



Appendix 22.1

Turning Tide: the economic significance of the Tidal Lagoon Swansea Bay

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Summary

This report is a submission from the Welsh Economy Research Unit of Cardiff Business School and reviews the expected economic consequences linked to the proposal to develop a Tidal Lagoon in Swansea Bay. The development would be the first of its kind in the UK and represents a real opportunity for local firms to become involved in an innovative project and potential further developments.

The development will comprise a tidal lagoon with 240MW of nominal rated electricity generating capacity. In addition the operational project would support tourism revenues in Swansea and surrounding areas and represent an important addition to visitor facing infrastructure in South West Wales and a major leisure resource. The project also offers local communities a shareholding in the project.

The project would represent an estimated £756m of capital investment. We estimate that the project would lever close to £300m of regional spending spread over a three year development period. This could result in a total additional £454m of additional output in Wales. The development phase of the project could lead to the creation of £173m of gross value added for Wales.

The construction phase of Lagoon development is estimated to support 5,540 person years of employment across Wales. If the Lagoon is completed to time across a three year build period, this equates to around 1,850 full time equivalent jobs supported across the region from 2015. The focus of the Lagoon project on job creation and support in manufacturing and construction sectors is important in the context of current challenges facing the Welsh economy.

The operational phase of the project after 2018 could support an estimated £5m in extra output for Wales, and £2.2m in GVA annually for the region. It is estimated that this level of additional output in terms of operating the Lagoon would support around 60 full time equivalent jobs per annum for the longer term.

This report estimates the economic effects of two visitor scenarios (70,000 and 100,000 leisure trips per annum) to the redeveloped area enclosed by the Lagoon, and estimates that some £1.5-£2.1m of gross value added and 65-90 full time job equivalents would be supported per annum through tourism levered when the Lagoon is operational.

1.0 INTRODUCTION

1.1 Outline of project

1.1.0.1 This report is a submission from the Welsh Economy Research Unit of Cardiff Business School and reviews the expected economic consequences linked to the Tidal Lagoon Power proposal to develop a Tidal Lagoon at Swansea Bay. This would be the first investment of this type in the UK at this scale.

1.1.0.2 We understand that the development will comprise a tidal lagoon with 240MW of nominal rated electricity generating capacity. In addition the operational project would support tourism revenues in Swansea and surrounding areas and represent an important addition to visitor facing infrastructure in South West Wales and a leisure resource including the development of a major sporting venue for sailing, rowing, swimming and other events. The project also offers an element of community ownership through a share offer which will seek to give preference to those living in the immediate vicinity of the project.

1.1.0.3 The project would represent in the region of £756m of capital investment. Our analysis of the project suggests that economic benefits would spill over into other parts of the South West Wales and Welsh economy. Additionally supply side improvements could result enhancing Wales' position in contributing to Tidal Lagoon development in other parts of the UK.

1.2 Objectives

1.2.0.1 The objectives of this report are to estimate the economic effects for Wales of the Tidal Lagoon Power project. The report examines economic effects associated with the construction and development phases as well as the operational stages of the project. We also seek to outline the extent of the expected tourism impacts associated with

the completion of the Tidal Lagoon Swansea Bay project. We derive inference for a potentially wider set of Tidal Lagoon Power projects based on the Swansea case, and we highlight the main determinants of economic impacts in the future.

1.3 Structure of the report

1.3.0.1 In the next Section of this report we outline the method used to undertake the economic impact analysis. The report then moves to consider the economic impacts of the construction and operation of the Tidal Lagoon and ancillary operations surrounding the developed facility. The final section then draws the analysis together showing how the planned development would strengthen the economic prospects of the Swansea, Neath Port Talbot and surrounding economy.

2.0 ECONOMIC ASSESSMENT APPROACH

2.1 Analytical method

- 2.1.0.1 In this section we set out the method used to estimate the economic effects associated with the construction and operation of the Tidal Lagoon in Swansea Bay, including the economic impact framework and the different analysis strands undertaken to support the economic modelling work.
- 2.1.0.2 The economic effects assessment is based on an economic model of Wales (see Appendix 1) that has recently been developed to track the existing and potential economic impacts for Wales of different electricity generation technologies.
- 2.1.0.3 Each of the phases in the development of any electricity generation facility supports economic activity. This occurs through the capital investment incurred in developing and constructing the installation, and the expenditure incurred in operating and maintaining it. The economic modelling of Tidal Lagoon Swansea Bay then has to consider the following elements:
- 2.1.0.4 **Development and planning:** An extended period of work is required before any on-site development of power infrastructure. This covers design and feasibility work, various surveys and the planning permission process. This can take a long time depending on the energy generation technology involved. In the case of the Tidal Lagoon in Swansea Bay planning and preparation work has been undertaken since June 2011 and with the planned start of construction in March 2015.
- 2.1.0.5 **Plant manufacturing:** This comprises the actual device that is used to generate electricity, for example the turbine installation, and the immediate ancillary devices surrounding the device and control system.

- 2.1.0.6 Whatever the energy generation technology the manufacturing of the devices are a significant component of the overall capital cost. Here the core plant is taken to include turbine manufacture and turbine caissons, stop logs, gates and sluice housings. Typically in electricity generation projects across Wales, much of the specialist plant manufacturing occurs outside of the region, although in the case of Tidal Lagoon Swansea Bay the objective is to move towards a local manufacturing consortium through which to develop selected components. We have sought to build this into the analysis.
- 2.1.0.7 **Balance of plant manufacturing:** This typically includes all the components that are not part of the generation device but are required for its operation (e.g. electrical ancillaries).
- 2.1.0.8 **Installation and commissioning:** The devices for electricity generation must be assembled and/or housed. In the case of Tidal Lagoon Swansea Bay this is a major item of spending and is expected to involve activities such as civil engineering and general construction connected to impoundment, coffer dam construction (and removal), and other site development, buildings, installation of electrical systems, and finally device installation. Here there is further scope for the involvement of local firms and labour even where major contracts are let to firms who are headquartered outside Wales.
- 2.1.0.9 **Operations and maintenance:** Once the Tidal Lagoon becomes operational, various on-going activities are required. This includes dredging, environmental monitoring, routine and unplanned maintenance, security, insurance etc., and with the project also encompassing tourism facing infrastructure which would lever additional employment opportunities.
- 2.1.0.10 We do not model decommissioning activities in this case. Hydroelectric turbines have a much longer operational life than other power generation technologies and with maintenance and some refurbishment, the life of these tidal lagoon plants will exceed 120

years. Additionally we expect the larger infrastructure to be in place for even longer than this.

- 2.1.0.11 For analytical purposes in the economic modelling and assessment, we group the first four bullets above (i.e. development and planning, plant manufacturing, balance of plant manufacturing, installation and commissioning) as the Tidal Lagoon development and construction phase. An assessment is then made of the operations and maintenance phase. We also seek to model some different tourism scenarios based on 70,000 and 100,000 leisure visitors per annum (see below for details). It is accepted that the Tidal Lagoon will not always be the prime reason for a day or staying visit such that care is required in attributing tourism impact to the developed infrastructure.

2.2 Different types of regional economic effects

- 2.2.0.1 The core economic benefits of the Tidal Lagoon in Swansea Bay are examined using an economic impact model of Wales which estimates:

2.2.0.2 **Direct Welsh Output, Gross Value Added and Employment Impacts.** This covers the employment supported directly through the construction, operation and maintenance of the Tidal Lagoon. This, for example, covers direct spending of Tidal Lagoon Swansea Bay on goods and services and their own staff.

2.2.0.3 **Indirect Welsh Employment Impacts.** This measure accounts for supply chain impacts in Wales. For example, as Tidal Lagoon Swansea Bay spends on Welsh goods and services, these same suppliers also have to purchase goods and services in Wales to meet these demands. Therefore indirect employment is supported in the regional economy. The additional economic activity in these companies is passed down through their supply chains and so on to generate additional, indirect benefits for many other companies.

2.2.0.4 **Induced Welsh Employment Impacts.** This captures the knock on benefits that additional employment supported directly and indirectly

has in the economy as salaries, earned by those employed in additional jobs, are spent on goods and service elsewhere in the economy.

2.3 Measures of impact

2.3.0.1 The assessment uses different measures to quantify the nature and scale of economic impacts associated with the development and construction phases of the Tidal Lagoon Swansea Bay and its operational and maintenance phases.

2.3.0.2 The above impacts considered in 2.2 can be measured in terms of output, gross value added and employment.

2.3.0.3 **Gross value added (GVA)** is an indicator of the value of activity supported. It is largely made up of wages and salaries, and company profits.

2.3.0.4 **Employment** is the number of jobs that are created within Wales. For operational phase impacts, we express these as Full Time Equivalents, a measure that converts full- and part-time jobs into a common currency. (Two part time jobs are assumed to equal one full time job). Two other employment measures are also used in this report.

2.3.0.5 **Person years of employment in Wales:** For the development and construction phases we estimate the person years of employment associated. The person years of employment in Wales comprises all direct, indirect and induced employment effects. For example this would cover the employment associated with not just the on-site development and installation works around the Tidal Lagoon Swansea Bay project, but also cover the employment supported in the Welsh supply chain as the managing contractor used by Tidal Lagoon Power purchases goods and services in Wales, and employment supported as direct and indirect employees concerned spend their incomes within Wales. Effectively, these impacts tend to be 'one off' as they are connected to capital phases of projects. The time period across which

this employment is generated remains undefined; for example, 100 person years may be 10 full time workers on site for a decade or 100 workers for one year.

2.3.0.6 **Person years of employment in Wales per MW installed.** As different electricity technologies operate at different scales there is comparative value in considering the person years of employment connected to Tidal Lagoon Swansea Bay per MW of installed capacity. This allows some comparison with recent economic analysis of other current and projected energy generation projects in Wales.

2.3.0.7 Finally here it is important to clarify the estimates that will be made of 'Welsh' Employment. As far as possible we report here employment generated on-site at Welsh locations during capital and operational phases, combined with off-site impacts across Wales. This will then include, particularly in development phases, some elements of the workforce that are peripatetic/short term migrants, and indeed some which may commute daily from outside Wales given that Swansea is a little over one hour from the Second Severn Crossing.

2.4 Sourcing from Wales

2.4.0.1 A key determinant of the scale of the regional economic effects relates to whether Welsh industries are able to benefit from the opportunities generated by the Tidal Lagoon in Swansea Bay. The extent to which Welsh industry benefits from opportunities depends on: the procurement approach pursued by the developer; the current Welsh supply side capacity available in respect of goods and services required by the project; and the extent to which Welsh firms already serving electricity generation companies and similar can adapt to the specific requirements of the project.

2.4.0.2 In this respect Tidal Lagoon Power has stated that it seeks as a minimum 50% Welsh content, and also seeks UK and Welsh suppliers of critical components to create a sustainable long term tidal lagoon

industrial base that will support this and further developments as well as providing long term operation and maintenance support. Moreover Tidal Lagoon Power sees the Swansea project as the first in a series of developments in Wales and the wider UK such that supply infrastructure developed as part of this project could gain additional opportunities in the long term in serving a wider network of lagoon projects. These benefits associated with wider developments are not accounted in this report but could be significant for the local economy.

- 2.4.0.3 For this report we have made use of the following sources to arrive at a reasonable view on Welsh sourcing propensities. First, recent research for Welsh Government by Cardiff University and Regeneris UK on the employment effects of different energy generation projects in Wales during development and operations. However, we note here that the Tidal Lagoon Swansea Bay project has different characteristics from much of the existing renewable capacity in Wales, and with no strict comparator in Wales from which to derive benchmarks of economic impacts.
- 2.4.0.4 Second, analysis of material provided by Tidal Lagoon Power on the main cost components of the lagoon project including an interim assessment on the availability of key components within the Welsh economy.
- 2.4.0.5 Third, a detailed understanding of the current supply side in Wales, derived from a series of prior projects on renewables, and related impact projects for other industries.
- 2.4.0.6 The development of a Tidal Lagoon in Swansea Bay would involve significant spend, on materials, labour and professional services. Over the development phase of the project Tidal Lagoon Power estimates that capital spending will be in the region of £750m.
- 2.4.0.7 As our methodology indicates, part of this spend will be on Welsh goods and services, and on Welsh labour. This regional spend will result in the support of regional jobs, income and gross value added, both directly, and indirectly, both in supply chains, and as directly

employed workers spend their wages (in part) in Wales. A number of specialist machines and services will not, of course be sourced from within Wales as they will be unavailable locally and this portion of spend will not have any beneficial economic effects on Wales. Our estimate of the development-related impact of the Lagoon is presented in Section 3 following.

2.4.0.8 Beyond the construction phase, the Lagoon will require on-going maintenance, again in part supplied by local companies and labour. This spend, estimated at around £5m per annum gross, will support jobs in Wales insofar as these elements are regionally sourced. This economic impact is also detailed in Section 3.

2.4.0.9 Our examination of the material supplied by Tidal Lagoon Power together with consultations undertaken lead us to an estimate of £299m (40%) of development for supplies, services and components that could be sourced within Wales, and with the remaining £457m that would need to be sourced elsewhere in the UK or overseas, reflecting a paucity of local supply. Tidal Lagoon Power is specifically asking turbine manufacturers what they can purchase within Wales, that would normally be made elsewhere.

	Development & Construction (2014-2018)		Operational (per annum)	
	£m	%	£m	%
Gross Spend	755.9		5.1	
Of which spend within Wales:	299.0	40%	2.5	48%
<i>Manufacturing & Production</i>	108.5	36%	0.5	20%
<i>Construction</i>	187.5	63%	1.5	61%
<i>Market Services</i>	3.0	1%	0.5	18%

2.5 Tourism levered around a new lagoon development

2.5.0.1 Using our experience in assessing the regional economic significance of tourism, we also provide an indicative estimate of how far leisure

visitation to the new impoundment might also bring local economic benefit. Whilst this cannot be directly related to Lagoon development, it is worth noting that the impoundment of water in Cardiff Bay has led to over 1m visits¹ per annum to a part of the City that formerly attracted very few.

2.5.0.2 As well as general tourism there is a strong expectation that the new infrastructure would support events including: sailing; coastal sea rowing; open water swimming, triathlons, biathlons and duathlons; and running events. There could be potential for around eight national events in these sports per year and with an additional series of regional events in these sports. Weekend based events for national sports of this type could have the potential to attract up to 6,000 – 8,000 people per event.

2.5.0.3 To capture some of these potential benefits, we develop two scenarios on numbers of visitors attracted to the Lagoon area. Clearly there is no way of accurately estimating the numbers of visitors that might be attracted to the Lagoon area following completion of the build phase. There are few strict comparators. However, some other local attractions serve as a possible benchmark. The average visitation in Wales to sites categorised as ‘country parks, gardens and other natural’ was an estimated 82,000 in 2012 according to Visit Wales. Local sites including Llyn Llech Owain, the Natural Botanical Gardens, Gelli Aur, Plantasia and Swansea Museum attracted visitors in a range between 83,000 and 139,000. The National Waterfront Museum Swansea attracted 267,000 visitors in 2012.² Further afield the Whitelees Farm windfarm development attracts over 100,000 visitors according to Scottish Power. The La Rance tidal barrage scheme is estimated by EDF to attract around 70,000 visitors per annum.³

2.5.0.4 On this basis we conservatively model scenarios of 70,000 visitors and 100,000 visitors. The economic impact of this visitation is estimated, following established methodology in Wales, in Section 4

¹ <http://wales.gov.uk/newsroom/tourism/2012/6121735/?lang=en>

² <http://wales.gov.uk/docs/drah/publications/Tourism/130603attractions2012en.pdf>

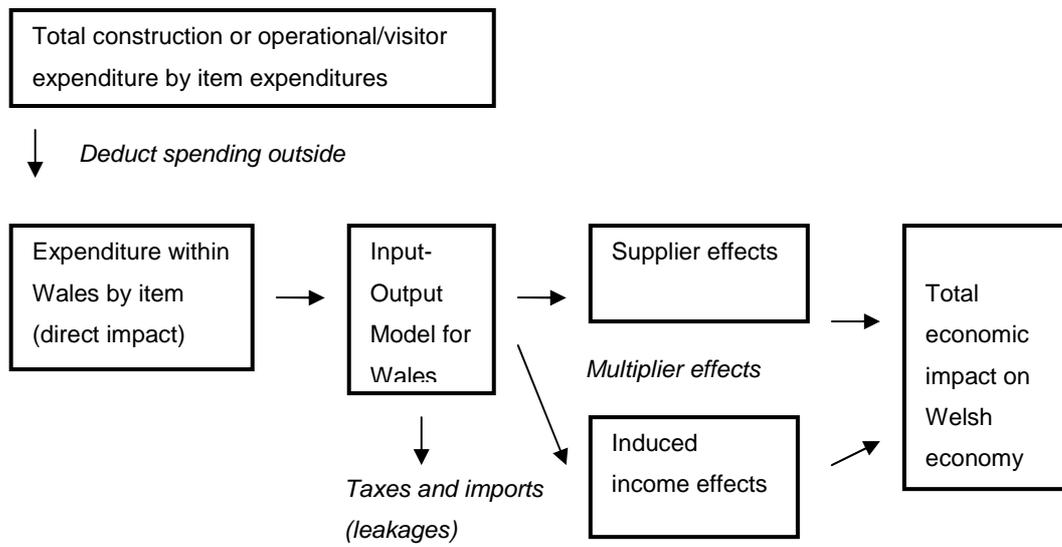
³ <http://www.british-hydro.org/downloads/La%20Rance-BHA-Oct%202009.pdf>

2.6 Economic model of Wales

- 2.6.0.1 To estimate indirect or multiplier consequences in Wales associated with the spending of Tidal Lagoon Swansea Bay, it is necessary to have a ‘picture’ of the local economy that specifies how the various Welsh industry sectors ‘fit together’ in terms of their trading relationships. This then allows the effects of spending and employment activity in one sector to be traced through the entire local economy.
- 2.6.0.2 Input-Output Tables provide the most comprehensive picture of an economy. These tables detail transactions between different sectors of the local economy and beyond. As well as being an important descriptive tool, the Input-Output tables can be used for economic modelling and for impact assessment. Input-Output Tables for Wales are the product of a continuing research project at the Welsh Economy Research Unit to develop a comprehensive picture of the Welsh economy, and the way it is changing over time⁴. The latest Tables divide the Welsh economy into 81 separate production sectors (see Appendix 1).
- 2.6.0.3 Figure 2.1 provides a simple schematic representation of the methodological approach adopted for this study.

⁴ www.weru.org.uk

Figure 2.1 Summary of approach



3.0 REGIONAL ECONOMIC EFFECTS OF THE TIDAL LAGOON DEVELOPMENT

3.1 Development Related Economic Impact

3.1.0.1 We estimate that the £299m of regional spending evenly spread over a three year development period starting in March 2015 will result in a total of an additional £454m of additional output in Wales. This means for every £1m spent in the region, an estimated further £0.52m of economic activity is supported. Around half of this, almost £223m, is in the construction sector, with manufacturing & production the next largest portion at £170m. We estimate around £34m of output in financial and professional services would be supported, largely comprising project management, planning and engineering activities.

Sector	Welsh Economic Activity (Output) Supported £m	GVA £m	Employment Person Years
Manufacturing & Production	169.7	55.7	1,160
Construction	223.8	83.6	3,450
Distribution, Retail & Hospitality	15.1	7.4	290
Transport & Communications	7.3	3.4	100
Financial & Professional Services	33.8	20.3	470
Other	4.0	2.1	70
Total	453.7	172.5	5,540

3.1.0.2 The build phase of Tidal Lagoon Swansea Bay leads to the creation of an estimated £173m of gross value added, again with the largest portion (some 48%) in construction, and a further 32% in manufacturing and production industries.

3.1.0.3 The construction phase of the Lagoon development is estimated to support around 5,540 person years of employment across Wales. If the Lagoon is completed to time, this equates to around 1,850 full time

equivalent jobs supported across the region for the three year construction period starting in 2015.

3.1.0.4 Due to the relatively higher labour intensity of construction, it is this sector that dominates in terms of employment impacts. We estimate over 3,450 person-years of employment across Wales are supported by the Lagoon in this sector – almost 62% of employment. Selected construction sector jobs, particularly those linked more to construction engineering, would be relatively high pay and of high quality. Due to uncertainties in the implementation of the development, we cannot say how many of these will be physically on site.

3.1.0.5 The focus of job creation and support in manufacturing and construction sectors is important in the context of current challenges facing the Swansea Bay and Welsh economies. In the Swansea case economic inactivity rates are relatively high at 29%, and with nearly 5,000 Job Seekers Allowance claimants in September 2013 (see NOMISWEB, 2013). In Wales as a whole, following the recession, manufacturing employment has fallen by over 40,000 people according to the *Annual Population Survey* (period 2007-2012) and with around 30,000 jobs lost in the construction sector. There are connections between jobs losses in the two sectors with poor performance in terms of construction output linking through to lower demands placed on elements of the manufacturing sector. Larger strategic projects such as Tidal Lagoon Swansea Bay integrating construction demand with local manufacturing inputs and new industry will be an important means of strengthening prospects in these important parts of the regional economy.

3.2 Operational Economic Impact

3.2.0.1 The very high and temporally concentrated development spend means that it is this part of the economic impact that is dominant. It is important to note that Tidal Lagoon Swansea Bay is first of an expected network of projects and construction and manufacturing employment

connected with this first build could possibly be used in future lagoon builds in Wales and elsewhere. In addition to this, Tidal Lagoon Swansea Bay will continue to have economic and employment benefits over the many decades of its operational lifespan. Using information from the developer we assume here some £5.1m of spending per annum during the operational phase (Table 2.1) of which just under half is estimates to be expended within Wales. This operational spend might be worth over £5m in extra output in Wales, and £2.2m in GVA annually for the region.

3.2.0.2 Clearly, the operational requirements of this novel technology are not completely understood, but even considering the results in Table 3.2 as indicative, it is clear that Tidal Lagoon Swansea Bay will, in its operational phase, generate reasonable employment opportunities locally – we estimate, some 60 full time equivalent jobs. Around half of these would be in the construction sector, but we expect the operational phase to maintain very varied types of employment encompassing activities as diverse as inspection, dredging, environmental monitoring, and control room tasks.

Sector	Welsh Economic Activity (Output) Supported £m	GVA £m	Employment FTEs
Manufacturing & Production	0.9	0.3	5
Construction	1.8	0.7	30
Distribution, Retail & Hospitality	0.2	0.1	5
Transport & Communications	0.8	0.3	5
Financial & Professional Services	0.9	0.6	10
Other	0.5	0.3	5
Total	5.2	2.2	60

Note: Assumes half of maintenance contingency estimate of £2m pa is spent each year; and 50% of this expended in Wales.

3.3 Visitor Related Economic Impact

- 3.3.0.1 As Cardiff Bay has shown, developments increasing the attractiveness and usefulness of Wales' shoreline can provide a catalyst for further investment and leisure use – with Cardiff Bay attracting over 1m visitors per annum. The Lagoon has the potential to provide a fillip for visitation to Swansea, for general leisure visits and for event-related trips (e.g. water and boat sports, festivals etc.). The lagoon could also build upon a very strong existing maritime heritage, which has already been levered into the visitor sphere, for example in the National Waterfront Museum and the Water Sports Centre of Excellence⁵.
- 3.3.0.2 For example, a study in 2008 (Cardiff Business School, 2008) examining the economic consequences of the National Waterfront Museum's operational activity showed that total spending of visitors to the Museum supported nearly £2.2m of Gross Value Added, supporting around 100 FTEs in the Welsh economy. There is also potential for re-branding and increased visitation following the launch of the Swansea Bay City Region⁶.
- 3.3.0.3 We attempt to capture this potential by assuming a modest 70-100,000 leisure trips per annum to a redeveloped area enclosed by the Lagoon (see earlier section 2 for basis of these scenarios). Here we assume that the distribution of day, staying and international visitors to the Lagoon would mirror the Welsh average (i.e. in 2011 an estimated 78% day visitation, 6% short stay (1-3 nights), 10% long stay (over 4 nights), 4% international and 2% business). On this basis we would infer that around 8 out of 10 visitors to the site would be more local in origin. It is impossible to draw any conclusions on the extent to which the Lagoon might in the future be the key driver of a visit to Swansea, but one might accept that the Lagoon would build on the tourism offer in the area such that estimated tourism spending impacts would possibly need to be 'shared' with other local attractions and retail offer.

⁵ www.museumwales.ac.uk/en/swansea

<http://wales.gov.uk/newsroom/tourism/2012/121022sb/?lang=en>

⁶ <http://www.southwales-eveningpost.co.uk/Swansea-Bay-launched-Wales-city-region-bid-boost/story-19535886-detail/story.html>

- 3.3.0.4 We use the Visit Wales Tourism Impact Planning Model developed by Cardiff Business School to estimate the gross value added and employment that could be supported by this visitation. The Tourism Impact Planning Model is a module of the Welsh Input-Output tables previously discussed in Section 2 but focuses on the direct and indirect economic effects associated with visitor economy spending.
- 3.3.0.5 Table 3.3 shows, even this relatively low level of visitation, if it mirrored existing tourism in Wales, could support a further £1.5-£2.1m of gross value added and 65-90 full time job equivalents.
- 3.3.0.6 This employment cannot be considered directly dependent on the Lagoon development, and indeed may not represent ‘new’ permanent jobs, but in part rather jobs safeguarded, and busier, more secure firms. However, once complete, the Lagoon would be a unique engineering feat that could provide an impetus for visitation quite apart from the attraction of the water it impounds.

Table 3.3 Tourism Related Economic Impact (indicative)		
	70,000 visitors	100,000 visitors
Gross Value Added (£m)	1.5	2.1
Employment (FTE)	65	90

Source: Tourism Impact Model for Wales, 2011

3.4 The Economic Impact in Context

- 3.4.0.1 The last 12 months have seen a raft of projects examine the economic and employment effects of potential new electricity generation technologies in Wales. Reports commissioned by Government and industry have covered onshore wind⁷, marine renewables⁸ and offshore wind, as well as more established fossil and nuclear technologies.
- 3.4.0.2 The above studies have involved the Welsh Economy Research Unit and the Input Output Tables for Wales, and we are thus able to assess

⁷ <http://www.renewableuk.com/en/utilities/document-summary.cfm?docid=107A0752-6FD5-4776-9B4067941F0ADB16>

⁸ <http://wales.gov.uk/docs/desh/publications/130816economic-impact-of-developing-marine-energy-en.pdf>

the economic impact of the proposed lagoon project in comparison to other generation technologies. Whilst this comparison must be considered indicative (due to the very different technologies and scales of implementation), it is none the less illustrative.

3.4.0.3 The economic impact of any generation technology will be driven by spend per megawatt installed, with this driven by factors such as the maturity of the technology, and the economies of scale relevant at the likely scale of facility development. As Table 3.4 shows, information for Tidal Lagoon Swansea Bay suggests that Lagoon development costs are roughly on a par with Solar PV (a more widespread and established technology, but one typically implemented at much smaller scale (per site) and hence with fewer scale economies.

3.4.0.4 The Lagoon development, at just over £3.1m of gross spending per MW installed would be somewhat more expensive per MW installed than offshore wind at £2.4m per MW, but significantly cheaper than tidal stream (£4.2m) or wave generation (£5m). However, it is noted that the Tidal Lagoon Swansea Bay project is the first in a possible suite of similar projects such that there is scope for costs per installed megawatt to fall further. It is also important to note the potential longevity of tidal lagoon type projects i.e. possibly for over 120 years.

Table 3.4 Gross Development & Construction Spend per Megawatt Installed	
Generation type	Gross Spend/MW (£m)
Tidal Lagoon (based on Swansea Bay Tidal Lagoon case)	3.1
Tidal Stream	4.2
Wave	5.0
Offshore Wind	2.4
Onshore Wind	1.3
Solar PV	2.9

Sources: Regeneris & WERU, 2013, Developers' estimates.

All figures approximate

3.4.0.5 Table 3.5 makes this point more strongly, comparing a variety of technologies installations on their development-phase job creation for Wales, both potential and actual, and including fossil as well as renewable and nuclear technology.

3.4.0.6 As the Table shows, the maturity and complexity of the technology is very important, with (combined cycle) gas turbine installations generating only 4.5 job-years of employment in Wales per MW installed, and with nuclear at 8.6 job years (driven by a more complex and safety-demanding technology).

3.4.0.7 Renewable technologies are more employment intensive per MW installed – although of course more expensive, in this construction phase at least. At 23 job-years per MW installed, Tidal Lagoon Swansea Bay would deliver a similar economic return to Solar PV; significantly in excess of relatively mature wind technologies and somewhat lower than wave and tidal stream renewables, possibly in the latter case because of the less complex construction requirements of near shore tidal impoundment.

Table 3.5 Employment Generated in Wales per MW and for Typical Installation (Development & Construction)								
	TLSB case	Gas	Nucl'r	On-wind	Off-wind	Sol-PV	Tidal stream	Wave
Job years in Wales per MW installed	23.1	4.5	8.6	12.8	8.3	20.8	35.3	32.3
Scenario facility MW installed	240	500	1,900	100	300	30	30	30
Job years for facility scenario	5,540	2,250	16,340	1,280	2,500	625	1,060	970

Source: *The employment effects associated with regional electricity generation*, Welsh Government, 2013

3.4.0.8 What is notable from Table 3.5 is the scale of installation for Tidal Lagoon Swansea Bay coupled with relatively high employment intensity. This suggests that only a new nuclear installation (or another wind farm at the scale of Gwynt y Môr) could rival Tidal Lagoon Swansea Bay for employment generation at a single installation site.

3.4.0.9 Employment impacts during the operational phase would, however, be somewhat lower (per MW installed) than other renewables at about 0.3 FTE jobs per MW (According to WERU and Regeneris (2013) other renewables range from 0.4 – 0.9 FTEs). This is due to the relatively straightforward, one-location maintenance compared to other renewables: Tidal Lagoon Swansea Bay would not be in deep, 'offshore' seas or spread across the Welsh landscape for example.

4.0 CONCLUSIONS

4.1 Discussion on economic estimates

- 4.1.0.1 This report has estimated the economic effects associated with the development and operation of the proposed lagoon development in Swansea. We stress that the numbers provided are estimates. The local economic effects from large construction projects in Wales typically turn on decisions made early in the development process, not just in terms of choice of managing contractor, but decisions on key components, and how individual contracts are packaged up. Small changes here can have important local effects both positive and negative.
- 4.1.0.2 Historically renewables projects in Wales (at commercial scale, particularly on shore and off shore wind) have fairly limited local economic effects during development because the highest value components, and elements of specialist professional services tend to be sourced outside of the UK, and with strictly regional opportunities linked to civil engineering, groundworks and selected metal components (see Munday et al., 2011⁹), and with the low level of economic impact possibly connected to higher streams of community benefit payments, particularly in more rural parts of Wales, and the fact that developers are based outside the region.
- 4.1.0.3 In this respect Tidal Lagoon Swansea Bay could offer the opportunity for a more sustained economic impact with the innovative project placed in a more industrial part of Wales and with a supply side background in metal goods and structures, and construction engineering which could feed into the project. Adding to the opportunity is the possibility that the planned lagoon would be the first in a series of projects (see Table 4.1, and indeed the first of its kind at this scale in the UK) such that successful local suppliers to an initial project could gain further business in the longer term. For example using a simple additive assumption, and ignoring future scale economies in terms of inputs the headline capital spending for Tidal Lagoon Power's two prospective projects in Wales alone (a total of £4.4bn of prospective investment) could support around five or six times the economic impact in Wales than that reported in Section 3 of this report for the Swansea Bay scheme alone.

⁹ Munday M, Bristow G and Cowell R (2011) "Wind farms in rural areas: how far do community benefits from wind farms represent a local economic development opportunity?" *Journal of Rural Studies*, 27, pp.1-12.

Table 4.1 Potential Suite of Tidal Lagoon Power Projects	
Lagoon	Estimated capital spending £bn
Swansea	0.75
UK 1 Project	4.47
Wales 2 Project	2.63
Wales 3 Project	1.75
UK 2 Project	2.52
Totals	12.12

Source: Tidal Lagoon Power Limited, 2013.

4.2 Local economic potentials

4.2.0.1 The development would also be expected to lead to some improvement in economic aggregates at the local area level, not least linked to improvements in economic activity rates, reduced unemployment, and increasing gross value added per capita. The economic baseline for the local authority economy reveals economic activity rates around two percentage points below the Welsh average, lower employment rates, and a higher unemployment rate than the Welsh average. Coupled to this are areas of persistent socio-economic disadvantage close to the proposed development.

4.2.0.2 More importantly a train of projects placing demands on specialist and general engineering and manufacturing sectors would provide a much needed diversification for local firms which have been under extreme pressure in the post-recession period, with construction output in Wales still at levels 25% below the pre-recession peak, and with manufacturing and construction sectors in Wales having lost almost 70,000 jobs in period 2007-2012 (Annual Population Survey, NOMISWEB and Index of Welsh Production; STATWALES, 2013).

4.3 Other potential effects

- 4.3.0.1 There is much that our assessment cannot quantify. An investment of the size envisaged continues a trend in the modernisation of the Swansea Bay economy that has embraced commercial, retail, cultural and sporting development. SA1, the National Waterfront Museum, Wind Street developments, and the elevation of Swansea City FC are obvious examples of factors that have grown the visibility of the city. An innovative lagoon investment which would be the first on this scale in the UK will add to this visibility and could improve prospects for the Bay area as a location for inward investment. Linked to this could be a series of property and retail market effects which are difficult to measure at this stage.
- 4.3.0.2 More specifically the lagoon development ties to recent regional aspirations for Wales to become a hub for marine renewables given the electricity generation potential of the tidal resource around the Welsh coastline. Marine renewables are expected to feature strongly as a theme in the next round of EU structural funds (2014-2020) under strategies to move to a low carbon economy and smart specialisation, and with a growth in installed capacity in marine renewables as one element of these strategies.
- 4.3.0.3 The UK Energy and Climate Change Select Committee has argued that marine renewables could be worth up to £3.7bn to the UK economy by 2020, and with Wales currently well placed due to the location of deep water ports, and university expertise on marine devices in North and South Wales, but with just a few exemplars to date to showcase the potential of the tidal resource. The lagoon development is at a much larger scale than currently planned wave and tidal stream devices and could provide an important exemplar. The scale of investment associated with the longer train of lagoon projects could lead to the development of a hub of supply side and university expertise on marine renewables which could challenge the accepted wisdom regarding the paucity of local economic impacts associated with renewables in the Welsh case.

Appendix 1 Input-Output Tables for Wales

The analysis of indirect and induced effects in section 3 of this report has made use of economic data contained within the Welsh Input-Output Tables. The Welsh Input-output project as a whole has been in progress since 1993. Tables have been published for each of the years 1994 to 1996, and for 2000, 2003 and 2007. The 2003 Tables were supported by the Welsh Development Agency and Cardiff Business School, and their development and construction undertaken by members of the Welsh Economy Research Unit at Cardiff Business School. The construction of the 2007 tables was supported by Environment Agency Wales.

The Welsh Input-Output tables reveal the different industries that make up the Welsh economy, and show how they fit together in terms of their sales and purchasing patterns. Each industry in Wales relies to a greater or lesser extent on local, regional, national and then international markets. Each industry also uses labour inputs, and imports goods and services. The Input-Output tables then allow comparisons between industries in terms of their pattern of resource use, and the sectoral and geographical destinations of their outputs, including the level of export activity.

The Tables can be used to identify sectors which are important to the local economy by virtue of their spending, employment, exports, or local linkages and consequent economic activity supported directly and indirectly in the Welsh economy. Then the Input-Output framework should also be seen as a detailed statement of account, with tables allowing reconciliation of the supply of, and demand for, goods and services in Wales.

In this report the Input-Output tables were used, for example, to generate multipliers for industries that would be involved in the developmental and operational phases of this project. For example, an increase in demand for the goods produced by the construction sector in Wales, would lead to an increase in the spending of the construction sector (direct effect). However, as the industry increases its spending, their suppliers in Wales will also have an increase in demands for their goods, and then also the suppliers to the suppliers experience extra demands, and so on (indirect effects). The shock of the increase in final demand ripples through the Welsh supply chain. Moreover, as a result of these

supply chain effects, the level of income in the economy will increase, and a portion of this income will be spent on Welsh goods and services leading to further increases demand. This is termed an induced income effect. The ratio of the direct, indirect and induced income effect to the direct effect is termed a multiplier. Multipliers can also be derived with regards to employment effects. Our multiplier estimates derive from the 2007 Input-Output tables; while these tables are now dated the multiplier values for large sectors of the Welsh economy do not tend to change markedly over these time periods.

In addition to the Welsh input-output tables we develop our tourism analysis using the Tourism Impact Planning Model for Wales 2011 produced by the Welsh Economy Research Unit for Visit Wales. The model links closely to the Welsh input-output framework. The table below provides a sample of the connections between tourism visits, employment and gross value added that were used in this study.

Appendix Table 1: Key relationships from Tourism Impact Planning Model for Wales 2011

Day Trippers		Short Break (1-3 Nights)	Long Holiday (4+)	Business	Inter- national	All Staying Visitors
		Gross Value Added (£)				
Per trip	£12.65	£107	£191	£171	£239	£156
Per Night	£12.65	£52	£47	£74	£46	£51
		Employment (FTE)				
Per 1m trips	560	5,040	8,730	6,660	10,390	7,035
Per 1m Nights	560	2,450	2,170	2,880	2,000	2,280

NB: Assumes overnight international visitors to Wales spend 2 nights outside Wales on average per trip

Sources:

GB Leisure Day Visits, 2011.

The UK Tourist 2011

Travel Trends 2011