

## **LINKING HIGHER EDUCATION TRAINING AND INDUSTRY IN THE WELSH LOW CARBON SECTOR**

A. Banteli, J. A. Gwilliam

Cardiff University, Welsh School of Architecture,  
Bute Building, King Edward VII Avenue, CF10 3NB, Wales, U.K.

### **Abstract**

*In order to transition towards economic growth and development the dissemination of Higher Education Institutions' (HEI) expertise to Industry is vital. However, traditionally HEIs have failed to respond in an effective and timely manner to Industry training needs. One of the reasons is their traditional focus on full degrees and a perceived lack of interest in delivery of more responsive courses including smaller awards and Continued Professional Development (CPD). The Low Carbon Research Institute, through the Welsh Energy Sector Training project, has undertaken research on HEI delivery in the area of Low Carbon Education available to the Welsh workforce. Results show that current training needs cannot be catered for by current education and training provision in Wales as this was found to lack the flexibility needed to cater for Industry's needs. This highlights the importance of WEST and similar initiatives in linking HEIs with Industry as well as the need for HEIs to investigate ways to enable effective engagement with Industry.*

**Key words:** *Higher education, Industry Engagement, CPD*

### **1. INTRODUCTION**

In order to transition towards economic growth and development the dissemination of the knowledge and expertise residing in HEIs is crucial, forming a central tenet of the Government's science and innovation strategy (HM Treasury, 2004: 69). The breadth of benefits resulting from this transfer of knowledge have the potential to impact at many levels including: the trainee, businesses / organisations, local communities and regions as well as the national economy (Lockett, 2008). However, this is only the case where the transfer of knowledge is successful, such as the relevance of content and responsiveness of processes, course content and delivery mechanisms to Industry's needs, essentially ensuring that training is accessible to this audience. It will however, be argued here that, HEIs are largely yet to demonstrate these abilities. Further, that the funding structures for HEIs place incentives on more traditional activities such as research and Degree based teaching schemes, explaining the lack of focus to date on the needs of the existing workforce (Lockett, 2008). However, this must now be seen in the context of the new Research Excellence Framework (REF) where the assessment criteria for HEIs has been broadened, and now includes the concept of 'impact'; where, *'impact is defined as an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life beyond academia'* (REF 02.2011, 2011). It is probably this assessment criterion that will encourage HEIs to consider wider engagement such as that which engages with beneficiaries beyond traditional academic partners to individuals, organisations, communities, at a local, regional, national or international level.

As has been found elsewhere, initiatives to date have enabled and promoted HE staff to undertake a variety of industrial engagement strategies including patenting, licensing and new company creation, while in contrast, knowledge transfer and continued professional development, training and consultancy have been relatively neglected realms of practice (D'Este, 2007). Further, no single agency has taken the lead on communicating and identifying skills and training needs at a regional level create, providing an additional barrier for HEIs to develop and deliver appropriate and responsive training (Chatterton, 2000).

It can also be suggested that the intensity of professionals' workload sets restrictions around time availability to undertake this necessary training. It is asserted here, that this barrier might be addressed

through the application of responsive learning patterns based on e-learning, enabling flexibility in time and location of learning experience however, it has been found that e-learning strategies and technologies have seen a slow uptake in HEIs (Bell et al., 2004).

The Welsh Energy Sector Training (WEST) Project has been funded by the Welsh European Funding Office's European Regional Development Fund, through the Low Carbon Research Institute (LCRI) Convergence Energy Programme (CEP). The LCRI aims to research energy efficiency intelligent building design, investigate low carbon technologies, and other allied strategies. The programme supports research projects focussing on: Hydrogen (H<sub>2</sub>), Large scale power generation (LSPG), Low carbon built environment (LCBE), Marine energy (Marine) and Solar Photovoltaic (Solar PV); while WEST aims to disseminate the research resulting from the LCRI CEP programme enabling Welsh Low Carbon sector's uptake and application of this cutting edge research.

This paper focuses on research undertaken within WEST which looks at HE training provision available to the Welsh workforce with regards to location, qualifications offered and study options. It then draws conclusions about training developed within the project that aim to respond to these needs.

## **2. METHOD**

This paper presents the results of the review of current higher education training available to Wales and the Welsh and English border (Border) that is relevant to the LCRI CEP research themes. We then go on to discuss the findings of this review and consider their significance for the availability of HE knowledge dissemination to the Welsh workforce. Finally, the influence of these findings on the shaping of the WEST training development is presented.

## **3. REVIEW OF EXISTING LOW CARBON EDUCATION AT HIGHER EDUCATION LEVELS**

A review of the training relevant to the LCRI CEP research, currently available across Wales and its borders was conducted; while for the Marine theme, the scope was broadened to include four courses delivered elsewhere in UK because there was only one course within the original area. This review considered factors relating to delivery including mode of study, qualifications offered as well as its geographical distribution. Further relevance of the courses to the LCRI CEP research themes, was identified through a review of module level curriculum. The courses included in this review are those that were found to deliver at least one module relevant to any of the LCRI CEP research themes. The relevance of the modules has been reviewed by the relevant WEST LCRI CEP Research Assistant for each theme. It is noted here that any course or module may have been categorised as relevant to more than a single LCRI CEP theme.

The availability of Postgraduate Diploma and Postgraduate Certificate courses was of particular interest. These qualifications were only considered in this study when offered as a validated qualification available for students to apply for directly; while they were not considered if they were exit awards, available only where a student fails to gain sufficient credits to achieve a Master degree.

Cases where Universities offered individual courses as separate units for Continuing Professional Development (CPD) were also reviewed. CPD provision is considered as a study option addressed to professionals who wish to update or increase their knowledge or even change a career pathway.

The Occasional Student study option is described in this report but no evidence of its availability has been found in relation to courses identified as relevant to the LCRI CEP themes.

This review should be regarded as indicative of the HE opportunities currently offered in locations accessible to Welsh employees, in the fields relating to the LCRI CEP. However, HE courses vary year by year and the situation will be in a constant flux. Further, the decision to include or exclude courses was made on the basis of publicly available information, which is not always comprehensive.

### 3.1 Courses' taught material and location

The courses were classified based on analysis of published materials describing the taught material contained within the modules. The module content has been used to categorise the courses in relation to their relevance to the LCRI CEP research themes:

- Hydrogen (H2)
- Low Carbon Built Environment (LCBE)
- Large Scale Power Generation (LSPG)
- Marine Energy (Marine)
- Solar Photovoltaic (Solar PV)

Although this report focuses on HE availability within Wales, the geographical area was extended to Europe for those courses delivered through a distance or blended learning model and to the wider UK for themes such as Marine.

42 courses were identified as containing relevant modules, of which 22 are located in Wales. 66 modules from these courses were identified as being relevant, of which 36 were from courses based within Wales (fig. 1).

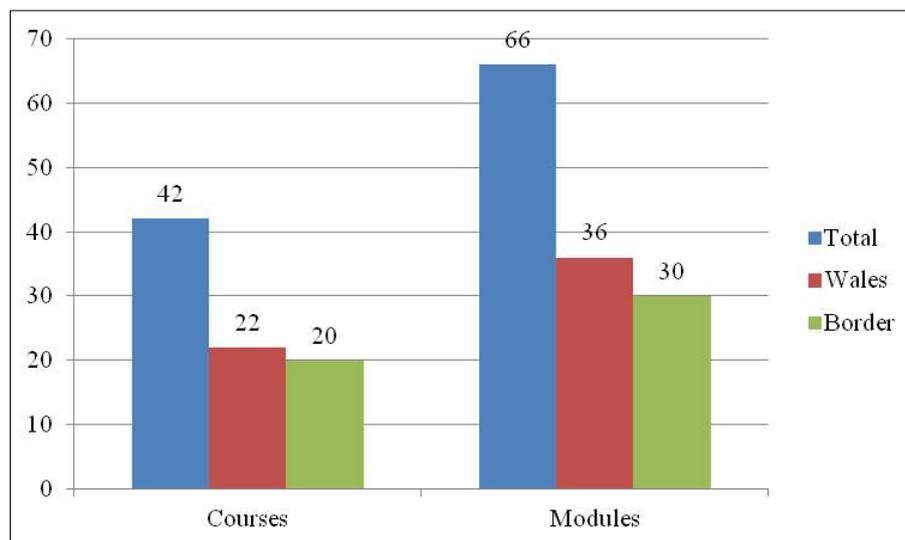


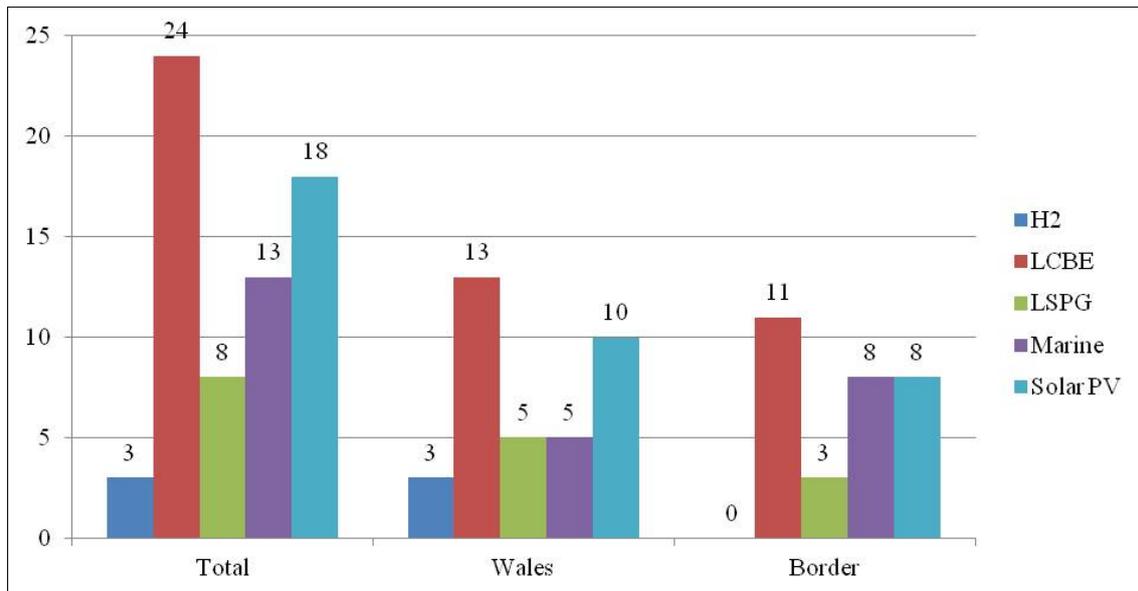
Figure 1 Courses and modules relevant to one or more LCRI CEP themes in Wales and the Border

Figure 1 represents the courses available at the time of the research (summer 2013); however, both Cardiff University as well as our partner Universities, Swansea University, Glyndŵr University and the University of South Wales are in the process of developing MRes and MSc in relevant fields including: Low Carbon Design, Large Scale Power Generation, Marine Engineering, Solar Photovoltaics and Hydrogen and Fuel Cell Technologies.

### 3.2 Modules with LCRI CEP research theme content and their distribution across Wales and its Border

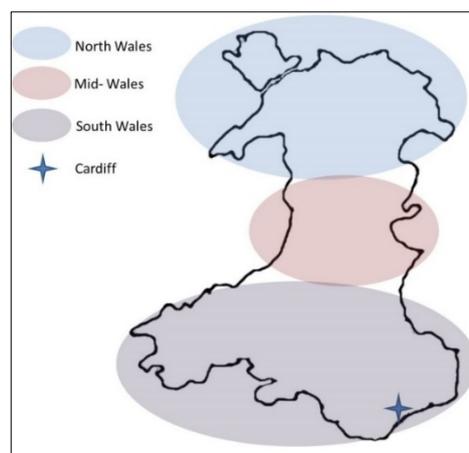
Since courses were found to contain modules that were relevant to more than one LCRI CEP theme, this review reports analysis taken at the level of modules. In this section, the theme relevance of the modules was identified as well as its delivery location. Firstly, availability of modules relevant to each LCRI CEP was investigated (Fig. 2), followed by consideration of their delivery location across Wales (Figures 3 and 4). Where a module is offered through collaborative delivery between two institutions and one of these is based in Wales, availability within Wales was assumed.

The largest proportion of LCRI CEP relevant modules were found to be relevant to the LCBE theme (24 of 66), followed by modules relevant to Solar PV (18) and Marine (13); whereas LSPG and H2 related modules had lower availability (8 and 3 respectively). Modules relevant to LCBE, Solar PV and LSPG showed a similar availability in Wales (13, 10 and 5, respectively) as exists in the Border region (11, 8 and 3, respectively); whereas, the majority of Marine relevant modules were delivered in the rest of UK (8 modules). The opposite trend appears for H2 for which there are 3 theme relevant modules in Wales and none in the Border.



*Figure 2 Modules available in Wales and the Border for each LCRI CEP theme*

Since the main focus of this report in terms of location is Wales, the courses that were identified as being delivered within Wales were more thoroughly considered in terms of the location of their training delivery and its distribution across Wales (Figure 3). This information is compared to the total availability of courses in Wales (Wales) as well as Wales and the Border (Total).



*Figure 3 Representation of Welsh regions for this study*

Out of the LCRI CEP related modules in Wales (36), most are located in South Wales (15) and Cardiff (10). The remaining 11 modules are located in Mid Wales (6) and North Wales (5). There are 13 LCBE related modules located in Wales of which the majority are located in South Wales (5) and Cardiff (5). Very few are located in mid Wales (2) and only 1 is located in North Wales. Modules that are relevant to Solar PV are equally spread throughout Wales, with South and North Wales having 3 available modules each, 2 are available in Mid Wales and 2 in Cardiff. LSPG related modules are mostly available in Cardiff (3) and South Wales (1) with 1 other course available in Mid Wales. Similarly, the modules relevant to Marine are found in South Wales (3) with only 1 in North Wales and 1 in Mid Wales. There is no availability of LSPG related modules in North Wales. There is no availability of Marine Energy related modules in Cardiff. All three modules that relate to H2 are located in South Wales and there is no availability of modules related to this theme in the rest of Wales. (Figure 4)

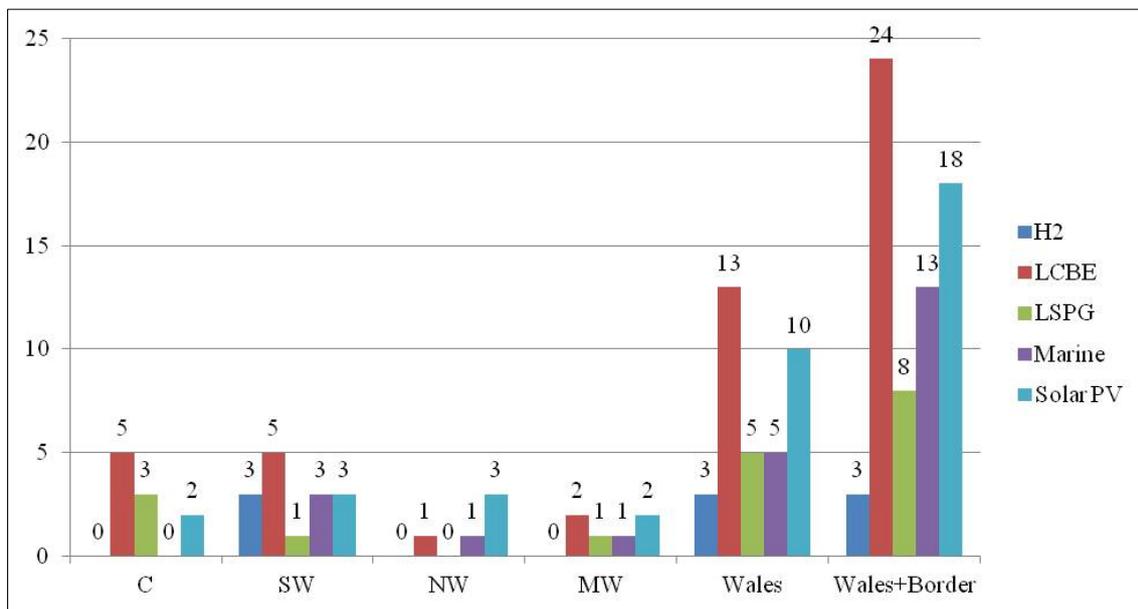
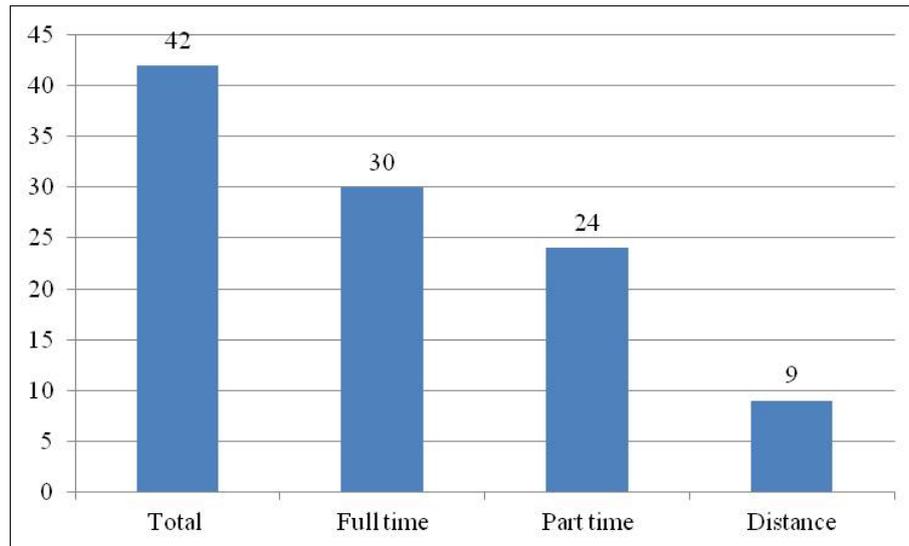


Figure 4 Modules available within Wales for each LCRI CEP theme

### 3.3 Course study options related to LCRI CEP research theme content

In terms of study options, the availability of courses is considered which can be studied full-time, part-time or by distance learning (Figure 7). Courses that are offered in Wales both locally and via distance learning are accounted as being offered locally. On the other hand, courses that are delivered in the wider UK both locally and via distance learning reported here as being offered by distance learning.

Out of the total 42 courses relevant to the LCRI CEP research themes, the majority are offered via a Full-time study option (30). Part-time and Distance learning is offered by 24 and 9 courses respectively. All courses that are offered via distance learning provide a more flexible study option through the distance learning route than the local study options. All distance learning courses offer part-time learning options over two to three years duration. One distance learning course offers the modules as CPD units which can be built up to a Master degree at the student's chosen pace. At the time of the research there were no distance learning courses that offered full-time study, however, this option is now available for an MSc related to the LCBE theme offered by Cardiff University. The courses were also analysed at module level with regards to their study options (Figure 8). For many modules, the course that they belong to is available through more than one study option. Therefore the total number of modules available for a particular theme may differ from the sum of the modules per study option.



*Figure 5 LCRI CEP research theme related courses and their study options*

From a theme specific perspective (Figure 8), For the LCBE theme related modules, the part-time study option (16) is more frequent than the full-time one (14). 7 modules related to this theme are available via distance learning.

For the rest of the research themes, most modules are delivered in a full time mode of studies, fewer are offered part time and even fewer through distance learning. For the Solar PV relevant modules, out of the 18 modules 12 are delivered full time and 8 have a part-time study option, with 4 available through distance learning. The majority of modules that are relevant to Marine are available through full time (8) or part time (7) study mode; whereas 3 courses are available through distance learning. For LSPG only 2 out of 5 locally delivered courses are available to be studied part time, whereas 3 courses related to the theme are offered through distance learning. Finally out of the 3 full time Hydrogen related modules 2 are also offered part time. There are no distance learning courses offered related to this theme.

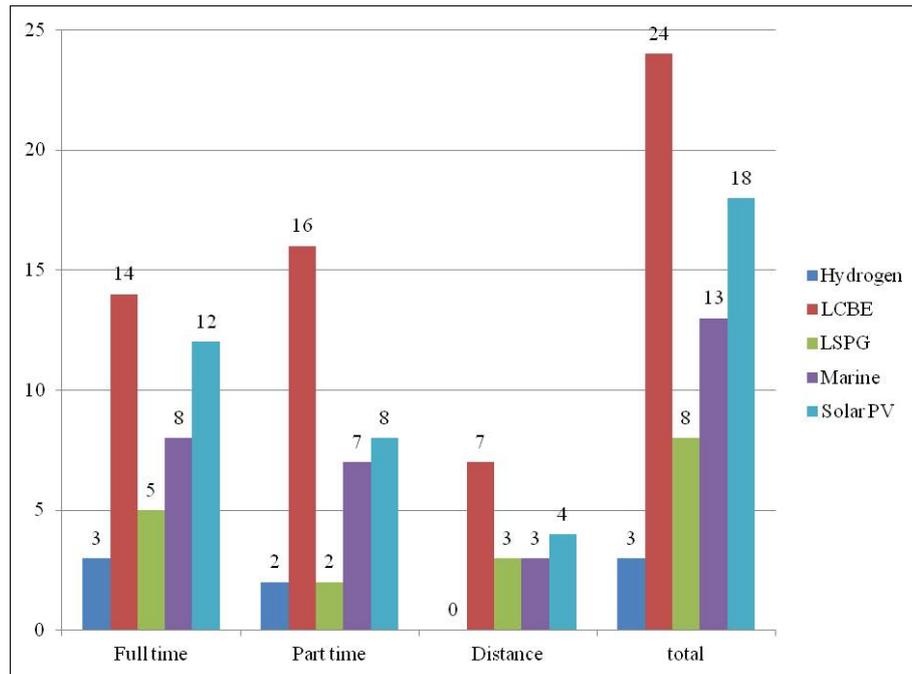


Figure 6 Study options of the modules relevant to the LCRI CEP themes

The Occasional Student Study route can be considered as a possible form of study either locally or at a distance; allowing students to select a specific part of a degree programme to study, in a flexible manner, similar to enabling CPD study of various modules. At the time of research this route was not publicly advertised as a study route for any of the degrees relevant to the LCRI themes considered in this report. However, this study route is being considered here because of its potential advantages to both students and HE Institutions. This study route provides flexibility in studies and allows professionals to benefit from a specific part of a taught course without committing to completing a full degree. This reduces the time and monetary commitment which the student needs to make. Considering that there is a need in the Industry for more flexible learning, this study option could provide an opportunity for HEI to engage with Industry and to attract more students. Although this route seems to be of benefit for both students and HEI, a report conducted within Cardiff University about Occasional Students (Stephenson, 2012) demonstrates that although there are universities in the UK offering the Occasional Student route, only the Open University has been promoting this as an option to prospective students. According to this report, the main issues for not incorporating and promoting this study route seem to be related with the administration of this route.

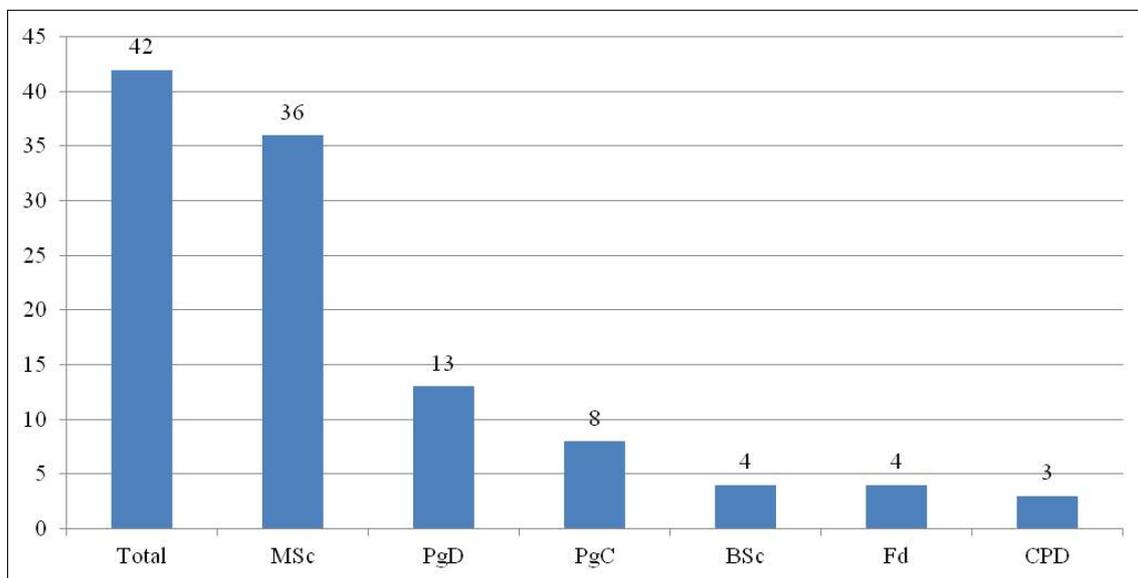
### 3.4 Qualifications related to LCRI CEP research theme content

The modules that relate to the LCRI CEP themes belong to courses that lead to qualifications (Figure 5) and the research concentrated on higher education qualifications of level 4 and above: Foundation degrees (Fd), Bachelor's degrees (BSc), Postgraduate Certificates (PgC), Postgraduate Diplomas (PgD), Master's degrees (MSc) and Doctoral degrees (PhD)(CQFW,2010). However, foundation and bachelor's courses were generally excluded from this analysis because their content was considered as too generic; however, exceptions to this rule were made where particularly focussed course content warranted inclusion. Also, as already stated, PgCs and PgDs were only considered when they were found to be offered as validated qualifications. Some Universities were also found to offer individual modules as separate units for Continuing Professional Development (CPD). It is suggested here that this study option is that which is most likely to be considered as suitable by professionals who would like to increase or update their knowledge in a particular subject area. The CPD provision as well as the availability of the option of applying for smaller awards, such as a PgD or a PgC, is therefore a key

focus of this report. The identification of this availability is highly important to the WEST project, as WEST aims to train professionals in employment within the low carbon sector, and this kind of smaller scale and flexible training is more likely to be of interest to a professional audience. Some of the courses offer more than one qualification option, therefore the breakdown of the modules into qualification options (courses leading to MSc/ PgD/ PgC/ BSc/ Fd or CPD) may exceed the total number of modules identified for each theme.

The time commitment of these qualifications varies if the courses are studied in full-time or part-time mode. An MSc is delivered in one year in full-time mode and two years in part-time mode. PgCs and PgDs normally last between nine months and a year full-time, or longer if studied them part-time. CPD courses have more flexibility and their duration depends on the institution offering them.

Out of all the courses with content that is relevant to the LCRI CEP themes (42), most of the courses lead to an MSc qualification (36). Of those, very few offer a Post Graduate Diploma award (13) and even fewer grant a PgC award (8). As previously discussed, undergraduate courses were only included in this study where directly relevant materials were identified in their delivery, of which BSc (4) and Fd (4) were identified. Only three courses offer modules as CPD units.



*Figure 7 Qualifications that can be achieved by completing courses which contain modules relevant to the LCRI CEP themes*

From a theme specific perspective (Figure 6), the majority of courses containing modules related to each theme belong to Masters Degree courses. There are 20 such modules relevant to the LCBE theme, followed by Solar PV (15), Marine (10), LSPG (8) and Hydrogen (2). For the **LCBE** theme, 20 modules lead to a MSc out of which 6 can lead to a PgD and 4 to a PgC. There are 3 Foundation degrees modules relevant to this theme. There seems to be a better distribution of qualification options for the **Solar PV** theme. 15 modules relevant to this theme lead to a MSc, out of which 5 also offer a PgD and 4 a PgC. 2 modules lead to a BSc and another 2 to a Fd degree. Of the 13 **Marine** relevant modules, 10 lead to a MSc, 4 of which offer a PgD option and 2 offer a PgC option. There is a Bachelor degree that contains 1 module relevant to the theme, and 2 modules that lead to a Fd degree. Of the 8 modules relevant to **LSPG**, all lead to a MSc out of which 1 also offers PgD and PgC options. There are 2 modules relevant to LSPG that lead to a BSc but there are no relevant Foundation degrees. There are 2 modules leading to a MSc and 1 to a BSc relevant to **H2**. There are no courses that offer the PgD or PgC qualification options relevant to Hydrogen. Foundation degrees are only relevant to

LCBE (3), Marine (2) and Solar PV (2) themes. The modules that are offered as CPD units (3) are only available within the LCBE theme.

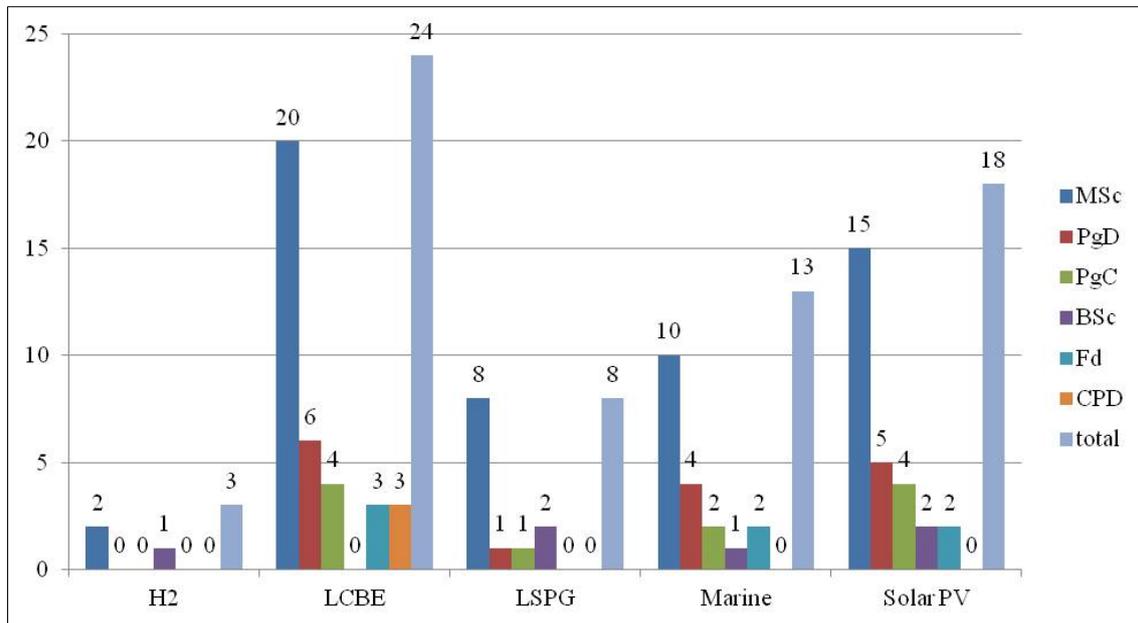


Figure 8 Modules relevant to the LCRI CEP themes and the qualifications they lead to

## 4. DISCUSSION

### 4.1 Existing HE low carbon education and training delivery across Wales and the Border

Of all the courses with relevance to the LCRI CEP research themes available in Wales (22) and its border with England, including the rest of UK for the Marine theme (20), the largest proportion focus on the Low Carbon Built Environment and Solar PV followed by Marine, LSPG and Hydrogen related courses. Hydrogen related modules are only available in South Wales, while most of the Marine related modules are available in the UK but outwith Wales. Those modules relating to LCBE, Solar PV and LSPG relevant courses are available almost equally in Wales and the Border. This situation is in flux as new courses are being developed. As mentioned in section 3.1 of this paper, Cardiff University as well as our partner Universities, Swansea University, Glyndŵr University and the University of South Wales are in the process of developing MRes and MSc in relevant fields including: Low Carbon Design, Large Scale Power Generation, Marine Engineering, Solar Photovoltaics and Hydrogen and Fuel Cell Technologies.

### 4.2 Distribution of HE low carbon education in within Wales

Availability of the courses was also examined in terms of its distribution within Wales as availability of these courses to the Welsh workforce would enable economic growth across Wales. The majority of LCRI CEP theme related courses are available in South Wales. The only theme that has relevant courses evenly distributed in Wales is Solar PV. For all the remaining LCRI CEP themes there is very little availability of relevant courses in Mid-Wales and even less in North Wales. Most of the courses that are relevant to the LCRI CEP research themes lead to a Master degree but less than half of them also offer a Postgraduate Diploma and/ or Postgraduate Certificate as a validated qualification which students can apply for directly. Smaller degrees like Postgraduate Certificates and Diplomas are more easily available to professionals as they require less time for their completion. Their scarce availability highlights the lack of HE provision accessible to working professionals in Wales.

#### *4.3 Current education delivery and qualification options*

WEST focuses on training uptake by working professionals. For this group, flexibility in terms of delivery method and qualification size is an important consideration. Very few Universities offer their course modules as Continued Professional Development (CPD) for professionals to take as separate units which could build up towards a higher qualification degree. All the courses that provide the CPD option are relevant to the LCBE research theme.

Most of the courses that offer a distance learning option are relevant to the LCBE theme, followed by Solar PV, Marine and LSPG. At the time of the research there were no distance learning courses offered for full-time study. However, this option is now available for an MSc related to the LCBE theme offered by Cardiff University.

It is obvious that training provision within the Low Carbon sector is limited in terms of study options and awards. The most commonly offered flexible study option is part-time; however, this still involves a significant weekly commitment over a number of years. Most of the available courses related to the LCRI CEP themes are MSc degree courses and very few offer PgCs or PgDs. A full MSc is not easily achievable by full-time employed professionals, whereas smaller awards (e.g. PgCs, PgDs and CPD modules) better suit their training requirements. The Occasional Student route which allows students to undertake only a part of a degree programme is mentioned in the report as an alternative route to postgraduate education which is able to address the Industry needs for more flexible learning. This route however is not embraced fully by HEIs in UK which, along with the lack of provision of smaller awards, highlights the need for an improved strategy of UK Universities' engagement with Industry.

## **5. CONCLUSIONS**

It can be seen that the results of this review of HE training provision relevant to employed professionals for the Low carbon sector in Wales has demonstrated that this is limited in scope both in terms of delivery mechanisms, and awards available. It was found that the flexible study was typically in terms of part-time traditional delivery, representing delivery requiring a significant weekly commitment, typically over a number of years; such as 4 – 6 hours a week over 2-3years. As can be seen this represents a requirement to make a regular, timetabled, and importantly physical commitment to long term study, which for many professionals would be a significant step to take, when balancing already complex work life balances.

Additionally, LCRI CEP related courses were typically only available where integrated within full MSc degree courses, with limited numbers of PgCs or PgDs. Again commitment to study towards an full MSc may not be attractive to full-time employed professionals, even in the presence of part-time study mode, as the dedication of time and effort is for a prolonged period. It is therefore argued here that the availability of smaller awards such as CPD awards, (typically requiring 1 hour+ commitment) , Smaller levelled and credit rated courses (10+ hours), PgCs (60 credits – 600 hours) and PgDs (120 credits – 1200 hours), study towards which might potentially be undertaken flexibly and over a longer time period, could be seen to be more aligned with professional development requirements. It can be seen that the delivery of such smaller, perhaps more achievable awards, especially through more flexible delivery modes including online and blended, might represent an appropriate strategy for UK Universities to promote ongoing engagement with the professionals in the low carbon Industries that they have frequently educated in the first place.

The training delivery of WEST modules has derived from the results of HE review and consultation with relevant industry professions with regards to their preferred training delivery options. Although the results from this consultation with industry are not discussed in this paper however, together with the HE review results demonstrate the need for flexible and easily accessible training. As a result WEST has progressed towards the use of a blended training delivery approach, incorporating both online learning activities together with traditional face to face delivery; with units developed and delivered in WEST, representing training material that the participants can go through at their own pace. The online activities and training materials can be accessed through a Virtual Learning

Environment (VLE) which enables enrolled users to view training materials and go through activities that include information dissemination, formative and summative assessment and further reading. The VLE also enables discussions through the form of forums among the course cohort or individual student tutoring.

The face to face sessions are designed according to the course content and include both workshops for skills dissemination as well as lectures. Based on the consultation results, the face to face sessions and lectures incorporate a breadth of relevant case studies, including presentations from professionals and experts in the field. Further to that, presentations of the face to face sessions are recorded and uploaded on the VLE for revisiting and self-study. This also enables the course to be delivered through a purely online mode at a later stage. The HE review demonstrated that training provision is not evenly distributed throughout Wales. WEST aims to address this problem by making the face to face sessions of the developed courses available in various locations across Wales to maximise accessibility.

Modules developed as a part of the WEST project aim to respond directly to this need delivering thematic training suites that include both 1 – 3 hour CPD sessions as well as small scale awards, 1 credit, corresponding to circa 10 hours' time commitment. All of the courses being developed through WEST are designed to be self-contained, whilst also providing approved prior learning (APL) opportunities, serving as stepping stones on towards larger qualifications. Further, the WEST thematic training suites enable participants to study at their own pace, frequently online.

The concept of APL is widespread across Europe and the UK, however, it is argued here that by enabling and signposting professionals to such small scale CPD and awards, professionals may be encouraged towards making the commitment to full HE qualifications. The project's continuation strategy further signposts investigation by the project team's institutions to enable the formal embedding of these routes for progression within institutional procedures more explicitly, ensuring students might seamlessly advance through CPD, 1 credit to 10 credit units (corresponding to 100 hours of participants time) and ultimately towards traditional larger HE qualifications such as a Postgraduate Certificate, Postgraduate Diploma, MSc or MRes (Masters of Research).

## **6. ACKNOWLEDGEMENTS**

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