at each home.

The Active Building Centre Research Programme: Living Well in Low Carbon Homes

Funder



What is your involvement within the project and what do you hope to achieve?

Understanding the perspectives of residents will be crucial if wider rollout of active homes is to be successful. Our Living Well in Low Carbon Homes research will produce original insights into the lived experience of active homes, exploring the interplay between people, homes and energy as the anticipated new dynamic role of buildings in energy infrastructure is realised. It will do so while gaining understanding of particular developer motivations and ethos, as well as social and political factors, behind the homes' development and design.

Using a combination of interviews and activities we are exploring the impact of living within these homes on residents' everyday lives and anticipated futures at different points in time, as well as how these contexts impact upon individual households' energy practices and internal relationships, in addition to their wider community relationships.

How has FLEXIS contributed to this project?

The FLEXIS social science work on 'social acceptability and responsible development of energy systems' and in particular that on 'System change and everyday life' has contributed to the Living Well in Low Carbon Homes research in the ABC.

Our **FLEXIS work** has utilised qualitative longitudinal interviews with residents in an ex-mining community (Caerau in Bridgend Borough) where ongoing work is exploring the potential for a community district heating scheme using heat from water in disused mine workings. With its focus on the importance of life-course and relationships; temporal sensitivity (encompassing e.g. living memories and anticipated futures) and attentiveness to place dynamics within and outside of the home, insights from FLEXIS have been applied directly to the work in ABC. In particular, we have used these to develop an approach that combines qualitative longitudinal interviews designed to elicit temporal narratives, with supplementary visual techniques to expand discussion with residents of active homes.

The Active Buildings Project currently runs until September 2022.



New active home with solar thermal collector walls, solar PV roof, ASHP and MVHR, electric vehicle charging point and battery storage

Comments from our key stakeholders



Ron Loveland

Welsh Government
Energy Adviser

“ ...with FLEXIS, we now have a large world-class, mainly energy-focused team, ideally placed to help Wales move as rapidly as possible to a net zero energy system.

Using the extensive funding from the Welsh Government and accessing much other innovation support, the team has built up a unique range of research and training expertise and staff in areas such as:

- exploring what a whole system approach to a net zero economy means in practice;
- applying a whole systems approach, covering low carbon power, heat and transport;
- the development of smarter, flexible and resilient electricity grids as high carbon fossil fuels for power generation are displaced by ever more low carbon renewable sources;
- exploring how new materials and effectively utilising waste products, can create a truly circular, resource-efficient, low-carbon energy economy;
- and much more

As we look forward through the 2020s, FLEXIS' expertise, honed through this real-world work, should help enable us to identify and pursue the smartest ways to use, store and generate low carbon energy in a wide range of resource-efficient ways at the local, regional, national and global levels- while also, through the development and communication of strong real-life based net zero strategic narratives, will assist in the process of engaging with the public, without the support of whom in encouraging the right behavioural changes will be very challenging.

Comments from our key stakeholders



Chris Williams

South Wales Industrial Cluster Lead.

“ FLEXIS with its very active Advisory Board and knowledgeable Principle Investigators, backed by capable researchers, has provided the perfect springboard for industry in South Wales to come together to explore and develop their route to net zero.

This combination of the senior industrial Advisory Board members and academics resulted in lively discussions around the challenges for the technologies and social impacts for the development of net zero regions. These open discussions and debates not only led to invaluable research programs to support industry with their visioning and long term strategies but also acted as a focal point for defining the development of the need for the South Wales Industrial Cluster.

FLEXIS demonstrated that by working together as an ongoing group, Industry, academia and government can use all the skills in the area as a team to help shape the long term vision for Industry in South Wales.



Chris Jones

Neath Port Talbot County Borough Council (NPTCBC)

“ FLEXIS has enabled the further development and implementation of decarbonisation, innovation and regeneration within Neath Port Talbot. The localised presence of the academic partners adds significant strength of the programme as it nurtures a culture of expertise and excellence, centered around the FLEXIS demonstration area.

FLEXIS has raised the profile of decarbonisation not just within the demonstration area and NPT Council, but across Wales and internationally.

Now, FLEXISApp takes forward the research from FLEXIS to develop low carbon technological solutions. We look forward to further supporting, developing and implementing initiatives with our academic and industrial partners, under the FLEXISApp programme.



FLEXIS App

Collaborate | Commercialise | Decarbonise
Cydwethio | Masnacheiddio | Datgarboneiddio



FLEXISApp is a £3M research, development and innovation programme focussing on industrial decarbonisation and economic growth.

Funded by the Welsh European Funding Office (WEFO), this project brings together academia, industry and government to develop innovative energy technologies to achieve net zero targets.

What will FLEXISApp do?

With industry contributing around 25% to the UK's CO2 emissions, FLEXISApp will take forward the research and demonstration capacity of FLEXIS and part fund the commercial development of energy technologies, that focus on industrial decarbonisation and greenhouse gas (GHG) reduction.

Through collaborating with industry partners, FLEXISApp will also strengthen the knowledge base and innovative ability of Welsh companies including driving new company and job creation in Wales.

Where will this take place?

Partnership projects will include industry within West Wales and the Valleys. Development and testing of technologies will take place within the FLEXIS Demonstration Area in Neath Port Talbot.

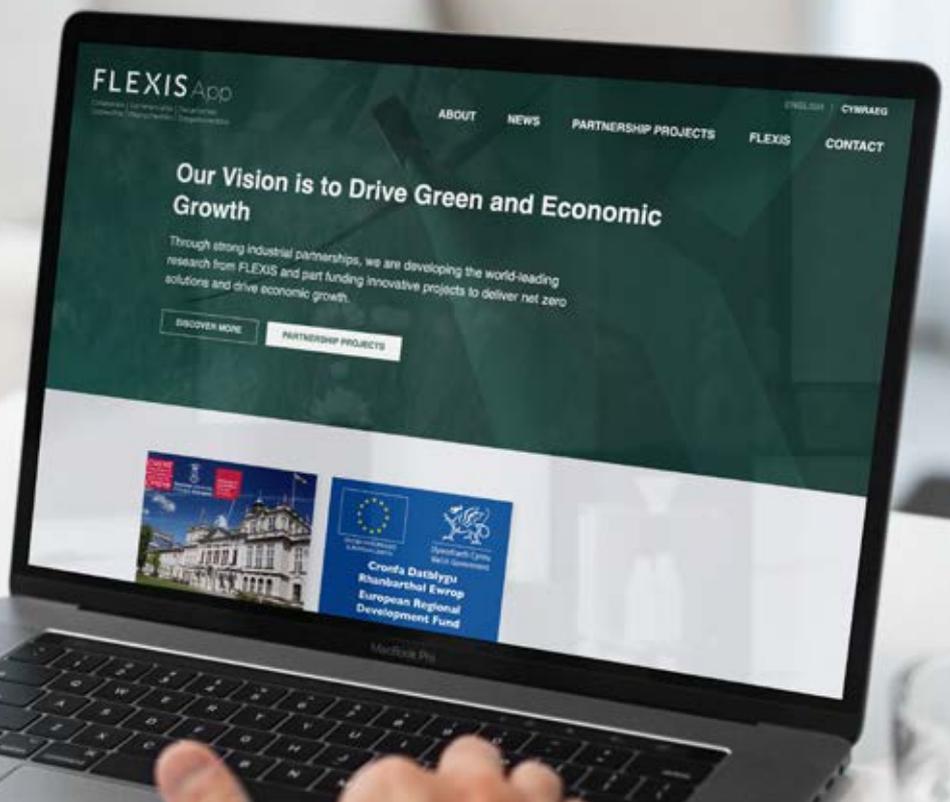
Innovative energy technologies will be tested and optimised as component parts of a functioning energy system. This is to prove their commercial viability and to create a centre of expertise that's recognised internationally.

More information about FLEXISApp and its partnership projects can be found online:

 www.flexisapp.wales

 [@FLEXISProject](https://twitter.com/FLEXISProject)

 [@FLEXIS](https://www.linkedin.com/company/flexis)





FLEXIS

SMART ENERGY FOR OUR FUTURE
YNNI CALL AR GYFER EIN DYFODOL