Severn Tidal Power Feasibility Study

Phase 2: Regional Economic Impacts Study

Produced by the Welsh Assembly Government on behalf of Severn Tidal Power Feasibility Study Regional Workstream

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REGIONAL ECONOMIC IMPACTS OF TIDAL POWER GENERATION IN THE SEVERN ESTUARY: Phase 2: Regional Economic Impacts Study

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Executive Summary

1. This paper has been prepared on behalf of the Severn Tidal Power Feasibility Study[1] regional workstream. The purpose of this paper is to (i) conduct an agreed re-working of the Phase 1 regional economic impact assessment, taking appropriate account of methodological and data issues raised by the independent external peer review, and (ii) to update the regional economic impact estimates to reflect revised financial and construction information produced since time of the Phase 1 research.

2. This analysis makes use of data reflecting the current list of Severn tidal power options. This report presents analysis for five options, Cardiff-Weston Barrage (B3), Shoots Barrage (B4), Beachley Barrage (B5), Welsh Grounds Lagoon (L2), and Bridgwater Bay Lagoon (L3d), and does not distinguish between the variants of these options for the purposes of the regional economic impacts assessment given the similarities of the expenditures on these option variants.

3. The analysis builds on the Phase 1 approach (undertaken by DTZ) with a number of updates and methodological revisions as follows:

    - Updated construction cost estimates are provided for each option;
    - More detailed leakage estimates have been incorporated with the construction estimates to better reflect the proportion of work that is likely to take place within the region;
    - The figures for employment and expenditure during the operation phase of each of the options have been updated based on more recent estimates;
    - The baseline employment and gross value added (GVA) data for the ports has been revised to include updated estimates for routine construction employment and an estimate for wider employment and GVA impacts induced across the region as a result of the ports;
    - New ports baseline scenarios have been developed to take account of predicted expansion in the port sector and the possibility of a major investment at Bristol Port;
    - The worst case scenario for the ports allows for the possibility of complete closure of upstream ports as a result of the largest barrage, Cardiff-Weston.

4. The impacts of these changes on the overall analysis compared to Phase 1 have been mixed. For example, increasing construction costs increases the estimated regional benefit, as does decreasing leakage. However, all of the changes to the ports data has acted to increase the estimated negative impact of the schemes on the ports and associated regional activity. Overall, it is still the case that the central estimate for each option generates a net benefit in terms of employment

[1] The Regional Workstream has involved representatives from the Department of Energy and Climate Change, Department for the Environment, Food and Rural Affairs, Department for Transport, Government Office for the South West, South West Regional Development Agency, South West Councils, English Heritage, Environment Agency, Natural England, Countryside Council for Wales, Cadw, Welsh Local Government Association, Wales Office, and the Welsh Assembly Government.

and GVA to the Wales and South West England region though there are still relatively wide ranges around these estimates.

Summary of Impacts

5. The figures outlined below show the net impact on the regional economy of Wales and South West England. The net figures are the result of summing the impacts from the construction, ports, marine aggregates, tourism and commercial fisheries sectors.

6. This analysis follows the format of Phase 1 in terms of presenting the results as a central estimate with sensitivity tested through high and low impact cases. Given the uncertainty that is inherent in projects of this magnitude there are no probability estimates attached to these different cases – the central case is based on a moderate set of assumptions some of which are then tested in the sensitivity analysis. Therefore, it follows from this that the central estimate may not, in practice, be the most likely outcome.

- **Cardiff-Weston** - The large barrage is expected to generate a net regional benefit in terms of GVA of £2.4bn (with a range between £6.1bn and -£0.8bn). Should the Deep Sea Container Terminal (DSCT) proceed then the likely range is £5.9bn to -£1.5bn with a central estimate of £2.1bn. In terms of employment, the central estimate is for 840 net additional jobs per year during construction (+5,500 to -1,600) and 120 during operation (+800 to -2,000). The impact of DSCT on employment is, as for GVA, to increase the negative impact with annual employment changes during construction at +440 (+5,300 to -2,200) and operation -80 (+700 to -2,500).

- **Shoots** - the central estimate is for a net GVA benefit of £0.9bn (£2.0bn to £0.3bn) with an annual employment gain of 1,240 during construction (4,000 to 600) and 80 during operation (250 to -100).

- **Beachley** - the central estimate is for a net GVA benefit of £0.5bn (£1.3bn to £0.1bn) with an annual employment gain of 940 during construction (2,000 to 600) and little change during operation (+150 to -150).

- **Welsh Grounds** - the central estimate is for a net GVA benefit of £1.2bn (£2.7bn to £0.4bn) with an annual employment gain of 1,740 during construction (5,000 to 600) and close to zero during operation (+250 to -100).

- **Bridgwater Bay** is the largest of the lagoon options and is the most-revised from phase 1. For Bridgwater Bay the central estimate is for a net GVA benefit of £2.3bn (£4.6bn to £0.5bn) with an annual employment gain of 3,240 during construction (7,000 to 1,000) and around 300 during operation (+700 to -250).

1. Introduction

1.1. This paper has been prepared on behalf of the Severn Tidal Power Feasibility Study regional workstream[2]. The purpose of this paper is to (i) conduct an agreed re-working of the Phase 1 regional economic impact assessment, taking appropriate account of methodological and data issues raised by the independent external peer review, and (ii) to update the regional economic impact estimates to reflect revised financial and construction information produced since time of the Phase 1 research.

1.2. This analysis also draws upon relevant economic and technical data which has emerged from other Severn Tidal Power workstreams, making appropriate cross-references to these sources. In particular, linkages are made to the supply-chain study, and information on navigation (relevant to assessing potential port impacts) and the Communities topic, both from the Strategic Environmental Assessment (SEA).

1.3. Note that employment estimates may not be directly comparable between this report and the SEA. This is due to slightly different methodology used to calculate gross employment (caused by the need to maintain consistency in this analysis with the work undertaken in Phase 1) and different geographical coverage (particularly in respect of the Communities topic).

1.4. The assumptions used in this report have been discussed, and agreed, by the Severn Tidal Power Feasibility Study Regional Workstream. In addition, the qualitative properties of the scenarios have been discussed with government economists and representatives of The Bristol Port Company.

1.5. The report contains a number of technical terms and references. These are explained in the glossary at the end of the main report.

1.6. The main results are summarised in section 4 of the report. Sections 5-8 then go on to discuss the results in more detail for each sector.

1.7. The annexes compare the methodology applied in this report with the Phase 1 methodology and the Peer Review recommendations.

[2] The Regional Workstream has involved representatives from the Department of Energy and Climate Change, Department for the Environment, Food and Rural Affairs, Department for Transport, Government Office for the South West, South West Regional Development Agency, South West Councils, English Heritage, Environment Agency, Natural England, Countryside Council for Wales, Cadw, Welsh Local Government Association, Wales Office, and the Welsh Assembly Government.

2. Background

2.1. As a part of the Severn Tidal Power (STP) Feasibility Study a specific need for an assessment of the potential regional economic impacts of alternative Severn Tidal Power options was identified. DTZ were commissioned to conduct an initial, high-level, assessment of the potential regional economic impacts focussing on whether Severn Estuary tidal power schemes would be expected to deliver significant net positive or net negative economic impacts for the South West of England and Wales. The research report was completed in January 2009.

2.2. A consultation on the STP Feasibility Study[3] took place in early 2009, setting out the initial evidence accumulated in the research studies, including the regional economic impacts study. Some of the consultation responses received raised questions regarding specfic aspects of the methodology and estimates presented in the DTZ report. An independent academic peer review of the DTZ study was subsequently commissioned.

2.3. The focus of the peer review was to inform the STP regional workstream whether the approach taken by DTZ was reasonable in the light of the issues raised in the consultation, and making clear where possible amendments to the approach would be likely to significantly impact on the conclusions reached in the study.

2.4. In particular, the independent peer reviewer was asked to consider (a) the ports baseline, (b) the displacement assumptions, and (c) the impact on current residents. The peer review has been published and is available at http://wales.gov.uk/docs/desh/publications/090918stppeerreviewen.doc and www.decc.gov.uk/severntidalpower.

2.5. The scope of the peer review did not extend to examining all of the areas examined in the DTZ study, instead focussing principally on those matters raised during the consultation, and particularly in respect of the potential impacts of the Cardiff-Weston barrage option on ports within the reference region. The scope of the peer review also did not extend to identifying any new research areas beyond those covered within the DTZ study.

2.6. The overall assessment of the peer review was broadly supportive of the general methodology employed by DTZ. However, some areas where re-working of the Phase 1 regional economic impact estimates would be of benefit were recommended. Following the peer review it was agreed that a re-worked Phase 1 analysis would be conducted which would:

- Adjust the estimates of the ABP[4] and Bristol[5] ports employment baseline;
- Add in desk-based estimates for construction / maintenance activity at the ports and construction cargo business;

[3] http://severntidalpowerconsultation.decc.gov.uk/
[4] Associated British Ports.
[5] The Bristol Port Company.

- Consider the labour market implications of tidal power scheme construction and operational phases (including ports employment changes);
- Review the local level analysis and undertake some additional sensitivity analysis:
- Clarify the use of terminology.

2.7. The focus of this paper is on addressing these requirements, focussing in particular on providing further analysis of the potential impacts on the transport and logistics sector (especially ports) and the construction sector.

2.8. The other sectors also considered within the initial DTZ assessment will be considered at this stage in terms of updating the earlier analysis and ensuring that it remains relevant. Where appropriate, the analysis has been updated using data from the Strategic Environmental Assessment. The other sectors considered here are tourism (this paper directly reproduces the Phase 1 results) and fisheries (updated to include revised employment estimates) from the Phase 1 work. In addition, the marine aggregates sector has been included in the analysis - this was briefly discussed in Phase 1. This sector has been included because some of the options impact either on ports used by the marine aggregates sector or on areas currently licenced for extraction.

2.9. Since the time of the publication of the Phase 1 regional economic impacts study, a variety of updated information has been produced through the on-going work of the STP Feasibility Study. Given this new information available to inform the estimates of regional economic impact, this paper additionally revisits the initial analysis to take account of the most recent data, including financial and construction information prepared by Parsons Brinckerhoff for the Options Definition Report, evidence collated as part of the revised supply chain study, and information on navigation (relevant to assessing potential port impacts) from the Strategic Environmental Assessment (SEA).

2.10. This analysis follows the format of Phase 1 in terms of presenting the results as a central estimate with sensitivity tested through high and low impact cases. Given the uncertainty that is inherent in projects of this magnitude there are no probability estimates attached to these different cases – the central case is based on a moderate set of assumptions some of which are then tested in the sensitivity analysis. Therefore, it follows from this that the central estimate may not, in practice, be the most likely outcome.

2.11. The analysis contained in this report is based on the best information available at this time. Given that the study of Severn Tidal Power options is still developing it is likely that there will be further revisions to some of the assumptions and estimates after this report has been completed.

3. Options

3.1. At the time that DTZ conducted the Phase 1 regional economic impacts assessment there were ten STP schemes under consideration[6]. Following the phase 1 consultation a shortlist of five schemes was identified for further study during phase 2.

3.2. This analysis makes use of data reflecting five shortlisted STP schemes, Cardiff-Weston Barrage (B3), Shoots Barrage (B4), Beachley Barrage (B5), Welsh Grounds Lagoon (L2), and Bridgwater Bay Lagoon (L3d), and does not distinguish between the variants of these options for the purposes of the regional economic impacts assessment given the similarities of the expenditures on these option variants. More detail on the options is given in the STP Options Definition Report (ODR).

3.3. The cost figures used to undertake this analysis include construction costs for each option, contingency costs and estimates for the construction of locks where appropriate. The analysis also takes account of ongoing operating costs for each option.

3.4. Certain costs have not been included in the main analysis though the potential impact is considered in section 5 (construction). Items excluded include ancillary works - works that are necessary as a consequence of the construction of a tidal power facility to mitigate the impact on day to day operation of existing assets - and expenditure necessary to prevent and reduce[7] adverse effects.

3.5. Also excluded from this analysis is expenditure on compensatory habitat. This is excluded because it is not certain either that such activity would take place in the region or how it would impact on the sectors that are considered in this analysis.

3.6. Table 1 shows the cost of construction for each of the options as used in this analysis along with the annual operating cost and the construction period. Also set out in this table are the additional costs of ancillary works, prevent & reduce measures and compensatory habitat for consistency with the ODR.

[6] B1 Outer barrage from Minehead to Aberthaw; B2 Middle barrage from Hinkley to Lavernock Point (As B3 but lands at Hinkley); B3 Middle barrage from Brean Down to Lavernock Point (Cardiff to Weston barrage): B4 Inner barrage (Shoots barrage): B5 Beachley barrage: F1 Tidal fence proposal: L2 Lagoon enclosure on the Welsh Grounds (Fleming Lagoon): L3 Tidal lagoon concept: R1 Tidal reef proposal: U1 Severn Lakes scheme. In the absence of further information DTZ treated option U1 as equivalent to B3.

[7] Mitigation measures include works such as improved flood and erosion defences, and port modifications while prevent & reduce measures include topographic modification, lock relocation and improved drainage. Further information is contained in the ODR.

Table 1 Options and Summary Information (£million)

Scheme	Cardiff - Weston	Shoots	Beachley	Welsh Grounds	Bridgwater Bay
Pre Construction	290	70	60	80	160
Construction	17,610	3,260	2,141	4,706	9,161
Construction Contingency	2,641	571	375	941	1,832
Ancillary Works	599	226	152	97	273
Measures to prevent & reduce adverse effects	745	285	325	278	348
Non-Intertidal Compensation	43	25	22	22	6
Inter-tidal habitat compensation (1:1 ratio)	612	128	106	286	77
Total Cost	22,540	4,565	3,181	6,409	11,857

Source: STP Options Definition Report

4. Overall Results and Net Impact

Summary of Impacts

4.1. The figures outlined below show the net impact on the regional economy of Wales and South West England. The net figures are the result of summing the impacts from the construction, ports, marine aggregates, tourism and commercial fisheries sectors.

4.2. Outputs are presented as a central estimate with high and low impact cases (which equate to best and worst cases). Given the uncertainty that is inherent in projects of this magnitude there are no probability estimates attached to these different cases – the central case is based on a moderate set of assumptions some of which are then tested in the sensitivity analysis. The factors that are tested to obtain the high and low impact cases are outlined in the sector sections which follow.

4.3. **Cardiff-Weston** - The large barrage is expected to generate a net regional benefit in terms of GVA of £2.4bn (with a range between £6.1bn and -£0.8bn). Should the Deep Sea Container Terminal (DSCT) proceed then the likely range is £5.9bn to -£1.5bn with a central estimate of £2.1bn. In terms of employment, the central estimate is for 840 net additional jobs per year during construction (+5,500 to -1,600) and 120 during operation (+800 to -2,000). The impact of DSCT on employment is, as for GVA, to increase the negative impact with annual employment changes during construction at +440 (+5,300 to -2,200) and operation -80 (+700 to -2,500).

4.4. **Shoots** - the central estimate is for a net GVA benefit of £0.9bn (£2.0bn to £0.3bn) with an annual employment gain of 1,240 during construction (4,000 to 600) and 80 during operation (250 to -100).

4.5. **Beachley** - the central estimate is for a net GVA benefit of £0.5bn (£1.3bn to £0.1bn) with an annual employment gain of 940 during construction (2,000 to 600) and little change during operation (+150 to -150).

4.6. **Welsh Grounds** - the central estimate is for a net GVA benefit of £1.2bn (£2.7bn to £0.4bn) with an annual employment gain of 1,740 during construction (5,000 to 600) and close to zero during operation (+250 to -100).

4.7. **Bridgwater Bay** is the largest of the lagoon options and is the most-revised from phase 1. For Bridgwater Bay the central estimate is for a net GVA benefit of £2.3bn (£4.6bn to £0.5bn) with an annual employment gain of 3,240 during construction (7,000 to 1,000) and around 300 during operation (+700 to -250).

Methodology

4.8. This section of the paper considers both the effects of re-working of the Phase 1 analysis and considers the new financial, construction, risk, and supply-chain information, and the potential impacts on navigation (and consequently

the ports) in updating the modelling of the regional economic impacts of the various tidal power options.

4.9. Further detail on how the figures in this section have been derived is contained in the subsequent sections 5-8.

4.10. No account is taken of any expenditures related to, but outside of the scope of the current analysis, for example expenditures on any associated electricity grid developments. Even though progress has been made in collecting information to assess the regional economic impacts, there remain unquantified potential impacts, which should be kept in mind in interpreting these results. As in the Phase 1 study, the economic impact of providing compensatory habitat has not been included in these revised estimates.

4.11. The information previously provided by Parsons Brinckerhoff informed a number of the assumptions made by DTZ in estimating the potential regional economic impacts of the STP options. Changes to the information inputs would be expected to impact on the regional estimates. The extent, and significance, of the impacts are set out in this paper. Similarly, the effects of the inclusion of the adjustments recommended in the independent peer review are set out below.

4.12. Where practicable the analysis aims to account for the profiling of costs and the timings of impacts. The analysis reflects revised information relating to:

- Revised construction costs, cost profiles and construction timings for each tidal power option;
- Disaggregations of construction costs and direct labour requirements for each option by type of activity;
- Revised operational and maintenance costs and phasing for each tidal power option;
- Where relevant, revised estimates of skill composition requirements to inform the estimates of local labour shares, and composition of employees during operation;
- Mitigation expenditures where they affect capital costs.

4.13. For the examined options, for consistency a 40-year reference period covering construction phase (varying across options) and operational phase impacts is considered. Operational impacts are assumed to commence from the completion of construction, therefore differing across the STP options.

4.14. The framework for the analysis is as follows.

- Construction – revised cost estimates and leakage data is applied as per the original analysis. For each of the 5 options high, medium and low impact scenarios are generated based on the sensitivity assumptions set out in section 5. Construction costs exclude compensatory habitat and pre-construction costs.

- Ports – revised baseline figures are used for all scenarios. Three scenarios are modelled for each option – "no change", "reasonable growth" and "baseline plus DSCT". "Reasonable growth" is taken as the central scenario and is the main focus of reporting, "no change" is closest to the original DTZ methodology and "baseline plus DSCT" demonstrates a particular case should the investment go ahead at Bristol.
- Operation – the methodology is the same as that employed by DTZ with updated employment and expenditure estimates.
- Other Sectors – the methodology builds on the Phase 1 work using findings generated in the SEA. Some of the impacts are quite speculative and, overall, have a relatively limited impact on the headline results - though the consequences for each sector may be large in relation to the size of that sector. The additional sectors covered are marine aggregates (because some of the options affects existing sites), commercial fisheries (particularly those affected by migratory fish) and tourism (the analysis here deals only with tourists attracted to any STP option rather than the overall impact on tourism).

4.15. One further test was conducted on the estimates for the Cardiff-Weston barrage to reflect possible commercial risk to the ports – each of the high, medium and low impact scenarios was tested using the worst case outcome for the ports located upstream of the barrage (i.e. 100% closure by the end of the construction period).

Table 2 Overview – Cardiff-Weston Barrage (B3)

	GVA £bn			**Average Employment per Year**	
	Construction	**Operation**	**Total**	**Construction**	**Operation**
Construction	1.4		**1.4**	3,000	
Operation		2.5	**2.5**		1,000
Ports	-0.7	-0.6	**-1.3**	-2,100	-700
Marine Agg.	-	-0.2	**-0.2**	-	-180
Fishing	-0.0	-0.0	**-0.0**	-60	-60
Tourism	-	0.0	**0.0**	-	60
TOTAL	**0.7**	**1.7**	**2.4**	**840**	**120**
Best			6.1	5,500	800
Worst			-0.8	-1,600	-2,000

4.16. Table 2, above, shows that the Cardiff-Weston barrage is expected to generate a net regional benefit in terms of GVA of £2.4bn (with a range between £6.1bn and -£0.8bn). Should the Deep Sea Container Terminal (DSCT) proceed then the likely range is £5.9bn to -£1.5bn with a central estimate of £2.1bn. In terms of employment, the central estimate is for 840 net additional jobs per year during construction (+5,500 to -1,600) and 120 during operation (+800 to -2,000). The impact of DSCT on employment is, as for GVA, to increase the negative impact with annual employment changes during construction at +440 (+5,300 to -2,200) and operation -80 (+700 to -2,500).

4.17. The impact of including the ports worst case across each of the medium and high impact scenarios (low remains the same) is to reduce GVA to £0.6bn and £3.7bn respectively.

4.18. The Cardiff-Weston barrage has a cost of £20.5bn and construction takes 9 years. Gross employment is estimated at 138,000 employment years or 15,500 per year. Leakage is estimated to be 63% and, after displacement and leakages, net additional employment is estimated to be 17,000 person years (increasing to 26,000 after multiplier effects are included).

Table 3 Overview – Shoots Barrage (B4)

	GVA £bn			**Average Employment per Year**	
	Construction	**Operation**	**Total**	**Construction**	**Operation**
Construction	0.5		**0.5**	1,500	
Operation		0.5	**0.5**		200
Ports	-0.0	-0.1	**-0.1**	-200	-100
Marine Agg.	-	-	**-**	-	-
Fishing	-0.0	-0.0	**-0.0**	-60	-60
Tourism	-	0.0	**0.0**	-	40
TOTAL	**0.5**	**0.4**	**0.9**	**1,240**	**80**
Best			2.0	4,000	250
Worst			0.3	600	-100

4.19. The ranges for the smaller barrages and lagoon are generally much smaller than for the large barrage and lagoon. This is because the smaller options do not generate negative impacts in the way the larger options do. For the Shoots barrage the central estimate is for a net GVA benefit of £0.9bn (£2.0bn to £0.3bn) with an annual employment gain of 1,240 during construction and 80 during operation.

4.20. The Shoots barrage has a construction cost of £3.9bn and a construction period of 5 years. Gross employment is estimated at 26,000 employment years or 5,000 per year. Leakage is estimated at 41% and, after displacement and leakages, net additional employment is estimated to be 5,000 person years (increasing to nearly 8,000 after multiplier effects are included).

Table 4 Overview – Beachley Barrage (B5)

	GVA £bn			Average Employment per Year	
	Construction	**Operation**	**Total**	**Construction**	**Operation**
Construction	0.3		**0.3**	1,200	
Operation		0.3	**0.3**		100
Ports	-0.0	-0.1	**-0.1**	-200	-100
Marine Agg.	-	-	**-**	-	-
Fishing	-0.0	-0.0	**-0.0**	-60	-60
Tourism	-	0.0	**0.0**	-	40
TOTAL	**0.3**	**0.2**	**0.5**	**940**	**-20**
Best			1.3	2,000	150
Worst			0.1	600	-150

4.21. For Beachley the central estimate is for a net GVA benefit of £0.5bn (£1.3bn to £0.1bn) with an annual employment gain of 940 during construction and little change during operation.

4.22. The Beachley barrage has a construction cost of £2.6bn and a construction period of 4 years. Gross employment is estimated at 18,000 employment years or 4,500 per year. Leakage is estimated at 47% and, after displacement and leakages, net additional employment is estimated to be 3,000 person years (increasing to nearly 5,000 after multiplier effects are included).

Table 5 Overview – Welsh Grounds Lagoon (L2)

	GVA £bn			Average Employment per Year	
	Construction	**Operation**	**Total**	**Construction**	**Operation**
Construction	0.8		**0.8**	2,000	
Operation		0.6	**0.6**		200
Ports	-0.0	-0.1	**-0.1**	-200	-100
Marine Agg.	-	-0.1	**-0.1**	-	-90
Fishing	-0.0	-0.0	**-0.0**	-60	-60
Tourism	-	0.0	**0.0**	-	10
TOTAL	**0.8**	**0.4**	**1.2**	**1,740**	**-40**
Best			2.7	5,000	250
Worst			0.4	600	-100

4.23. For the Welsh Grounds lagoon the central estimate is for a net GVA benefit of £1.2bn (£2.7bn to £0.4bn) with an annual employment gain of 1,740 during construction and close to zero during operation.

4.24. The project has a cost of £5.7bn and a construction period of 6 years. Gross employment is estimated at 39,000 employment years or 6,500 per year. Leakage is estimated at 36% and, after displacement and leakages, net

additional employment is estimated to be 8,000 person years (increasing to nearly 13,000 after multiplier effects are included).

Table 6 Overview – Bridgwater Bay Lagoon (L3d)

	GVA £bn			Average Employment per Year	
	Construction	**Operation**	**Total**	**Construction**	**Operation**
Construction	1.2		**1.2**	3,500	
Operation		1.2	**1.2**		450
Ports	-0.0	-0.1	**-0.1**	-200	-100
Marine Agg.	-	-	**-**	-	-
Fishing	-0.0	-0.0	**-0.0**	-60	-60
Tourism	-	0.0	**0.0**	-	10
TOTAL	**1.2**	**0.9**	**2.3**	**3,240**	**290**
Best			4.6	7,000	700
Worst			0.5	1,000	-250

4.25. Bridgwater Bay is the largest of the lagoon options and is the most-revised from phase 1. For Bridgwater Bay the central estimate is for a net GVA benefit of £2.3bn (£4.6bn to £0.5bn) with an annual employment gain of 3,240 during construction and around 300 during operation.

4.26. The Bridgwater Bay lagoon has a construction cost of £11.0bn and a construction period of 6 years. Gross employment is estimated at 77,000 employment years or 13,000 per year. Leakage is estimated at 49% and, after displacement and leakages, net additional employment is estimated to be 13,000 person years (increasing to 20,000 after multiplier effects are included).

5. Construction Sector

Summary of Impacts

5.1. **Regional Impacts** – After accounting for leakage, displacement and multipliers, the net regional impact is 3,000 additional jobs per year for Cardiff-Weston and 3,500 for Bridgwater Bay. The Welsh Grounds lagoon creates 2,000 additional jobs, the Shoots barrage 1,500 and Beachley 1,200. After discounting the GVA flows, the net regional impact ranges from £1.4bn for Cardiff-Weston down to £0.3bn for Beachley.

5.2. **Sensitivity ranges** – the estimates are subject to uncertainty so high and low impact estimates have also been derived. The net regional impact for Cardiff-Weston is likely to fall in the range 2,000 to 7,000 jobs per year (again, similar to Bridgwater Bay). For the smaller options the range is likely to be between 1,000 and 5,000. GVA for Cardiff-Weston is estimated to be in the range £1.0bn to £3.4bn, Bridgwater Bay is estimated to be between £0.6bn and £2.8bn and the smaller options in the range £0.2bn to £1.8bn.

Methodology

5.3. To estimate the potential net regional economic impacts, the starting point is to estimate gross GVA and employment estimates using expenditure data for each option provided by Parsons Brinkerhoff (PB). Direct employment from construction expenditure was estimated based on the ratio of turnover to employment[8] for a range of construction activities relevant to the Severn tidal power options, this being applied to relevant expenditure for each stage of the construction process and aggregated across the respective stages[9]. Estimates of total GVA were derived from the product of average GVA per head across construction activities and total estimated project-specific employment. The implication of this modelling approach is that larger expenditures would tend give rise to greater estimated gross project-related employment.

5.4. **Construction Costs** – As discussed in paragraph 3.3 above, this analysis only includes the main construction costs and contingencies. It does not include ancillary works, prevent and reduce measures or compensatory habitat provision. The itemised costs by each option are outlined in Table 1. A rough estimate of the potential impact of including these additional costs is outlined in Table 12 and paragraphs 5.16 and 5.17.

5.5. **Labour Requirements** - PB have recently (November 2009, updated December 2009) produced an estimate of the composition of construction

[8] Data sourced from the Annual Business Inquiry, Office for National Statistics. Note that there may be some small differences in gross employment figures between this analysis and PB estimates. This is due to the need in this analysis to produce both a range and a central estimate to maintain consistency with the Phase 1 work.

[9] The core phases are site investigation, design, supervision and site overheads; caissons; embankments; navigation locks; surface buildings; mechanical and electrical components, including turbines. The amount of labour input requirements is determined by the different skills requirements, labour intensity, and durations of each phase.

labour requirements[10], and revised estimates of total FTE jobs, updating previous estimates, and reflecting changes to the Cardiff-Weston option. Differences in the scale and designs of the alternative short listed options are then used to derive employment estimates. The paper provides information on the component of overall construction employment requirements in the "region" over the construction phase. Information is also provided on construction employment requirements by different skills categories for the region.

5.6. **Leakage** - The estimated gross impacts were adjusted to generate the expected net impacts. Leakage estimates (the estimates of non-local labour share), were estimated based on an assessment of expected labour (skills) inputs provided by Parsons Brinkerhoff which informed assumptions of local labour share and capacity. Revised leakage estimates were provided for this analysis. For the DTZ work, common leakage rates were applied to each option based on the estimated leakage for each construction activity. For this exercise, each option is assessed separately to allow for differences in scale and construction methodologies. The new leakage assumptions are set out in Table 7 below.

[10] Estimates of labour input requirements for a Cardiff Weston barrage were provided by STPG in 1989, and updated by STPG in January 2002.

Table 7 Construction - Estimated Skills Profile and Job Leakage Rate

Construction stage	Skill level Low/medium/high	Key skill sets	Likely share of local labour (%)				
			Cardiff-Weston	Shoots	Beachley	Welsh Grounds	Bridgwater Bay
Preliminaries and Site Overheads	30/60/10%	General labourers/building trades/ civil engineers	50%	85%	90%	85%	85%
Caissons	20/60/20%	General labourers/building trades/ civil engineers	45%	90%	90%	90%	90%
Embankments	30/60/10	General labourers/building trades/ civil engineers	85%	80%	85%	80%	80%
Navigation Locks	20/60/20%	General labourers/building trades/ civil engineers	65%	90%	90%	85%	85%
Surface Buildings	20/70/10	General labourers/building trades/ civil engineers	50%	50%	50%	50%	50%
Mechanical and Electrical	5/50/45	Apprentices/technicians/engineers	10%	10%	10%	10%	10%
Design & Supervision	0/0/100	Professional Engineers	50%	50%	50%	50%	50%
Site Investigation	10/50/40	General labourers/building trades/ civil engineers	25%	25%	25%	25%	25%
Contractor's Oncosts & Profit	n/a						
Ancillary Works	20/60/20	General labourers/building trades and technicians/ professional engineers	70%	70%	70%	70%	70%
Contingencies	n/a		35%	60%	55%	65%	52%

Source: Parsons Brinkerhoff, Options Definition Report

5.7. **Displacement and multiplier** - An average rate of 67 percent for displacement was employed for local activity based on English Partnerships guidance for large-scale national projects (as used in Phase 1). A multiplier value of 1.54 was applied to the net direct impact estimates in generating estimates of the total net regional economic impacts[11]. Sensitivity analysis was conducted on a number of the assumptions. No adjustment was applied for optimism bias, though a 15 percent contingency had been included in the construction costs.

5.8. **Net Impacts** - The additional Gross Value Added (GVA) estimates were expressed as present values using a social discount rate of 3.5 percent applied to the first 30 years, and 3 percent for years 31-40, at 2008 prices as per Green Book guidance. The employment estimates were not discounted, presenting estimates of annual average jobs[12].

5.9. **Sensitivity** - Consistent with DTZ, scenarios are developed and applied as follows. In the Low scenario leakage is increased to 75 percent for all construction elements, except for turbines which is retained at 90 percent, with displacement unchanged at 67 percent. In addition, a new assumption is tested – caisson leakage is increased to 50% for options Shoots, Welsh Grounds and Bridgwater Bay to reflect the fact that existing facilities outside the region could be employed. For the High scenario turbine leakage was reduced to 20 percent from 90 percent in the original DTZ work. This is not tested here as it is considered more likely that turbine production will take place outside the region. Consistent with DTZ displacement is reduced from 67 percent to 20 percent.

Results

5.10. The results of the reworking of the construction analysis for both employment and gross value added are set out in Table 8 to Table 11 below.

[11] DTZ considered a multiplier value of 1.54 for the South West of England and 1.79 for Wales, using the lower value as the more conservative assumption, relevant information being published by the South West Regional Observatory and the Welsh Economy Research Unit at Cardiff Business School. DTZ suggest that, based on an analysis of input-output tables that, on average, the multiplier value may be around 5-10 percent larger for the combined "region" than for the separate regional multipliers.

[12] This approach was used by DTZ to summarise net employment impacts given the different denominators where construction employment was measured by person years, ports employment as annual average jobs (with peak employment impacts) and the use of full-time equivalent (FTE) jobs for operational employment effects.

Table 8 Construction - Total Employment Impacts

Option	Gross Employment Years	Employment after Displacement and Leakages	Regional Employment After Multiplier Effects
Cardiff-Weston	138,000 (335,000–104,000)	17,000 (41,000-13,000)	26,000 (63,000-20,000)
Shoots	26,500 (63,000-14,000)	5,000 (12,000-3,000)	8,000 (20,000-4,000)
Beachley	18,000 (43,000-13,000)	3,000 (7,000-2,000)	5,000 (11,000-3,000)
Welsh Grounds	39,000 (88,000-18,000)	8,000 (19,000-4,000)	13,000 (29,000-6,000)
Bridgwater Bay	77,500 (179,000-40,000)	13,000 (30,000-7,000)	20,000 (46,000-10,000)

Table 9 Construction - Annual Average Employment

Option	Gross Annual Average Employment	Employment after Displacement and Leakages	Regional Employment After Multiplier Effects
Cardiff-Weston	15,500 (38,000-12,000)	2,000 (5,000-2,000)	3,000 (7,000-2,000)
Shoots	5,500 (12,000-3000)	1,000 (2,000-1,000)	1,500 (4,000-1,000)
Beachley	4,500 (11,000-3,000)	750 (2,000-500)	1,000 (2,000-1,000)
Welsh Grounds	6,500 (15,000-3,000)	1,500 (4,000-1,000)	2,000 (5,000-1,000)
Bridgwater Bay	13,000 (30,000-7,000)	2,000 (5,000-1,000)	3,500 (7,000-2,000)

Construction Employment Summary

5.11. The Cardiff-Weston barrage is estimated to generate 138,000 gross construction jobs. After taking account of leakages and displacement this represents 17,000 regional construction jobs over the construction period. This translates to a regional impact of a net additional 26,000 jobs after including wider economic impacts. In annual average terms, this represents 3,000 additional jobs per year with a range of 2,000 to 7,000.

5.12. For a smaller barrage such as Beachley, the gross construction jobs are estimated to be around 18,000. In terms of regional impact, the central

estimate for annual average employment is 1,000 with a range of 1,000 to 2,000.

5.13. The largest of the lagoons (Bridgwater Bay) is estimated to have a net regional impact of similar scale to Cardiff-Weston despite having a lower gross impact. This is partly due to the leakage estimate for Cardiff-Weston being higher than for Bridgwater Bay (in other words, more of the activity for Cardiff-Weston takes place outside the region) and also due to the shorter construction time for Bridgwater Bay which concentrates the employment impacts into fewer years.

5.14. The following tables outline the gross value added impacts of the construction phases. Note that GVA figures are presented as gross and net present values over the construction period rather than as annual averages.

Table 10 Construction - GVA Impacts (£ Billion)

Option	Gross GVA Impact	Impact After Leakages	Impact After Leakages and Displacement	Regional GVA Impact After Multiplier Effects	Present Value of Regional GVA Impact
Cardiff-Weston	8.7	3.5	1.1	1.8	1.4
Shoots	1.7	1.1	0.4	0.5	0.5
Beachley	1.1	0.6	0.2	0.3	0.3
Welsh Grounds	2.4	1.7	0.6	0.9	0.8
Bridgwater Bay	4.7	2.7	0.9	1.4	1.2

Table 11 Construction - GVA Sensitivity Ranges (£ Billion)

Option	High	Medium	Low
Cardiff-Weston	3.4	1.4	1.0
Shoots	1.2	0.5	0.3
Beachley	0.8	0.3	0.2
Welsh Grounds	1.8	0.7	0.4
Bridgwater Bay	2.8	1.2	0.6

Construction GVA Summary

5.15. As with employment, Cardiff-Weston is estimated to generate the highest gross and net GVA figures. Focussing on the present value of GVA, the central estimate is £1.4 billion over the construction phase with a range of £3.4bn to £1.0bn. Beachley is estimated to have a much lower impact with a range of £0.8bn to £0.2bn. The large lagoon, Bridgwater Bay, will have an estimated impact of £1.2bn (£2.8bn to £0.6bn). Bridgwater Bay has an

estimated lower impact than Cardiff-Weston in GVA terms because of the higher absolute cost over the construction phase in Cardiff-Weston.

Additional Costs

5.16. As mentioned previously, this analysis excludes certain construction items – ancillary works, prevent & reduce measures and compensatory habitat. These costs vary across the schemes and represent varying proportions of the total costs for each scheme. As a rough approximation, it is possible to adjust the overall construction impacts for each scheme to account for these additional costs. The table below adjusts GVA and employment for the central estimates by the percentage increase represented by these additional costs.

Table 12 Impact of Adding in Wider Construction Costs

Option	Original		Percentage Uplift	Revised	
	GVA (£bn)	Employment		GVA	Employment
Cardiff-Weston	1.4	3,000	9.7	1.5	3,300
Shoots	0.5	1,500	17.0	0.6	1,800
Beachley	0.3	1,000	23.5	0.4	1,200
Welsh Grounds	0.8	2,000	11.9	0.9	2,200
Bridgwater Bay	1.2	3,000	6.3	1.3	3,200

5.17. The impacts outlined above would feed through directly to the net impact figures outlined in Chapter 4. So, for example, Cardiff-Weston employment impact would increase by 300 and GVA would increase by £0.1bn.

6. Operation Phase

6.1. This analysis has made no new assumptions or adjustments to the methodology used to calculate the operational phase impacts. However, new data has been produced by PB which estimates employment and expenditure by year for each option.

Table 13 Annual Operational Expenditure and Employment

Option	Employment	Expenditure £m
Cardiff-Weston	850	276
Shoots	150	45
Beachley	90	27
Welsh Grounds	150	56
Bridgwater Bay	400	111

6.2. The data is adjusted for displacement (central case assumed to be 50%) and multiplier effects (using the electricity generation multiplier of 2.36) and the expenditure figure is converted into GVA using the same turnover/GVA ratio as used in Phase 1. Sensitivity is then tested using alternative assumptions on displacement (tested at 25%, 50% and 75%). This translates into net impacts as follows.

Table 14 Operation - Annual average Employment Impacts

Option	High	Medium	Low
Cardiff-Weston	1,500	1,000	500
Shoots	250	200	100
Beachley	150	100	50
Welsh Grounds	250	200	100
Bridgwater Bay	700	450	250

Table 15 Operation - Net GVA Impacts (PV £billion)

	High	Medium	Low
Cardiff-Weston	3.8	2.5	1.3
Shoots	0.8	0.5	0.3
Beachley	0.5	0.3	0.2
Welsh Grounds	0.9	0.6	0.3
Bridgwater Bay	1.8	1.2	0.6

7. Ports Sector

Summary of Impacts

7.1. **Construction Phase Impacts** – Cardiff-Weston has by far the largest impact on the port sector. During the construction phase it is estimated that employment will be 2,100 lower each year than it otherwise would have been. This translates into lower GVA of £0.7bn (present value) over the duration of the construction phase. Should the Deep Sea Container Terminal (see paragraph 7.22 for explanation) project go ahead, annual employment losses rise to 2,500 and overall GVA falls by £0.9bn. For each of the other options the medium impact case is for employment to be around 200 lower each year and only a small impact on GVA.

7.2. **Operation Phase Impacts** – Again, Cardiff-Weston has the largest impact with average annual employment being 700 lower than it would otherwise have been. This represents a total GVA loss of £0.6bn. Under the DSCT assumptions these figures rise to 900 jobs per year and £0.8bn GVA. For the other options employment is around 100 per year lower and the total GVA loss is around £0.1bn.

7.3. **Sensitivity Ranges** – For Cardiff-Weston the worst case is closure of ports upstream of the barrage. Employment is likely to be between 1,400 and 3,500 lower each year during the construction phase and 500 to 2,300 lower during the operation phase. The total impact over both phases in terms of lost GVA is likely to be between £0.9bn and £2.9bn (£1.1bn and £3.6bn for DSCT). The next highest impact comes from Bridgwater Bay due to the worst case assumption that the lagoon has a significant impact on navigation during construction. The worst case impact of Bridgwater Bay during construction is likely to be around 1,000 jobs per year (£0.2bn GVA) though the best case is for no impact. The smaller options vary between 0 and 400 jobs per year during construction (GVA impact <£0.1bn) and 0 to 200 jobs per year during operation (GVA 0 to £0.3bn)

Methodology

7.4. This analysis focuses on the potential impacts on those ports upstream of at least one of the Severn tidal power options, i.e. Bristol, Cardiff, Newport and Sharpness. Other ports within the South West of England and Wales "region" such as Swansea, Barry and Port Talbot ports are considered primarily in relation to potential intra-regional displacement effects.

7.5. The main focus is placed on Bristol Port as it is by far the largest affected port in the Bristol Channel, and the previous assessment that Bristol Port could be disproportionately affected given its deepwater facilities, its larger economic hinterland and that it can accommodate the larger Panamax and Capesize vessels (only Port Talbot of the other local ports is able to handle such large vessels).

7.6. In making an updated assessment of the potential (negative) impacts on ports, consideration is also given to the importance of impacts from potential mitigation expenditures and any impacts on vessel access and access times, i.e. the time taken to navigate the Severn Estuary and any reduction in the time available to enter and leave ports. No detailed analysis of trends in vessel sizes and continued future access is undertaken, assuming that mitigation measures will permit the largest current vessels access to port infrastructure. However, it should be noted that there may be some differences between navigational impacts and economic impacts – a small change to transit times, for example, may have a disproportionate effect on port business by increasing marginal costs thus making the port uncompetitive.

7.7. This analysis takes as its starting point, the baseline figures and assumptions used in the Phase 1 work (outlined in Annex 1). Certain assumptions are retained, in particular, those relating to the replacement of port activities and the changes to displacement used to generate the high and low impact scenarios. There are a number of revised assumptions and adjustments made to take into account peer review comments and any new data. The new assumptions revise the initial baseline, change some of the sensitivity analysis, and incorporate estimates for future growth at the ports.

Ports Baseline

7.8. The baseline as used in Phase 1 has been adjusted to take account of two additional factors. First, an estimate is made for the number of people employed in routine construction and maintenance at Bristol Port. Second, an estimate has been made of the number of induced jobs that occur in the region as a result of port activity. Both of these changes were recommended by the peer review.

7.9. **Routine construction** - Data is available from Roger Tym & Partners (2004) on the total level of construction employment at the Port of Bristol. For this analysis, it has proved difficult to obtain estimates for the split between routine and one-off construction employment. Therefore, it has been necessary to make an estimate. As a first approximation, it was assumed that 50% of the identified construction jobs were routine. This suggests around 240 jobs before the application of multipliers. A port manpower survey conducted on behalf of DfT (Department for Transport, 2005) indicated that professional engineering and maintenance employees account for around 10% of direct employment at ports. The estimate of 240 represents around 7.5% of direct employment at Bristol making it broadly consistent (assuming that some of the "professional" jobs won't be in routine construction). Therefore, this estimate is adopted. In terms of the multiplier effect on this construction employment, the same overall multiplier is used here as elsewhere in this analysis (1.54).

7.10. **Multiplier** - The analysis of multipliers is an area that will require further work, in particular to update the existing estimates (some of which date from 2004) and to include the effect at the greater combined

Wales/South West region. This has not been possible for this analysis. However, one adjustment has been made to address the issue of induced employment. This was omitted entirely by DTZ but the peer review recommended that some estimate be made. The peer review suggested that around 80% of multiplier effects take place in the first round or two of expenditure (i.e. the direct and indirect effects). This leaves 20% as income or induced effects. Applying this to the Bristol Port data gives an induced jobs figure of 400.

7.11. **Revised baseline** - The above changes have the effect of increasing the baseline employment attributable to Bristol Port by around 770 jobs. This increases the multiplier at Bristol to 1.67, higher than the Phase 1 estimates (which were 1.54) but consistent with other estimates (DfT, 2005 and Peer review) and lower than others (e.g. Oxford Economics, 2009). Applying the methodology outlined above to convert this into impact data gives the following results (note, no account is taken of ports downstream of the options as these will be largely unaffected):

Table 16 Ports Employment Baseline

Port	DTZ		Re-working	
	Employment	GVA (£ million)	Employment	GVA (£ million)
Bristol	4,590	190.4	5,360	222.3
Cardiff	590	24.4	590	24.4
Newport	290	11.8	290	11.8
Sharpness	60	2.5	60	2.5
TOTAL	**5,530**	**229.0**	**6,300**	**261.0**

Sensitivity Analysis

7.12. In this section consideration is given to revising the potential worst case impacts ("high impact" case) of some options on the ports, reference case[13] and scenarios (including a possible expansion at Bristol Port), displacement effects and multiplier values. Note that optimism bias will be considered at the strategic level and will not be incorporated into the regional analysis at this stage.

7.13. **High impact case** - Under the Cardiff-Weston option the worst case scenario now includes the possibility of closure of ports upstream of the barrage. This is one area where marginal economic impacts have been considered to be more damaging to the ports that the mitigation analysis would suggest. This has the effect under the high impact scenario of increasing the construction displacement for Cardiff-Weston to 50% and the operational displacement to 100% (see Annex 1 for Phase 1 figures).

[13] The reference case being the best estimate of a project's economic cost allowing for risk and optimism bias (see Additionality Guide and HM Treasury Green Book).

7.14. The high impact displacement for Bridgwater Bay has been increased to 25% to reflect the fact that this option is now considerably larger and likely to create more disruption to navigation than originally envisaged. The high level of displacement is continued through the operation phase though it is likely that, in practice, once initial mitigation works are complete the ongoing impact will be lower. This change increases the high impact displacement for Bridgwater Bay to 15% in the construction phase and 25% in the operation phase.

7.15. **Reference Case and Scenarios** - In this section additional scenarios are developed, and their implications considered, taking account of economic and sector-specific conditions and trends, and of appropriate guidance[14]. Three scenarios are employed here as recommended: (i) 'no change', (ii) 'reasonable growth', and (iii) 'baseline plus DSCT'[15]. Given the uncertainties in developing longer-term scenarios, particularly attention is given to potentially different impacts in respect of output and employment.

7.16. **"No change"** - The "no change" scenario has been analysed in order to allow comparison with the Phase 1 work. It takes the revised baseline outlined above as the starting point.

7.17. **"Reasonable Growth"** - The peer review suggests an approach to developing a 'reasonable growth' scenario as follows:

- Use a simple trend extrapolation methodology;
- Do not make adjustments for the current recession given the long time horizon of this analysis;
- Ensure the projections are consistent, reflecting all ports in the STP area, and the demand and price of electricity etc.;
- Employ conservative annual growth rate assumptions[16];
- Use conservative assumptions for trend extrapolation of port employment[17].

7.18. The 'reasonable growth' scenario covers potential growth at Bristol Port, Sharpness and ABP South Wales operations. In forming such scenarios, no consideration is given to potential short-run impacts from additional business through the transport of Severn tidal power construction materials. This is an issue that will need to be considered at a later date.

7.19. The analysis makes use of the forecasts contained in the MDS Transmodal produced UK port demand forecasts for the UK for the

[14] See HM Treasury, The Green Book (2003).
[15] DSCT refers to the proposal for a Deep Sea Container Terminal at Bristol Port.
[16] On this aspect the peer review notes the favourable macroeconomic conditions during the 10 year period to 2008 - if not appropriately reflected these could result in the provision of over-estimates when using simple trend extrapolation.
[17] Again, the peer review notes the 'once-for-all' growth gains experienced by many UK ports following privatisation, further raising the question of whether UK ports could expect to maintain the growth rates in recent years.

Department for Transport in 2007. These forecasts run to 2030 and are broken down by type of cargo (see Table 17 below). For the purposes of this exercise, the forecasts are extrapolated to cover the 40 year analysis period.

7.20. Bristol Port volume is assumed to grow at the UK average (1% per year) because it is the most diverse of the ports in terms of cargo mix, reflecting the UK as a whole. The other ports are assumed to grow at the rate of the bulk cargo forecasts (0.2% per year) reflecting the main cargos that are handled. This gives the result that the growth rate accelerates slightly throughout the period because the largest of these ports grows at the fastest rate. Employment is assumed to grow at a slower rate than output to reflect productivity improvements. It is difficult to assign specific growth rates to either employment or output without knowing how the cargo mix will change and the potential impact of new investment, working practices etc. For this exercise, employment has been assumed to grow at half the rate of output.

Table 17 Overall Forecast Growth in GB Port Traffic in Tonnes to 2030

Mode of Appearance	% Change 2005-2030	%CAGR 2005-2030
Bulk Traffic GB		
Liquid Bulk	+9%	+0.3%
Dry Bulk	-8%	-0.3%
Other general cargo (including import/export vehicles)	+16%	+0.6%
Total GB non-Unitised	**+4%**	**+0.2%**
Ro-ro	+101%	+2.8%
Lo-lo	+135%	+3.5%
Total GB Unitised	**+112%**	**+3.1%**
Total GB	**+30%**	**+1.0%**

Source: MDS Transmodal, 2007

7.21. The year-by-year figures for this scenario are not reported here given that both the absolute numbers and the growth rate change each year over the 40 year period for both employment and GVA.

7.22. **Deep Sea Container terminal** – This scenario has been developed to reflect the fact that Bristol Port has applied for permission to invest in a deep sea container terminal which would significantly alter the economic impact of the port.

7.23. In developing the baseline plus DSCT scenario, the information utilised is drawn from information published by The Bristol Port Company on proposals to develop a new deep-sea container terminal at Avonmouth Docks[18]. The documents indicate that, subject to approval of the submitted Harbour Revision Order (HRO) by the Department for Transport, that construction could commence in 2009/2010 with the DSCT completed around 4 years later. During the construction phase the Port estimates that there will be 360 direct jobs. These have been converted into economic impacts using

[18] "Bristol Container Port: Proposed Deep-Sea Container Terminal", The Bristol Port Company.

the same multiplier and GVA conversion as was used in the main construction analysis. 1,760 jobs are anticipated by The Bristol Port Company to be created by the project, and nearly 8,000 existing port-related jobs safeguarded.

7.24. A further assumption has been made in terms of the lead-in period from the start of operation to full impact – it has been assumed that this process takes 5 years to reach full capacity and a further year before the full multiplier impact is felt. The DSCT impacts are added on to the baseline and, once the full impact has been established (yr 10) the projections flatline for the remainder of the analysis period. The scale of the impacts as presented by the Port data has not been tested in this analysis.

Table 18 Annual Impact of Deep Sea Container Terminal on Bristol Port Baseline

	Baseline	Construction	Year 10 Full Operation
Employment	5360	554	7120
GVA £million	222	33	336

Results

7.25. The reference case used in this report is based on the "reasonable growth" scenario. Where appropriate, reference is made to the other scenarios, in particular, the DSCT scenario. The analysis is presented for both the construction and operation phases of the options under consideration. The small barrage and lagoon (Shoots, Beachley and Welsh Grounds) options are presented as a single option because there is little difference in terms of their impact on the ports. Cardiff-Weston and Bridgwater Bay are reported separately given their relatively large impact on navigation in the Severn Estuary.

Table 19 Impact on Ports Employment, Reasonable Growth Scenario

Option	Impact	Construction			Operation
		Max	Avg		Avg
Cardiff-Weston	High	6,500	3,500		2,300
	Medium	3,900	2,100		700
	Low	2,600	1,400		500
Shoots, Beachley, Welsh Grounds	High	600	400		200
	Medium	300	200		100
	Low	0	0		0
Bridgwater Bay	High	1,600	1,000		500
	Medium	300	200		100
	Low	0	0		0

7.26. In Table 19, above, "Max" refers to the highest level of employment lost in any one year during the construction phase (usually the final year of construction). In the case of Cardiff-Weston, this represents complete closure of all ports upstream of the barrage. "Avg" refers to the average level by which employment is reduced throughout both the construction and operation phases. The high, medium and low scenarios are based on varying the level of port activity that is displaced by the STP options (for Cardiff-Weston the peak displacement at the end of the construction period for the high impact is 100%, medium is 60% and low is 40%).

7.27. For Cardiff-Weston, average employment related to the ports is estimated to be 2,100 lower than it otherwise would have been during the construction phase (range 1,400 to 3,500) and 700 per year lower (500 to 2,300) in the operation phase.

7.28. The impact of the smaller barrages and lagoons is relatively limited during both the construction and operation phases.

7.29. The central case for Bridgwater Bay is similar to the smaller barrages. However, the High impact case represents the potential that Bridgwater Bay has for disruption to ports as a result of necessary mitigation works. Average annual employment is expected to be 200 lower in the central case though this could rise to 1,000 per year under the high impact scenario.

7.30. In terms of the DSCT scenario, impacts on the ports increase significantly, particularly for Cardiff-Weston with a smaller impact from the other options. In the central case, employment is 2,500 per year (range 1,600 to 4,100) lower than it otherwise would have been during construction period and 900 per year lower (range 600 to 2,800) during operation.

Table 20 Impact on Ports GVA (PV £billion), Reasonable Growth Scenario

Option	Impact	Construction	Operation		Total
Cardiff-Weston	High	1.2	1.7		2.9
	Medium	0.7	0.6		1.3
	Low	0.5	0.4		0.9
Shoots, Beachley, Welsh Grounds	High	0.0	0.2		0.3
	Medium	0	0.1		0.1
	Low	0	0		0
Bridgwater Bay	High	0.2	0.5		0.7
	Medium	0.0	0.1		0.1
	Low	0	0		0

7.31. As with employment, the largest negative impact on the ports occurs under option Cardiff-Weston with GVA some £1.3bn (£0.9 to £2.9) lower over the 40 year appraisal period than it otherwise would have been. The impacts are split more or less evenly between the construction and operation phases. Again, the impacts increase under the DSCT scenario with possible GVA losses ranging from £1.1bn to £3.6bn with a central estimate of £1.6bn. DSCT has a marginal impact on the other options.

7.32. The impacts of the smaller barrages/lagoon are much smaller, again, in keeping with the much smaller impact on navigation in the Severn Estuary.

7.33. The impact from Bridgwater Bay could be as high as £0.7bn overall with the main impacts felt during operation. However, as previously pointed out, once mitigation measures are in place the port business may recover much more quickly.

8. Other Sectors

8.1. The main regional sectors likely to be affected by the STP options are ports and construction. However, the options may also affect a range of other sectors. Because the impacts on these other sectors are relatively smaller and less clear cut, it is difficult to assess potential impacts with any great certainty. Therefore, the estimates in this section should be treated with some caution. The estimates for each sector are set out in the following section. However, no overall summary is provided due to the differing effects across options, impact scenarios and construction/operation phases.

Tourism

8.2. The Phase 1 work did not fully quantify impacts on the tourism sector. It identified areas of potential impact and whether the impact was likely to be positive or negative. The Communities topic paper in Phase 2 also adopts this approach and provides a qualitative assessment of impacts. The overall conclusions are that there will be a range of both positive and negative impacts through both the construction and operation phases. However, overall it was unclear whether such effects would be large or whether the net effect would be positive or negative.

8.3. One specific area was quantified during Phase 1 and that was the potential for any scheme to attract new tourists into the region as a tourist attraction in its own right. As such, estimates were made of the impact of a visitor centre located in the region. In the absence of any updated quantified estimates the outputs of this analysis are reproduced here. The figures represent gains to the regional economy.

Table 21 Tourism Impacts

	GVA PV £m			Employment		
	High	**Medium**	**Low**	**High**	**Medium**	**Low**
Large Barrage	27	14	3	130	60	20
Small Barrage	20	10	3	80	40	10
Lagoon	3	2	0.4	10	10	<10

8.4. For the purposes of this exercise, the Large Barrage represents Cardiff-Weston, the Small Barrage represents Shoots and Beachley and the Lagoon represents Welsh Grounds and Bridgwater Bay. The impacts are assumed to take place during the operation phase.

Commercial Fishing Activities

8.5. Phase 1 work estimated the total impact in terms of employment and GVA on fisheries activity in the region. The Phase 2 Communities analysis updates the estimates for employment based on revised assumptions and baseline data. The approach adopted here is to adjust the Phase 1 estimates on a pro rata basis using the difference between the original and revised employment

estimates. The implication of this approach Phase 1 assumptions in terms of GVA per head, multipliers, leakage and displacement remain unchanged.

8.6. In a revision from Phase 1, all job losses are predicted to occur by the end of the construction period and are never regained. Over the longer term (to 2140) the Communities paper estimates that commercial fishing activity will have declined regardless of STP options. However, due to the much shorter time period under consideration here this assumption is not factored in. Also, given that the central assumption is for loss of specific activity and the estimates are relatively crude, no sensitivity analysis is undertaken and the central estimate applies across the High, medium and low scenarios. Finally, the impacts are assumed to be felt equally across each of the STP options.

Table 22 Job Losses in Commercial Fishing Activities

Option	Construction		Operation	
	Phase 1	Phase 2	Phase 1	Phase 2
Cardiff-Weston	30	58	60	58
Shoots	40	58	70	58
Beachley	40	58	70	58
Welsh Grounds	40	58	70	58
Bridgwater Bay	40	58	70	58

Source: Severn Tidal Power – SEA Topic Paper, Communities, Feb 2010 and Severn Tidal Power Feasibility Study, Jan 2009

8.7. In terms of GVA Impacts, the table below reproduces the Phase 1 figures and new estimates for Phase 2.

Table 23 GVA Losses in Commercial Fishing Activities (PV £m)

Option	Construction		Operation	
	Phase 1	Phase 2	Phase 1	Phase 2
Cardiff-Weston	7	14	22	21
Shoots	4	14	30	21
Beachley	4	14	30	21
Welsh Grounds	4	14	30	21
Bridgwater Bay	4	14	30	21

Source: Severn Tidal Power Feasibility Study, Jan 2009 and Phase 2 estimate

8.8. As can be seen from the tables above, the impact from the Phase 2 analysis is accelerated due to a higher proportion of the jobs disappearing during the construction phase. The impact is then generally lower during the operation phase due to the lower number of jobs overall that are lost.

Marine Aggregates

8.9. The Phase 1 work did not assess the impact of the STP options on the marine aggregates sector though it did note that impacts were likely to be relatively small. The work did, however, provide some outline estimates for potential impacts which are utilised here.

8.10. The Communities topic paper has provided estimates for the aggregates baseline in the region and has also estimated potential impacts from each of the options. The impacts are based on whether each of the options will interfere with access either to an area currently licensed for marine aggregates extraction or to one of the ports that currently handles marine aggregates. The analysis focuses on existing operations and does not take account of any new opportunities that may arise as a result of STP options or activity that may be transferred to other ports requiring new investment.

8.11. The analysis shows that only two of the options are likely to be affected – Cardiff-Weston and Welsh Grounds. For both options the conclusion is that activity may be affected negatively during construction but that the impacts are likely to be small. For the operation phase, the analysis estimates a worst case for Cardiff-Weston of 10% of activity lost and for Welsh Grounds the figure is 5%. Baseline employment in 2006 is estimated to be 1,100 in the affected area. Estimates for productivity and employment growth are built in to the model so that employment increases throughout the period. Over the 40 year appraisal period the 10% and 5% maximum impacts equate to average employment being 130 and 70 lower than it otherwise would have been.

8.12. In terms of translating these job losses into economic impacts, the methodology is relatively crude reflecting the speculative nature of the initial estimates. Leakage and displacement are likely to be low and so are not considered. In addition, multiplier effects are likely to be relatively low – DTZ estimated that for construction materials and aggregates the direct multiplier was 0.35. This is adopted here rather than the wider type 2 multiplier which is likely to overstate the impact of a relatively low value adding sector. DTZ also estimated that 14 FTE jobs in the sector equated to around £1m of activity. Note that in the table below the impacts are all felt during the operation phase. The present value of GVA for Welsh Grounds is higher than might be expected relative to Cardiff-Weston (i.e. more than 50%) because the operation phase starts earlier and runs for longer.

Table 24 Impact on Marine Aggregates, worst case

Affected Options	Average direct Employment reduction per year	After Multiplier Effects	GVA Equivalent per year	GVA PV £ Million
Cardiff-Weston	130	180	13	175
Welsh Grounds	70	90	6	100

8.13. The estimates in the table above are based on a worst case scenario. Sensitivity testing given the relatively crude level of analysis would not be all

that meaningful so the estimates are applied equally across all impact scenarios.

Glossary

Additionality. An impact arising from an intervention is additional if it would not have occurred in the absence of the intervention; *The extent to which an activity is undertaken on a larger scale, takes place at all, or earlier, or within a given geographical area as a result of the project. Thus, an impact arising from a project is additional if it would not have occurred in the absence of the project.

Affordability. An assessment of whether proposals can be paid for in terms of cashflows and resource costs.

Base case. The best estimate of how much a proposal will cost in economic terms, including an allowance for risk and optimism.

***Baseline.** A description of conditions existing at a point in time against which subsequent changes can be detected through monitoring. A baseline study is also required in order to establish what the conditions would be if development were not to take place. Conditions may not be stable even in the absence of development; there may be decline, improvement or cyclic conditions.

Crowding out. The extent to which an increase in demand occasioned by government policy is offset by a decrease in private sector demand. **Crowding out differs from displacement because it relates to wider economic effects. It is a macroeconomic rather than microeconomic phenomenon. It can be thought of as being 'indirect' displacement in that its effects are like displacement but it occurs through macro-economic adjustment.

Deadweight. Expenditure to promote a desired activity that would in fact have occurred without the expenditure.

Discounting. A method used to convert future costs or benefits to present values using a discount rate.

Discount rate. The annual percentage rate at which the present value of a future pound, or other unit of account, is assumed to fall away through time.

Displacement. The degree to which an increase in productive capacity promoted by government policy is offset by reductions in productive capacity elsewhere; *The proportion of a project outputs accounted for by reduced outputs elsewhere in the target area.

**** Gross economic impact.** Overall economic impact, not accounting for any other factors.

Gross value added. The value in monetary terms of the economic output within a region over a specific time period.

***Leakage.** The proportion of outputs that benefit those outside of the project's target area or group.

***Multiplier effects.** Further economic activity (jobs, expenditure or income) associated with additional local income, local supplier purchases and longer term effects. ** The size of the multiplier depends on the period over which it is measured, and the geographical area considered. Input-output models can be used to capture the multiplier effects.

****Net economic impact.** The gross economic impact having accounted for elements outlined above (gross minus deadweight, displacement crowding out, leakage, substitution plus multiplier impacts.

Net Present Value. The discounted value of a stream of either future costs or benefits. The term Net Present Value (NPV) is used to describe the difference between the present value of a stream of costs and a stream of benefits.

Optimism bias. The demonstrated systematic tendency for appraisers to be over-optimistic about key project parameters, including capital costs, operating costs, works duration and benefits delivery.

***Reference case.** The position in terms of target outputs over a set period of time if the project/intervention did not take place.

Risk. The likelihood, measured by its probability, that a particular event will occur.

Sensitivity analysis. Analysis of the effects on an appraisal of varying the projected value of important variables.

Substitution. The situation in which a firm substitutes one activity for a similar activity (such as recruiting a different job applicant) to take advantage of government assistance. ** This can be thought of as firm level displacement, i.e. a firm will substitute one activity for another in response to the STP scheme

***Target area.** The area within which benefits will be assessed.

Sources: The Green Book, HM Treasury, TSO; *Additionality Guide (2004), English Partnerships; ** DTZ employed definition.

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ANNEX 1

Phase 1/Phase 2 Methodology Comparison

1. In conducting the Phase 1 re-working and updating of regional economic impacts analysis, it is useful to set out the key assumptions and methodology employed by DTZ, and to highlight where any differences arise in this reassessment, and the rationale and evidence supporting any such amendments.

2. The DTZ report provided first-stage, high level, estimates of the net (additional)[19] regional economic impact of alternative tidal power options - the net economic impact being gross impacts adjusted for factors such as displacement, crowding out, leakage effects, substitution, and multiplier effects. Though some local level analysis[20] was conducted, the focus of the study was principally on a combined Wales and South West of England constructed "region". This geography is retained as the principal focus in this paper.

3. The study focussed on a number of sectors: Construction, Transport & Logistics (including ports), Fishing, Land-Use Planning, Tourism, Accommodation, Residential & Population, and Other Industries. In this report only the Construction and Transport & Logistics (Ports) sectors are re-modelled in detail though updated estimates for other sectors are provided where appropriate.

4. Sensitivity analysis was conducted to, as far as practicable at that time, reflect uncertainties, particularly in respect of 'leakage' and 'displacement'. Such sensitivity analysis resulted in broad ranges of estimated impacts. However, the use of updated information and additional data sources which will be incorporated into the analysis at this stage is anticipated to assist in refining some of these estimates. However, this report also includes some additional sensitivity analysis and scenarios not considered in the DTZ analysis, a feature which tends to work in the opposite direction.

5. DTZ clustered similar tidal power options during the analysis, where information was insufficient to appropriately distinguish between options, with option specific estimates in respect of construction, for example, to clustered sector impacts, for example, ports. This approach is retained for this paper[21].

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[19] The additional impact is the extent to which activity takes place, on a large scale, at en earlier timing or within a specific areas or group as a consequence of the intervention, see Additionality Guide (2004, p.3) and HM Treasury Green Book. The net additional impact is the impact of the option of intervention less the impact of the reference case.

[20] DTZ employed two definitions for the local level impacts, the first based on district authorities located around the Severn Estuary (Cardiff, Newport, Vale of Glamorgan, Monmouthshire, Gloucestershire, South Gloucestershire, Bristol, North Somerset, Sedgemoor and West Somerset, and the second Rural areas, Urban areas and Coastal towns.

[21] As noted by DTZ, the implication of this approach is that construction durations may deviate slightly from the assumed phasing of construction impacts.

6. Each option was assessed over a 40-year reference period, covering both the construction phase (the duration varying across options) and during the operational phase[22]. The standard approach as set out in the Green Book is that costs and benefits should generally be considered over the period of the useful economic lifetime of option assets, including any residual value in the assessment. In this case the life is considered to be 120 years. This period is not used as this is not a full cost benefit analysis.

7. As noted in the DTZ study, for some elements of the analysis it was not feasible to provide quantified estimates. Additionally, wider environmental effects more broadly defined such the value of ecosystems, and visual and noise pollution impacts, for example, were not examined. The consultants Economics for the Environment Consultancy Ltd. (EFTEC) have been separately commissioned to undertake economic research on an ecosystems valuation of the Severn Estuary. As in the original DTZ study, no account is taken of the wider social and environmental costs and benefits in this assessment.

8. The DTZ analysis made particular use of the engineering and technical information provided by Parsons Brinkerhoff (PB) and the Strategic Environmental Assessment (SEA). These sources are again employed in this study, making use of the latest data.

9. In addition, this updated analysis more fully reflects the issue of mitigation expenditures, given the potential adverse consequences for some of the Severn Estuary ports resulting from disruption affecting vessel access and transit times to the ports during both construction and operational phases for some Severn tidal power options[23].

10. An important issue given consideration in deriving updated regional economic impact estimates is the extent to which the incursion of additional expenditures on mitigation measures, for example, the provision of locks, could potentially alleviate some of these negative regional economic impacts. The extent to which options for mitigation (and their costs) compare with the estimated ports impacts through mitigating actions is considered, drawing on the available analysis of vessel transit times, and potential queuing impacts, reported in the revised Navigation Topic paper for the SEA. It should be noted that there may be differences between navigational impacts and economic impacts – mitigation may make transit possible but it may have marginal economic impacts which affect competitiveness.

11. To estimate the impacts of the ports of Bristol, Cardiff, Newport and Sharpness, DTZ used the data collected in the Roger Tym & Partners (2004) study of Bristol Port, grossing up the impacts across the other ports based on each ports value of cargo handled (based on MDS Transmodal cargo volume data and cargo value data from Roger Tym & Partners (2004). DTZ made

[22] Sensitivity analysis was conducted examining the impacts over a shorter ten-year (operational) period.

[23] DTZ, however, also identified some potential positive effects on the ports sector through acquired business relating to the delivery of Severn Tidal Power construction materials.

adjustments to reflect their view of employment that would be likely to continue even in the absence of Bristol Port, using the data available to derive an implied multiplier of 1.54. GVA to employment ratios were employed to assess the ports impacts.

12. In terms of displacement, the DTZ analysis identified that other ports within the South West of England and Wales could have the potential to acquire any business lost at Bristol Port, though the assessment suggested that most of this would be displaced to ports outside of the region (i.e. a negative impact at the regional level). Only between 2-29 percent of the lost trade value was anticipated to be 'intra-regional displacement' (based on the analysis of MDS evidence).

13. DTZ employed the following displacement percentage assumptions[24] (presented in Table 27).

Table 25 Phase 1 Displacement Scenarios

	% Displacement Scenarios		
	High Impact	Medium Impact	Low Impact
Construction			
Cardiff-Weston	40%	30%	20%
Small barrage / lagoon	5%	2.5%	0%
Tidal fence / tidal reef	No estimate	No estimate	No estimate
Operation			
Cardiff-Weston	80%	60%	40%
Small barrage / lagoon	10%	5%	0%
Tidal fence / tidal reef	No estimate	No estimate	No estimate

14. The effects were assumed to increase linearly over the phase of works to the maximum estimated level, taking the mean rate over the relevant time period for both construction and operational phases[25]. Operational displacement was considered for the 40-year reference period, assuming straight-line depreciation for the low and medium scenarios of one-tenth per annum and for the high impact scenario of one-twentieth per annum.

15. In addition, it was assumed that long-term reallocation of port assets (i.e. substitution)[26], for both capital and labour, would take place over 10 and 20 year periods following the end of the construction phase, effectively 20 and 30

[24] The medium leakage and displacement assumptions used by DTZ, and the sensitivity analysis, were confirmed as reasonable in the peer review.
[25] For the representative large barrage a construction period of 10 years was assumed, the impacts increased by 1/10th each year; with a 5 year period taken for the representative small barrage and lagoon.
[26] To consider substitution the DTZ analysis reduced the duration and impact of negative displacement effects for the operational phase.

year periods. However, DTZ also noted that labour re-absorption could occur more rapidly than assumed in relatively buoyant labour markets.

16. The peer review highlighted the importance of the assumption of the gradual phased absorption[27] of assets at the Port of Bristol in moderating the negative port employment impacts, suggesting some potential adjustments in the modelling.

[27] It is also of importance to note that these negative impacts are focussed around the particular option of a large barrage, which therefore remains a central issue in this paper.

ANNEX 2

Peer review

1. An independent academic peer review of the DTZ study was subsequently commissioned.

2. The focus of the peer review was to inform the regional workstream of the Severn Tidal Power feasibility study as to whether the approach taken by DTZ was reasonable in the light of the issues raised in the consultation, assessing whether the assumptions made were reasonable, and making clear where possible amendments to the approach would be likely to significantly impact on the conclusions reached in the study.

3. In particular, the independent peer reviewer was asked to consider (a) the ports baseline, (b) the displacement assumptions, and (c) the impact on current residents. The peer review has been published and is available at http://wales.gov.uk/docs/desh/publications/090918stppeerreviewen.doc

4. The scope of the peer review did not extend to examining all of the areas examined in the DTZ study, instead focussing principally on those matters raised during the consultation, and particularly in respect of the potential impacts of the Cardiff-Weston barrage option on ports within the reference region. The scope of the peer review also did not extend to identifying any new research areas beyond those covered within the DTZ study.

5. The overall assessment of the peer review was broadly supportive of the general methodology employed by DTZ. However, some areas where re-working of the Phase 1 regional economic impact estimates would be of benefit were recommended. Following the peer review it was agreed that a re-worked Phase 1 analysis would be conducted which would:

    - Adjust the estimates of the ABP[28] and Bristol[29] ports employment baseline;
    - Add in desk-based estimates for construction / maintenance activity at the ports and construction cargo business;
    - Consider the labour market implications of tidal power scheme construction and operational phases (including ports employment changes);
    - Review the local level analysis and undertake some additional sensitivity analysis:
    - Clarify the use of terminology.

6. The peer review identified a number of issues in respect of the ports baseline, and recommended that the analysis should adjust the estimates of the ABP and Bristol ports employment baseline, and add in desk-based estimates for annual

[28] Associated British Ports.
[29] The Bristol Port Company.

routine construction / maintenance activity at the ports and construction cargo business.

7. The peer review recommended reviewing the baseline employment for both ABP and BPC. However, given the relative dominance of BPC in the data, the different time periods covered by the studies and the fact that multipliers will need to be reviewed at the combined regional level, the analysis focuses on the Bristol Port figures with other ports assumed to be as per the DTZ analysis. This is an area where further work may be required to update the earlier studies of port impacts and to consider the wider regional consequences.

8. As recommended, in undertaking this re-working to adjust the estimates of the ports baseline and multiplier[30] estimates use is made of a number of sources including survey data collected for Bristol Port[31] to refine the analysis. For this re-working use is made of the 2003-04 data employed by DTZ as the baseline year, reflecting the Bristol Port study data available[32].

9. The DTZ methodology made a number of assumptions and employed a grossing up procedure to generate port employment baselines. In terms of the former, DTZ grossed up Bristol Port data using cargo value for each of the ports in the reference region. However, in re-working the analysis it is recognised that the market values of goods transported via ports may not be directly correlated with value added activity, in other words more intensive processing activity at ports may be required for some cargoes of lower values[33].

10. The peer review report clearly set out the differences that emerged between the baselines and multiplier estimates derived in the RTP study of Bristol Port and the estimates used within the DTZ study. These are set out in the table below.

[30] A number of studies have employed multipliers to assess the impacts of ports within the UK. A recent example is Oxford Economics (2009) who estimated an employment multiplier of 2.21 and an activity multiplier of 2.05 for the UK ports and shipping industries.
[31] Roger Tym & Partners (2004).
[32] Following the recommendations of the peer review, despite the standard approach of preferring to use more recent date, several reasons were presented for not doing so here; (i) this would need to be undertaken in conjunction with shifting other STP baselines to ensure consistency, (ii) new business surveys required to collect the data might be untypical given the current macroeconomic conditions, and; (iii) the use of appropriate reference cases could be more effective in addressing changes since the initial base year.
[33] This point was made during the Phase 1 consultation.

Table 26 Phase 1 Employment Baselines and Multipliers, Bristol Port

Employment category	RTP	DTZ
(A) Direct jobs		
Port jobs	740	740
Port-related industries	2,250	2,250
Total direct jobs	2,990	2,990
(B) Indirect jobs		
Transport services	1,510	650
Suppliers of goods and services	970	970
Total indirect jobs	2,480	1,620
(C) Induced jobs	1,590	0
Total direct, indirect and induced jobs	7,060	4,610
Implied regional multiplier: (direct + indirect + induced)/direct	k = 2.36 (7,060 / 2,990)	k = 1,54 (4,610 / 2,990)

Source: BPC consultation response, 23rd April 2009.

11. As the peer review noted, the Roger Tym & Partners (2004) study of Bristol Port initially included an estimate of 483 FTE construction jobs (and their associated multiplier effects) in the multiplier estimate, based on averaged construction activity covering the period 1994-2003. The peer review did support the inclusion of such activity, though noting issues in making such estimates, and the need to employing a specific associated multiplier, to ensure that the baseline was not under-estimated.

12. As noted in the peer review, further clarification relating to transport services (indirect jobs) and induced jobs, is also needed, given the different implied multipliers that result[34]. Although DTZ made an adjustment to the multiplier values, the peer review considered that that methodology also was not suitable[35].

13. The peer review highlights the importance of developing an appropriate reference case (and the importance of the choice of reference case[36]) and scenarios in assessing the potential regional economic impacts of alternative Severn tidal power options.

[34] The peer review identified that the implied multiplier value of 2.36 and the supplier multiplier of 1.83 from the Roger Tym and Partners (2004) would both be unusually high in the context of the UK regional employment multiplier. For the former the multiplier was constructed using the English Partnership recommendations of a local level income multiplier of 0.29. Using the suggested regional income multiplier would have given rise to an even higher implied multiplier of 2.63. For the supplier multiplier the peer review (p.8) also notes the unsuitable application of the income multiplier to a multiplicand including both direct and indirect employment.

[35] The approach reduced employment in transport services, retained suppliers of goods and services at 970, and assumed an income multiplier of zero, implying no induced jobs.

[36] This issue is considered, for example, in the English Partnerships (2008).

14. The DTZ report, although not expressed explicitly, made use of effectively a 'no change' reference case. As the peer review noted such 'no change' reference cases are frequently used, especially where the reference period covers a significant time period and where there are considerable uncertainties, both points being relevant to this analysis. However, the peer review also noted that an alternative reference case may have been more suitable.

15. **Reasonable Growth"** - The peer review suggests an approach to developing a 'reasonable growth' scenario as follows:

    a) Use a simple trend extrapolation methodology;
    b) Do not make adjustments for the current recession given the long time horizon of this analysis;
    c) Ensure the projections are consistent, reflecting all ports in the STP area, and the demand and price of electricity etc.;
    d) Employ conservative annual growth rate assumptions[37];
    e) Use conservative assumptions for trend extrapolation of port employment[38].

Displacement Effects

16. The consultation and peer review highlighted the existence of some degree of contention over the ports displacement assumptions. As previously identified, ports displacement is a combination of (i) 'displacement' effects from the loss of port business outside of the "region"[39], and within-region displacement to other ports, and (ii) 'substitution' effects from activities gradually replacing declining port activities.

- Loss of Port Business

17. The peer review suggested undertaking additional sensitivity analysis of the impact of potential (extra-regionally) lost port business, given the magnitude of losses suggested in the DTZ analysis[40]. The approach recommended was to focus on three elements:

    a) A commodity by commodity analysis of port trade likely to be lost extra-regionally;
    b) A detailed risk assessment of likelihood of loss (to the region) occurring;

[37] On this aspect the peer review notes the favourable macroeconomic conditions during the 10 year period to 2008 - if not appropriately reflected these could result in the provision of over-estimates when using simple trend extrapolation.
[38] Again, the peer review notes the 'once-for-all' growth gains experienced by many UK ports following privatisation, further raising the question of whether UK ports could expect to maintain the growth rates in recent years.
[39] Such extra-regional displacement reflects a withdrawal from the regional circular flow of income and has the effect of decreasing the regional multiplier. Within-region displacement does not give rise to negative impacts at the regional level.
[40] DTZ estimated inter-regional transfer of business of 2 to 29 percent, with a 'medium' estimate of 30 percent of Bristol Port losses being extra-regional under the B3 barrage option.

c) The risk of decline leading to port closure (the threshold[41] for such an event) and potential timing of such an outcome.

18. Conducting this level of analysis has not been possible at this stage of the reworking. Broadly, this analysis follows the original DTZ approach. The exceptions being the consideration of port closure in the worst case scenarios and the consideration of possible port closure even in the even of the medium and low impact scenarios due to the potential loss of competitiveness caused by even small changes to operating costs or transit times.

- Replacement of Port Activities

19. In terms of the replacement of port activities[42], the peer review identifies a priority need to consider potential replacement activity at the Port of Bristol site, making a case for alternative scenarios of what could reasonably be expected to occupy the site over time, and the role of the port in the wider city and region. No assessment is included here of the role of the port in the wider city and region within this report.

20. The peer review suggested that given the location of the Port of Bristol that it would be unlikely that the current port resources would remain unutilised in the event of the port closure. It also confirmed that whilst is may be reasonable to assume that reallocation of port resources would take place over time, it was less reasonable to assume that (i) replacement activities would be of equal value to existing activities[43], or (ii) employment gains would balance employment losses (Peer Review, pp.12-13).

21. Such an analysis over long periods (the original DTZ study used a 40-year reference period, and the expected asset length of the barrage would be around 120 years) moves away from the multiplier framework, which whilst having infinite rounds, are short-term dynamics, into long-run economic growth theory.

22. However, there is no consensus on longer-term economic growth processes, with some researchers placing particular value on export-earning activities, (supporters of export-led models of regional economic growth). As the peer review, some alternative models such as neoclassical convergence models, endogenous growth theory, and new economic geography (NEG) models instead emphasise the importance of within-region growth (Peer Review, p.15).

23. Some thought is therefore required to the implications of alternative long-run models of regional and local economic growth, to inform what activity might be expected to locate at the site, and the potential value of these activities.

[41] DTZ employed an assumed decay rate procedure in producing estimates.
[42] The impact of the estimated port-associated job losses would be expected to be moderated (at least in part) over time through the redeployment of assets at the ports (for example, land on the port sites for alternative uses).
[43] For example, one speculative scenario would be that the site could be used in the future for housing developments.

Clearly, ones views on the determinants of regional economic growth will have a role in assessing the anticipated "value" of any replacement activities. However, a full survey is beyond the bounds of this particular paper and this analysis, if thought necessary, would need to form a separate study.

Multiplier Values

24. The peer review emphasises the importance of the appropriate construction of employed multipliers in the assessment of possible regional impacts[44]. Such multiplier-based analyses have been commonly used to estimate the impacts of large-scale expenditure injections and withdrawals in the regional or local context.

25. The peer review makes some specific suggestions regarding adjustments to the value of the multiplier to employ over the long term, including:

    a) Making a modest adjustment for steadily declining regional multipliers over time as a consequence of increasingly open economies (globalisation);
    b) Changes to the multiplier as a consequence of alternations to the composition of activities replacing the port[45];

26. The peer review raises issues around the use of a combined South West England and Wales "region" multiplier, in particular the use of the lower of the two multipliers as a conservative assumption. For this study, given the issues of assessing the precise location of activities and impacts this geography is retained. At the appropriate time, further work could consider such a disaggregation.

Labour Market and Local Level Analysis

27. As the peer review notes, conducting further local level analysis is inhibited due to (i) a lack of definitive reasoning for selecting particular local area disaggregations (ii) lack of agreement on the sub-sets of areas which should be assessed, and (iii) greater complexity in estimating the appropriate multiplier given additional local level leakages, and larger data constraints. However, the peer does suggest conducting a broad review of the impacts on the previous conclusions of using 'best match' LLMAs (best match given that LLMAs are not defined using local authority districts).

28. This paper does not consider local level analysis further – this work is taken forward in the Communities paper.

[44] Such multipliers may be estimated, for example, by using business surveys to estimate local supply linkages or from input-output tables.
[45] As the peer reviewer notes, lower multiplier will occur where replacement activities for the port provide reduced export income injections.

Clarification of Terminology

29. The peer review identified that some of the differences of opinion expressed during the consultation were, at least in part, a consequence of HM Treasury terminology being applied to the tidal power project (the 'intervention'), and with the identified adverse impact on the ports being treated as a separate intervention. The peer review notes that such effects on the ports should be considered to be entirely a displacement effect.

30. Though appropriately recognising the possibilities of both 'intra-regional displacement' of business (to other ports within the South West of England and Wales reference region) and 'extra-regional displacement' of business of ports outside of the region[46], the peer reviewer identified that strictly the HM Treasury guidance is applicable to effects within the intervention target area. For clarity, as recommended, this paper draws a distinction between 'displacement' being the whole of the ports impacts, and the terminology 'loss of business' for the impacts of knock-on effects.

31. The peer review also identifies the need for clarification in respect of the terminology relating to 'substitution'. As recommended, in this paper use is made of the terminology 'long term resource reallocation' in re-assessing the potential re-use of port sites, and subsequent potential regional economic impacts.

[46] For the reference region such extra-regional displacement reflects a negative impact. From a UK perspective the negative impact would be that part of the displacement outside of the UK.

ANNEX 3

Baseline data

1. This analysis has not explicitly updated the baseline data from the phase 1 work undertaken by DTZ as this was not one of the areas highlighted for further work. Also, there was little time between Phase 1 and Phase 2 for substantive changes to impact on the analysis. The main exception to this is the ports baseline which has been substantially revised as set out in Section 7. Further work was undertaken as part of the Communities topic to establish baselines for the smaller sectors including tourism, commercial fishing and marine aggregates. For completeness, the baseline data is set out in the table below:

Table 27 Baseline Data

Sector	Baseline
Construction	52,200 construction workers in the local study area (taken from DTZ), updated to 46,800 in the Communities Topic paper)
Ports	Gross economic impact in region of 6,300 employees and £261m GVA per year (Recalculated for this analysis)
Tourism	72,400 employed in study area (taken from Communities topic)
Commercial Fisheries	79 FTEs (Communities)
Marine Aggregates	1107 FTEs (Communities)