Smart strategies for the transition in coal intensive regions

Project No: 836819

Study Tour, 20 November 2019
Cardiff, Wales, UK

Minutes

WP 7 – Task 7.1 / D7.1

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TRACER website: www.tracer-h2020.eu

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1 Introduction

The second study tour of the TRACER project took place in the target region in Cardiff, Wales, UK (UKL1 ad UKL2) on 20th November 2019, **alongside the TRACER 1st Progress Meeting.**

The study tour was organised in line with the WP7 activities "Research and Innovation Cooperation of coal intensive regions", under the Task 7.1 Organisation of study tours to best practice regions. **The goal of the study tour** was to show **Research and Innovation projects in Wales**, existing **best practices in the target region** and **promote successful activities within the TRACER project.** In total 28 participants attended the study tour.

Figure 1: Ebbw Vale, a former coal mining and industrial town, Wales, UK

2 Innovative projects - University of Cardiff

FLEXIS project

FLEXIS (Flexible Integrated Energy Systems) is a £24 million research operation designed to develop an energy systems research capability in Wales which will build on the world class capability that already exists in Welsh Universities. FLEXIS is made of approximately 100 academics, researchers and administrative staff from three of Wales' leading universities – Cardiff, Swansea and University of South Wales. FLEXIS is based on WEFO's (Welsh European Funding Office) ERDF Programme, Priority Axis 1: Research and Innovation. The budget is dedicated for 6 years.

The topics covered by the project are:

- Integrated Energy Networks
- Integrated Energy Storage and Generation
- Smart living in the Built Environment
- Fuels and Earth Energy Systems

The academic locations are the following:

- Swansea University
- Hydrogen Centre – Energy Park
- FLEXIS Office/Centre
- Gas Turbine Research Centre

The project collaborates with over 208 organisations.

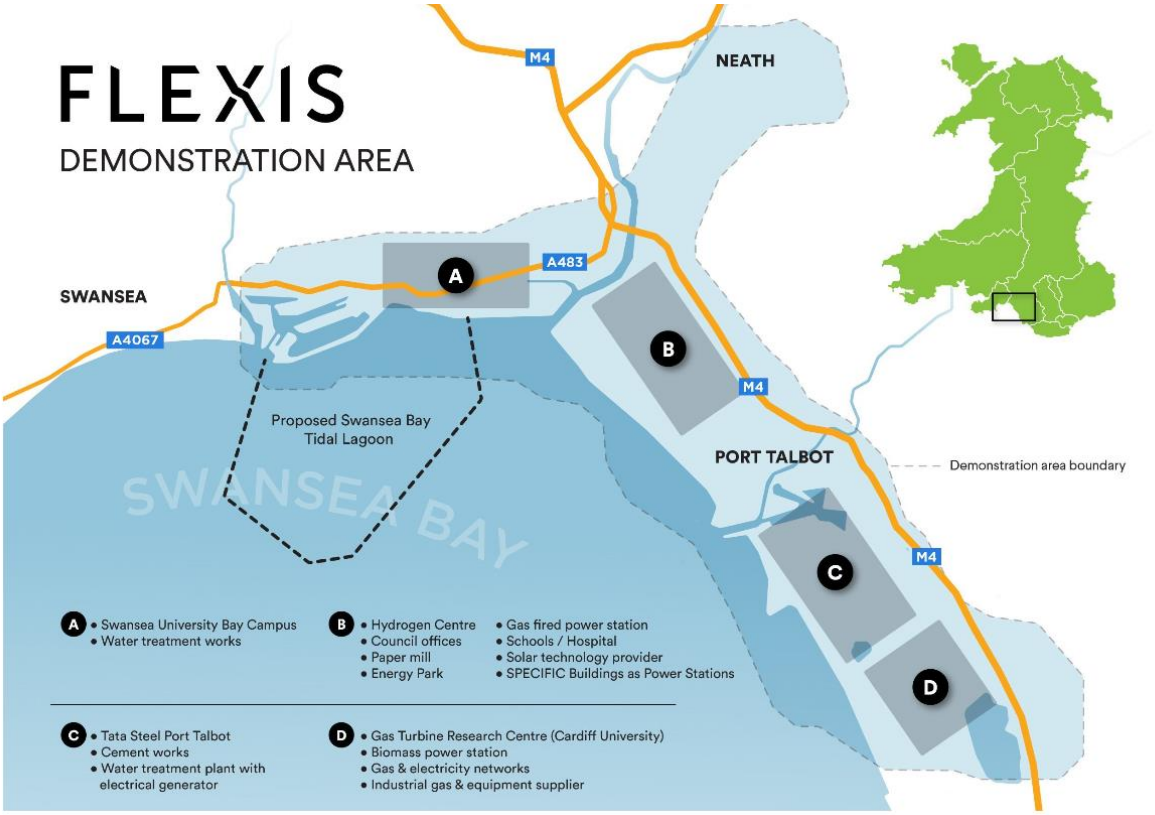

Figure 2: FLEXIS demonstration area (Source: http://www.flexis.wales/demonstration-area/)

The FLEXIS Demonstration Area spans 50 km^2 of Neath Port Talbot, a region characterised by its industrial heritage and the UK's largest point source of CO_2 emissions. Work carried

out at the Demonstration Area will bring together academia and industry to deliver low carbon energy solutions, facilitated by ties with Neath Port Talbot Council, industrial partners and world leading academic institutions. the aim is to model the energy and CO_2 flows in the region, improve the resources efficiency, improve the flexibility if the energy networks and reduce waste and CO_2 emissions.

Figure 3: Study Tour participants at the University of Cardiff

FLEXIS' aim is to create a culture of research and innovation across Wales and be known across the world as a leader in energy systems technology. The project also includes driving innovation to create jobs and produce real economic impact. One of objectives is to create significant critical mass and attract new researchers to Wales. In addition, the aim is to embed excellent researchers within research led companies in Wales, attract new companies, thus supporting the Welsh economy and creating jobs.

An international cluster will be developed through collaboration with private and public sector research organisations in Wales, throughout Europe, and worldwide.

To enable the UK to meet its climate change commitments, energy systems will need to be developed that enable decarbonisation of our energy supply, whilst ensuring its security and affordability. Fuel poverty, particularly amongst the elderly, is of growing importance as energy prices increase to accommodate ever more complex renewable energy systems and the associated new infrastructure. The project aims to tackle the socio-economic aspects of this challenge including public perceptions and communication about energy research and development, and the associated costs and benefits. An interdisciplinary approach is essential in order to solve these diverse, complex and inter-dependent challenges (Source: http://www.flexis.wales/about/).

FLEXIS – Mine Water Heat Recovery

There are 7.7 million properties on UK Coalfield, 2 million thereof sit on the shallow coal workings. Many areas have flooded mine workings in the near sub-surface.

Mine water can provide a focus for sustainable regeneration of former mining areas, demonstrating a new renewable energy resource that can deliver heating and cooling for sustainable communities. Community heating/cooling provide answers to energy trilemma: security, affordability, sustainability. The first demonstration site in Wales is operational since 2014, located in Crynant, the Dulais valley.

SEREN Project – Sustainable Earth Energy

The aim of this project was helping to make Wales self-sufficient in Energy (identifying ground energy options; renewable and sustainable energy mapping), address economic renewal strategy for Wales (creating new companies and jobs in Wales; building technical capacity; renewable and sustainable energy mapping), address cross cutting themes of environmental sustainability and equal opportunities.

The project collaborated with other EC Convergence areas and low-carbon geo-projects. It assisted Welsh companies in exploring their products and services. In addition, welsh companies were linked up with low carbon technology providers and problem holders worldwide. Finally, one of the goals was to attract companies working on innovative low-carbon technologies to Wales.

The project linked with Silesia, Poland (Central Mining Institute) with ended in joint projects in Poland. SEREN project collaborated also with the European Institute for Innovation and Technology.

The project benefited from transnational activities:

- Identified innovative technologies that can benefit Welsh companies
- Welsh companies were introduced to Polish and Eastern European markets
- Identified R&D and commercial opportunities
- Access to research infrastructure and complementing expertise
- Sharing best practice
- Access to new funding sources
- Access to new partners and opportunities – using Partner's networks
- Showcasing Welsh expertise in Poland and Europe

The project was designed to complement Wales' work in the area of smart specialisation at the highest political level. The low-carbon agenda is thus strongly embedded in the region's smart specialisation efforts, to which SEREN has made a major contribution.

The project's novel ground-energy schemes are also being used to address critical issues, such as fuel poverty, environmental injustice and social inclusion in deprived areas of Wales, and can be adapted to specific conditions in other European regions.

Total investment for the project SEREN was 11.8 mln. EUR with the EU's European Regional Development Fund contributing 6.6 mln. EUR through the "East Wales" Operational Programme for the 2007-2013 programming period. SEREN has been instrumental in creating new SMEs and sustaining existing companies in a region with high unemployment. Schemes based on SEREN improve access to affordable energy, create jobs and mitigate environmental impacts. As the first country in the world to incorporate a legal duty relating to sustainable development into its constitution, Wales as a region is a globally recognised low-carbon champion. But translating this commitment into successful low-carbon and green-energy solutions on the ground is a constant challenge.

Led by Cardiff University's award-winning Geoenvironmental Research Centre, the EU-funded SEREN project has refined and developed practical tools and templates aimed at fast-tracking low-carbon innovations from the lab to the market.

The project took a hands-on approach to developing new commercial opportunities for micro- and small businesses with fewer resources for research and technological development in

the low-carbon and ground-energy sectors. The project worked very closely with these SMEs to help turn their ideas for product and service innovations into viable commercial outcomes, which deliver significant economic benefits while bridging cutting-edge academic research and industry practices.

Cross-cutting themes (CCT) – equal opportunities, gender mainstreaming, sustainable development and tackling poverty and social exclusion – were taken into consideration when channelling efforts into cost-effective outcomes. New templates (Eco-code and E&D-code) were developed for engaging SMEs and helping them reduce their carbon footprint, which other EU regions are now being encouraged to use. UN agencies UNESCO and UNIDO have already shown interest in these tools.

Some 90 SMEs were supported, 111 jobs created, 28 collaborative projects set up and 36 new processes and products developed thanks to this enlightened collaboration with SMEs in the region. SEREN also raised awareness of environmental sustainability and equal opportunities within 80 companies.

Source: https://ec.europa.eu/regional_policy/en/projects/united-kingdom/wales-is-becoming-a-low-carbon-champion)

Zero Carbon: Transport, Industry and Electricity

Domestic road transport is by far the biggest emitter at around 92%. Household transport emissions need to be close to zero in 2050. Councils will be allowed to impose tough restrictions on the most polluting diesel vehicles as of 2020. More than 2,000 schools around England and Wales are located near roads with illegal and dangerous levels of emissions.

Key milestones from the Government's Road to Zero Strategy

- By 2030: at least 50% and as many as 70% of new car sales being ultra-low emission
- By 2040: end the sale of new conventional petrol and diesel cards and vans, all new cars and vans to be 100% zero emission or to have significant zero emission capability
- By 2050: almost every car and van to be zero emission

It is planned to have 11 mln electric vehicles by 2030 and 36 million by 2040. For that electricity as a transport fuel is crucial. Smart flexible system will need new business models and services to match system needs with vehicle charging requirements and consumer preferences. Over 75% of electric vehicles could be using smart charging by 2050. Smart charging vehicles could enable the storage of roughly one fifth of the UK's solar generation for when this energy is needed.

Importance of innovation should be highlighted. Diversification of charging infrastructure is important.

Decarbonising Transport through Electrification (DTE) addresses a range of low-carbon transport modes (road, rail, aerospace and maritime) alongside associated infrastructures to support existing and deliver future mobility needs, treating these as an integrated system embedded within the electricity energy vector with the goal of decarbonising the transport sector.

3 The Works, Ebbw Vale

Ebbw Vale is an industrial town and urban area (from 2011 built-up area). Ebbw Vale developed as a coal-mining centre. Iron was processed using local coal, ore, and limestone. Steel production began later.

Figure 4: Ebbw Vale, study tour participants

There were times when the rolling mill at Ebbw Vale was the biggest in Europe, with the steelworks employing 14,000 people. However, the problems of the British steel industry in the 1970s led to closing down its steelmaking operations around in 1978. The site of the former Ebbw Vale Steel Iron and Coal company was finally closed in 2002. In 2002 steelworkers symbolically marched away from the site following its closure. The collapse of the town's chief industries brought economic difficulties. In 2005 the site was purchased by Blaenau Gwent County Borough Council and in 2009 site reclamation was completed.

Much public money has been spent trying to revive the place. The money for redevelopment comes from the EU's Regional Development Fund. West Wales, the Valleys and Cornwall are the only UK regions to qualify for such funding.

'The Works' District is composed of 7 buildings:

- General Offices
- Learning zone
- School
- Leisure centre
- Energy centre
- Multi Storey Car Park
- Cableway (mechanical link to connect The Works to Ebbw Vale Town Centre)

Ebbw Vale District Heating Network Project is ongoing. General Offices building is connected to district heating, through two separate heat exchangers serving respectively: space heating, domestic hot water production. Total installed heat capacity is 7,780 kW (gas CHP. 375 kW electric, 400 kW heat; two biomass boilers: 495 kW each, coupled to two thermal stores; 4 x 1750 kW gas boilers.

Different European Research Projects reached the Ebbw Vale: RESILENT, DRIVE, PENTAGON.

4 ERDF SPECIFIC - Active Buildings, Swansea University

The SPECIFIC Innovation and Knowledge Centre (IKC) has developed the buildings as power stations vision where integrated systems allow buildings to generate, store and release their own energy. The centre brings together world class academic and industrial expertise in aa range of technology areas that include photovoltaics, solar thermal, cooling, heat and electrical storage. SPECIFIC's goal is to foster a new industry and close the gap between research and exploitation.

Figure 5: SPECIFIC Innovation and Knowledge Centre

Areas of expertise:

- ***Printed photovoltaics*** - Developing a range of solar cell technologies and processing techniques that will allow high-efficiency thin-film photovoltaics to be manufactured at scale using earth-abundant, low cost materials. Working with the most promising photovoltaic technologies to find ways to manufacture them at scale is very important. Currently the work is carried out on four distinct technologies: perovskites, CZTS (copper, zinc, tin, sulphur), organic photovoltaics and dye sensitised solar cells).
- ***Energy capture***

  Solar thermal - SPECIFIC is researching state of the art of solar thermal energy generation by installing technologies that use different methods of heat abstraction from the environment. The research is based on direct and diffuse solar radiation

(separate and combined), unique air source thermal capture and the conversion of the captured energy into usable forms for our connected technologies).

Thermo-electric generation (TEG) - Thermoelectric generators are devices that exploit the Seebeck effect – a phenomenon in which temperature difference produces a voltage difference between two electrical conductors – to generate an electrical current.

- ***Electrical storage*** - The focus has been, and currently is, on portable batteries (mobile phone) and automotive. Building scale storage systems are the focus of SPECIFIC project.
- ***Thermal storage*** - SPECIFIC aims to enhance UK research and development in heat storage as an off-grid gas replacement technology. The team is currently working on diurnal (day to night) and inter-seasonal (summer to winter) thermal storage.
- ***Industrial coating*** – SPECIFIC is developing ground-breaking coatings for building materials that can be manufactured on an industrial scale in the UK. Once developed, these products will form the roofs, walls and windows of buildings to generate, store and release safe, clean renewable energy.
- ***Building energy systems*** - Embedding solar technologies into established building design and modelling processes will be critical for wider adoption of the 'Active Buildings' concept.

Active Office

The Active Office is UK's first energy-positive office, designed to generate more energy than it uses over the annual cycle. The Active Office contains a 2000 litre water-based thermal storage, which is capable of storing sufficient energy to provide space heating for the following day and enables times-shifting of electrical heating demand. The system also includes a 100 L accumulator tank, this buffers the output of the PVT system until it can be charged into the 2000 L thermal store. If required, an air source heat pump acts as a top up or backup to the solar thermal generation used to charge the thermal store. The thermal store provides all space and water heating for the Office via an intelligent building control system.

Figure 6: Active Office

5 Baglan Bay Innovation Centre (FLEXIS)

Solar Heat Energy Demonstrator (SHED)

The SHED in Margam is used to trial large scale demonstrators. It is a 1990's industrial unit, of poor quality construction, and is currently home to two major solar heat storage demonstrators.

Diurnal Solar Store

A solar air collector of approximately 590m^2 on the southwest facing wall of the building supplies heat into the building or to a large water tank, which stores heat for use the following day (Figure 7). Gas consumption was eliminated as a result of installing this system, with an estimated energy saving of 75%. A BSRIA independent monitoring report for September 2012 to November 2013 stated that it "achieved a low carbon and economical heating solution", which had the "performance of a ground source heat pump with the flexibility of air source". It concluded that the solar air collector and solar store were "demonstrated to be a viable renewable heating option".

Figure 7: SHED

Inter-seasonal Heat Store - Solar Heat Storage: Eliminating Gas heating

The second large scale demonstrator in the SHED is the Inter-seasonal Heat Store. This system stores heat from a Tata Steel Colorcoat Renew SC solar collector on the roof of the building in SIM (salt in matrix) thermochemical material. Moist air passed over the SIM causes an exothermic reaction, releasing heat from the salt matrix for use in the room.

More information:

https://www.specific.eu.com/assets/downloads/casestudy/Solar_Heat_Storage_FINAL.pdf

Active Railway Shelter – Transport for Wales Project

SPECIFIC utilises a rail approved platform waiting shelter as an Active Building demonstration. The shelter was installed at the Solar Heat Energy Demonstrator (SHED) site and will be used for testing and verification of suitable technology to enable the structure to generate(capture), store and release enough energy to run essential services in a low carbon manner.

As a minimum, the development of a standalone product which could be installed independently will be investigated, and the operational carbon emission impact of this active structure will be measured and monitored, with a view to providing data on effectiveness and efficiency in situ. If possible, and with a view on the circular economy, the project also will seek to develop bolt-on solution which allow Active Building technologies to be integrated into the existing structures of this type across rail platforms in Wales and across the UK.

Figure 8: Active Railway Shelter

6 Lessons learned

- Poor infrastructure needs to be improved first
- Improvement of IT networks in the area is necessary
- Lack of strong regional policies and leadership of the government is essential to overcome the challenge as there was no plan B for the Ebbw Vales
- Social care and education are important issues
- Attracting new funds (regional and EU) is crucial to implement innovative ideas in the region
- Innovative projects and research should be promoted

7 Agenda

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 836819.

Horizon2020 TRACER Coal regions in Transition

Day 2 Study Tour

20th November 2019 (Wednesday)

9:00	10:30	Welcome Cardiff University FLEXIS programme + Decarbonisation http://www.flexis.wales/	Prof Philip Bowen Dr Koj Prof Liana Cipcigan
11:30	13.00	The Works, Ebbw Vale Horizon2020 DRIVE: Next generation innovative technologies enabling smart grids, storage and energy system integration with increasing share of renewables: distribution network. Project Demand Response Integration Technologies – Unlocking the Demand Response Potential in the Distribution Grid", by Cardiff University. https://cordis.europa.eu/project/rcn/211957/factsheet/pl PENTAGON aims to deliver a new generation of eco-districts that exploit a wide range of renewable energy generation sources enabled by advanced energy management services acting on different energy carriers (thermal, gas and electric). http://www.pentagon-project.eu/partners/	David Ware Paul Colston Amy Taylor
12.30	13.00	Lunch with Blaenau Gwent County Borough Council	Dave Ware
14.00	14.45	Swansea University, ERDF SPECIFIC Active buildings Active Building Centre Active Classroom / Active Office (2 groups and conducted tours of both facilities)	Dr Justin Searle Bruce Philip Dr Christian Bryant Admin: Adam Holley
15.15	16.00	Baglan Bay Innovation Centre (FLEXIS) (Split into 3 groups and presentations) • SHED Heat storage salt • Thermochemical Developments • Transport for Wales – Active Railway Shelter	Bruce Philips Dr Jon Elvins Chris Bailey Admin: Adam Holley