bigdilemmas

2010/2011

The future of renewable energy in the UK

Lessons from the Severn Barrage

Foreword

The University of Exeter is known for world leading research into 'Climate Change and Sustainable Futures' and has recently established the Environment and Sustainability Institute in Cornwall to further research in environmental sustainability. In addition, the University is committed to developing sustainability literate graduates. In 2010, the Big Dilemmas Project was launched with the view to develop a better understanding of the sustainability dilemmas that society is trying to grapple with. Twenty of the brightest students from across the University were selected to form a think-tank. Working with stakeholders and lead academics., they focused on the theme 'The Future of Renewable Energy in the UK' and drew lessons from the developments of the Severn Estuary tidal energy schemes. Under the previous Government five different constructions for energy generation were evaluated. Although the scheme has been shelved for now, it might be resurrected in the future in one shape or another. This makes it an interesting case study for policy makers, investors and activists alike. The think-tank researched challenges around energy security, protection of biodiversity, public engagement and economics. In this pamphlet the students are presenting their conclusions* and are offering some insightful propositions on how to approach complex sustainability dilemmas. I echo Martin Wright's (Forum for the Future) comment at the final Big Dilemmas symposium: "If we want to move towards a sustainable society, we need to win hearts and minds. We need to change the narrative and promote optimism, entrepreneurship and innovation. The students who are participating in this project are doing just that."

Harriet Sjerps-Jones, Sustainability Curriculum Development Manager, University of Exeter, 2011

Sources have been referenced where possible and have been verified by the students to their best ability, however the University of Exeter can not take any responsibility for the validity of the data quoted in this publication

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Introduction

When the Department of Energy and Climate Changed announced on October 18th last year that the Severn Tidal Barrage Project would be shelved, it put another twist in the story of harnessing energy from the Severn Estuary. Since as early as 1925 (The Ecologist, 2010), proposals have been made to generate predictable, renewable electricity at the Estuary – the latest of which generating up to 5% of UK electricity demand (DECC, 2010). It must be questioned, however, why so many attempts have failed to get the go ahead.

If looked at from an engineering perspective, the project is an exciting one; even before electricity was proposed, there was a barrage proposed to produce a large shipping harbour, road and railway transport and an increased level of flood protection (Caine, 1995). The barrage, shown below, would certainly have been an impressive sight and celebration of engineering. Since then, the potential for large scale electricity generation has made it popular to the engineering world.

Looking at major projects from one perspective has never been satisfactory. For the Severn, this was highlighted by shelving of the project on economic reasons seven times between 1925 and 1981. However, an interdisciplinary approach is ever more important, particularly in issues relating to energy and climate change. A move towards a more holistic approach with the Severn Barrage Project was taken in 1984 and 1989, when the environmental impacts of such a project were taken far more seriously (DECC, 2010).

With The Severn Estuary being subject to conservation designations on both a national and international scale, the environmental impact of a barrage is a huge consideration. With intertidal mudflats and sandflats extending to 23,000ha in the area being just one of the concerns, the barrage proposals have brought about conflict as to the nature and extent of change and damage it would bring about.

Engineering, economics and ecology are not where the issues surrounding the barrage end. Public acceptance, integration to the electricity transmission network, shipping and the role of policy are just some of the many factors which much be considered for the project. These are the issues that organisations such as Corlan Hafren are faced with. An industry consortium formed after the October announcement by Government, Corlan Hafren are proposing that private sector money could finance the project (Corlan Hafren, 2011).

This clearly won't be the last that is heard of the Severn Tidal Barrage. With the future proposals likely to need interdisciplinary approaches and analysis, it is hoped that the approach taken by the Think Tank in this report can provide a useful overview and insight to the lessons that can be learned from the story so far.

Laura Daniels

References:

Caine, B. (1995). Thomas Fulljames, 1808 - 1874: surveyor, architect and civil engineer. Available: http://www2.glos.ac.uk/bgas/tbgas/v113/bg113007.pdf. Last accessed 25/05/2011.

Corlan Hafren. (2011). Welcome to Corlan Hafren. Available: http://www.corlanhafren.co.uk/. Last accessed 25/05/2011.

DECC. (2010). Additional Background Information. Available: http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/severn_tidal_power/feasibility/background/background.aspx. Last accessed 25/05/2011.

The Ecologist. (2010). Severn Barrage Faces Economic rather than Environmental Hurdles . Available: http://www.theecologist.org/News/news_analysis/522790/severn_barrage_faces_economic_rather_than_environmental_hurdles.html. Last accessed 25/05/2011.

Energy Policy, Renewable Energy & the Business Case

The interest in building the Severn Barrage stems from the pressing concerns surrounding climate change. To tackle this looming threat the government has implemented targets to reduce greenhouse gas emissions by 80% by 2050 and to increase the amount of energy generated from renewable sources to 15% by 2020. This in effect means 30% of electricity generated in the UK has to come from renewable sources by 2020 and the entire electricity system needs to be effectively de-carbonised by 2030. To address these challenges the government has published a number of white papers in recent years. The key objectives outlined in these policy prescriptions are to decarbonise the economy at an affordable price whilst maintaining acceptable levels of energy security.

Barrage Pros

The Severn Barrage has the potential to play an important role in the transition to a low carbon economy as it represents a semi-reliable indigenous source of zero carbon electricity. In the long term it would help to reduce both the nation's carbon emissions and the country's dependence on imported fossil fuels. The power generated could theoretically provide up to 5% of the country's electricity needs.

Barrage Cons

The barrage is a huge investment and the twelve year construction timeline makes it unattractive for politicians looking to make a dent on the 2020. Due to its size it could potentially soak up a lot of government resources and crowd out other renewable technologies struggling to find their way into the electricity generating mix. Finally, one of the major worries is that the barrage could cause significant and potentially irreversible environmental damage.

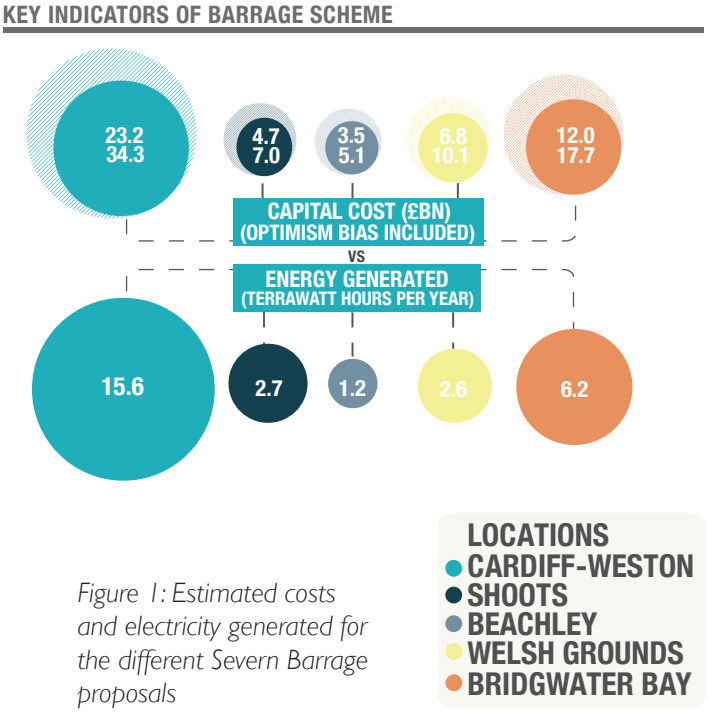


Figure 1: Estimated costs and electricity generated for the different Severn Barrage proposals

Details of the Barrage

Figure 1 shows the Cardiff-Weston barrage proposal is the largest of the options being considered and would cost approximately £23.2bn. Once built the barrage would generate 15.6 terawatt hours of electricity per year over its one hundred and fifty year operating lifetime. An indication of how the barrage compares with other technologies in terms electricity produced and carbon saved can be seen in *figure 2*.

Does it represent a good investment?

In order to get an idea as to whether the barrage represents a shrewd investment the *Levelised Cost Of Electricity* (LCOE) can be used to compare how the barrage compares to other low carbon generation technologies. Levelised costing calculates in current terms all capital, fuel and operating and maintenance costs associated with the generating plant over its lifetime and divides the total cost by the estimated output in kWh over the lifetime of the plant. It can also be interpreted as the constant level of revenue needed each year to recover all

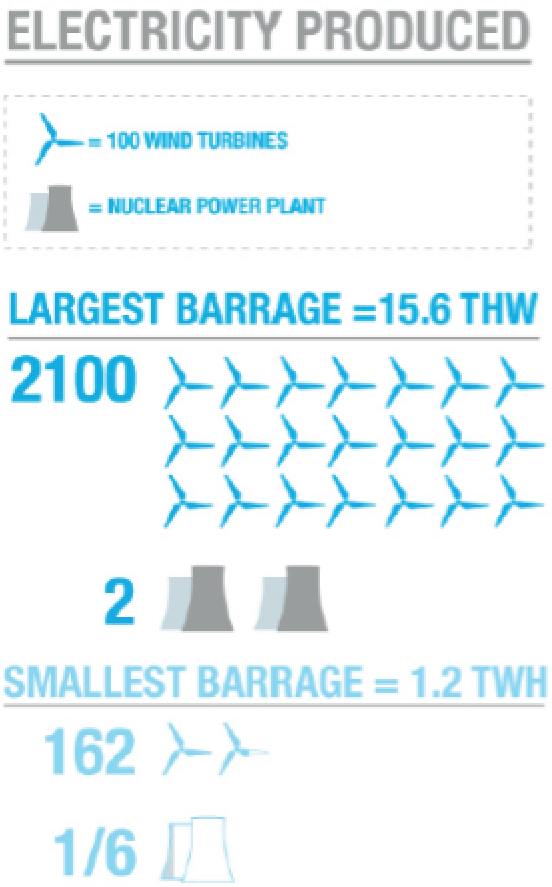
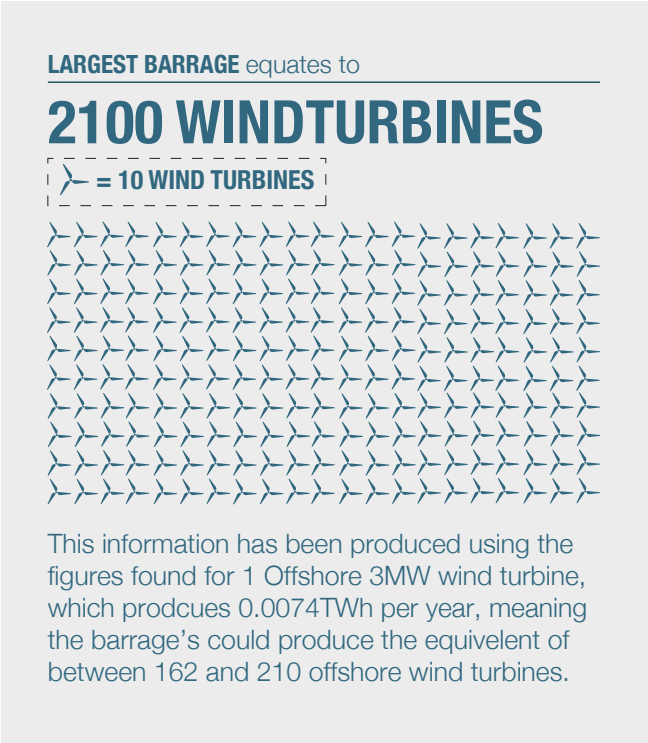


Figure 2



KEY INDICATORS OF BARRAGE SCHEME
Data source: Severn Tidal Power. Feasibility Study Conclusions and Summary Report. October 2010.
http://www.decc.gov.uk/assets/decc/

the expenses over the life of a power plant. The advantage of LCOE is that it allows the comparison of various technologies of unequal life times and capacities as shown in *Figure 3*. The graph shows that the levelised cost of the barrage, when considered from an investor's perspective, is significantly higher than the other low carbon technologies. However, when viewed from a social perspective the levelised cost can be seen to be more in line with the technologies.

The levelised cost of electricity is a useful tool for analysing the costs of different technologies but it has its limitations and should not be used in isolation to decide on how to invest for the future. While it shows which technology is the cheapest, it does not necessarily indicate the optimal mix of technologies and it also fails to consider how immature technologies might develop in the future. The analysis does raise an important question about whether investing in the cheapest electricity system is the wisest option. Perhaps we should pay a premium to get a more robust system that will be better equipped to face the challenges that lie on the road ahead?

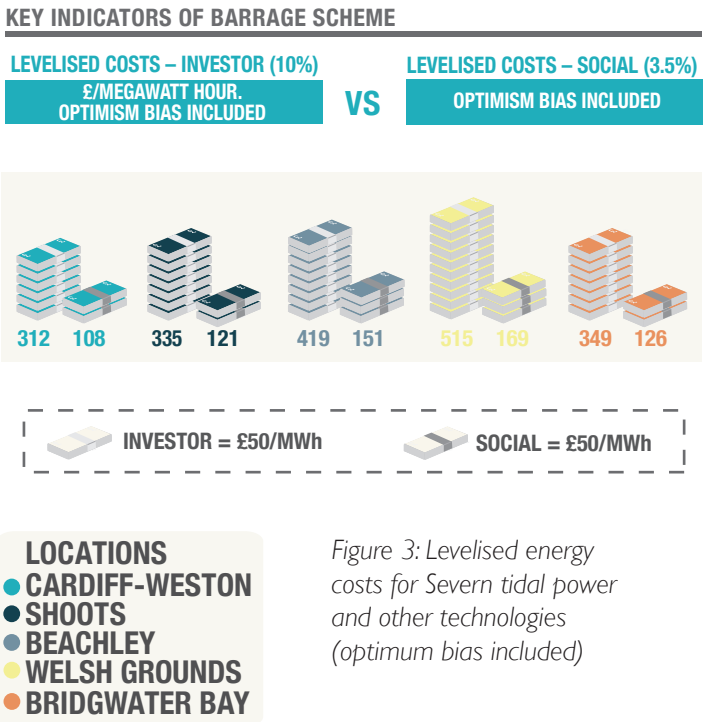


Figure 3: Levelised energy costs for Severn tidal power and other technologies (optimum bias included)

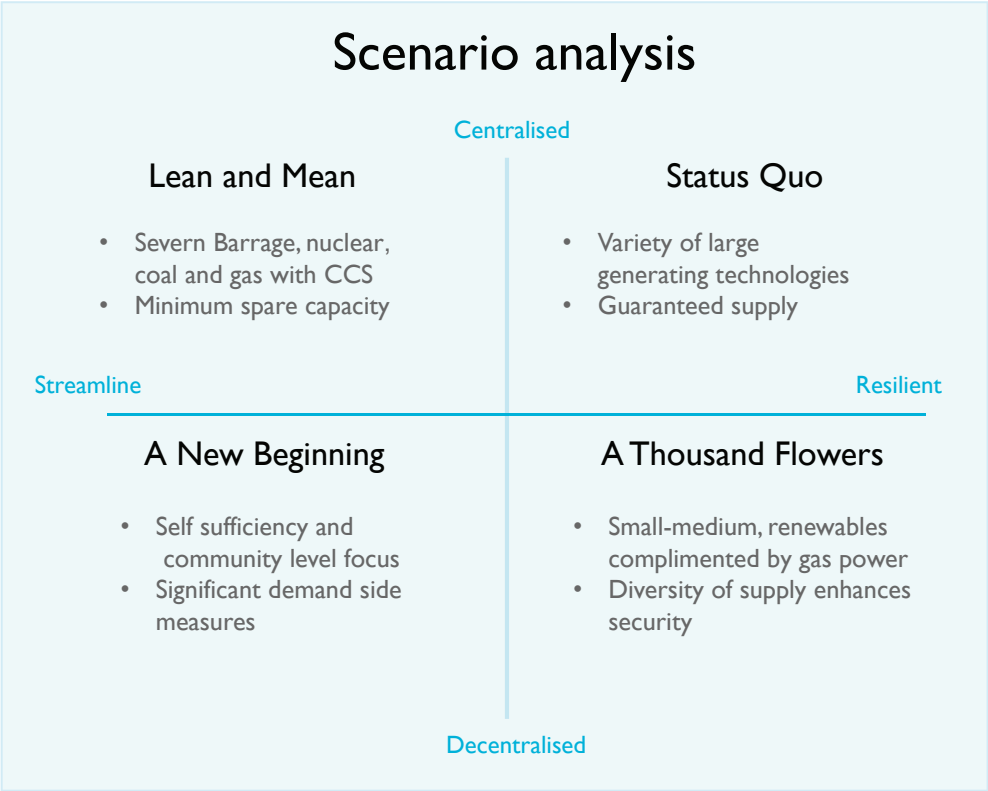


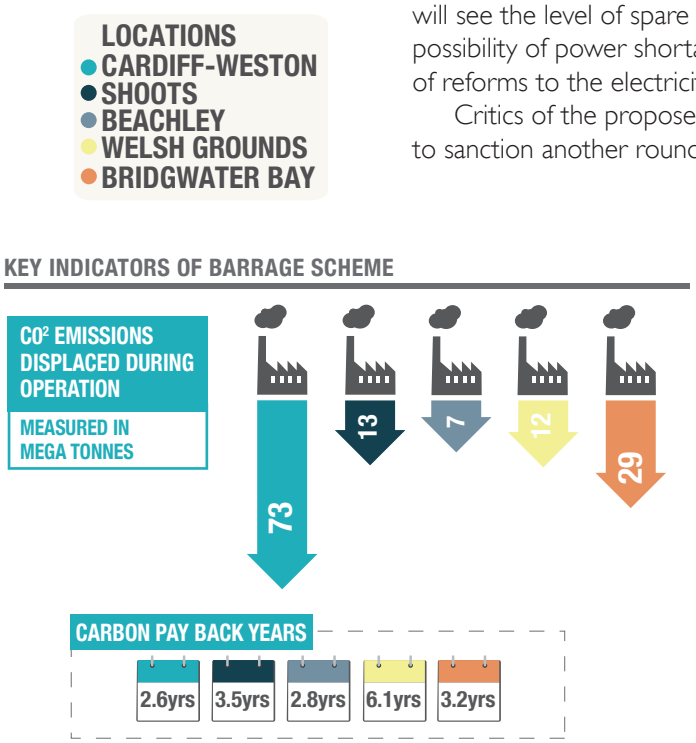
Figure 4

Scenario Analysis

Given that the barrage could play a significant part in our electricity generation portfolio we should attempt to assess its compatibility with different future energy systems. Through scenario analysis as outlined in *figure 4* we can map out how the electricity system in the Great Britain might evolve over the next fifty years.

The analysis shows that today we have a largely centralised electricity network characterised by a variety of large generating technologies that are capable of delivering a secure supply of electricity to the nation. Part of the government's dilemma is that a number of nuclear plants are due for retirement in the next decade. This development will see the level of spare capacity in the system decline and could expose us to the possibility of power shortages. To counter this the government has proposed a number of reforms to the electricity market that will boost the supply of electricity in the future.

Critics of the proposed government reforms see them as an underhand attempt to sanction another round of nuclear power plants. This course of action will increase energy security and help the country to meet its emissions targets, however, it is unclear at what cost. The trajectory of this sort of government policy can be seen to be a continuation of the status quo instead of an attempt to introduce a significantly more decentralised model that looks to inspire self-sufficiency, distributed generation and demand side measures as a means of making the transition to a low carbon economy. The Severn barrage fits in with the centralised generation model and while it is not as reliable as nuclear power it would provide the electricity system with added resilience.



How well does the barrage fit with the grid?

The barrage will produce two peaks of electricity generation per day shortly after high tide as shown in *figure 5*. The water will be trapped behind the barrage and let out over a period of about 7 hours. It is during this period that electricity will be generated.

Compatibility with the electricity grid

Similarly at times of low tide no electricity will be produced so other sources of electricity generation will have to fill the gap in supply. The barrage offers an intermittent but predictable source of power generation that is governed by the tide times in the Severn estuary.

Figure 5 also shows the wide variation in output both during and between generation periods. The daily changes in the output profile of the barrage raise a number of serious questions relating to grid management and transmission capacity.

The barrage will produce a substantial amount of renewable electricity and introducing it onto the grid is possible but not straightforward. A review of how the electricity market and grid functions will be needed to ensure that the electricity generated is used efficiently and that there is enough capacity in the system to satisfy demand at any given time.

Complementarity of other tidal resources in the UK

Comparisons have been made with the other proposed barrage locations across the UK to see whether a combination of barrages at sites with differing tide times could effectively produce a more constant source of electricity generation. *Figure 6* shows the sites around the UK with the most tidal power potential.

Complementarity of tidal resources around the UK

The graph in *figure 7* shows that the Severn barrage is the most productive (blue line) and that if all the barrages went ahead (dark red line) there would be four gaps in electricity generation although only one significant one at 10am in this case. If the Severn barrage were to be built alongside the Soloway Firth and Morecambe Bay options, the total electricity generated would remain reasonably steady at around 5.5GWh throughout the day apart from during the twohour gap at 10am. Our analysis suggests that the combination of these three tidal resources arguably offers a better fit with the grid than the Severn Barrage alone.

Favourable conditions for the construction The high upfront costs of the barrage mean that a large amount of investment would have to come from the private sector. To attract this amount of private capital the government would have to introduce appropriate incentives that guarantee sufficient returns on investment for investors. In addition to this an appropriate planning route and an environmental 'carte blanche' would help to reduce investment risks to an acceptable level. The electricity market would have to be tweaked to ensure that the electricity generated by the barrage is actually sold to the grid in favour of cheaper and more carbon intensive generating technologies. Finally strong public support for action on climate change and an endorsement by the local population would ensure that the barrage faces minimal barriers to its development. In reality many of these conditions are unlikely to be met.

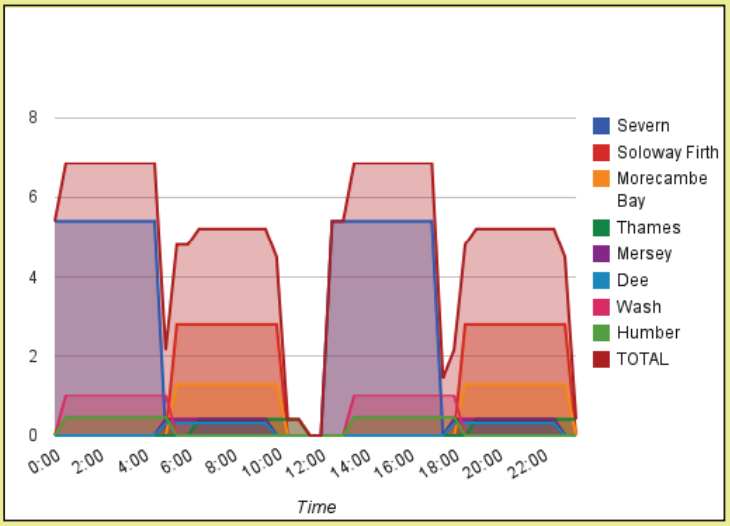


figure 5

Figure 6: Tidal sites around the UK

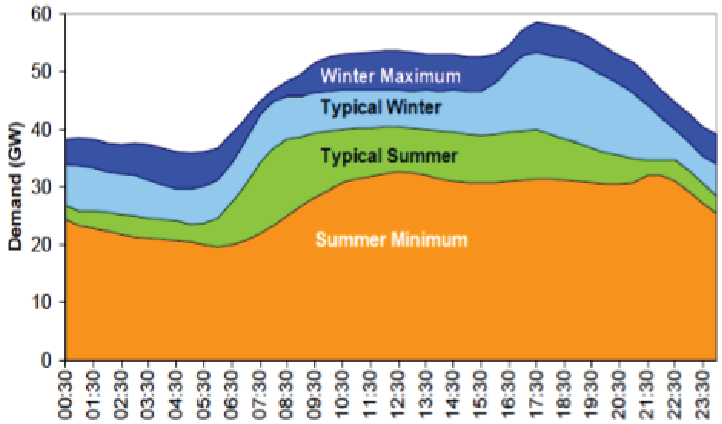


Figure 7: The average electricity generation potential has been measured for each site in order to ascertain whether different combinations provide a more constant source of power.

Predicting the future

In order to make a decision as to whether the barrage should go ahead and which of the future scenarios represents the best way forward we need to take stock of our future energy needs. While demand is predicted to double by 2050 it is unclear how other developments will affect our ability to make the transition to a low carbon economy. It has been suggested that the heating and transport networks will most likely have to be largely electrified and advances in electricity storage technology will be needed to help reduce the intermittent nature of many renewable energy sources.

Deciding on the most cost effective interventions given the high levels of uncertainty is no easy task but it is clear that we need to act now rather than later. The four scenarios envisaged all have far reaching implications for the future in terms of infrastructure, behavioural change, demand side measures, spare capacity, government intervention and public ownership. Choices made now will shape the development of our electricity system in the years to come so it is worth noting that following one pathway may well rule out following others in the years to come. The Severn barrage and the UK's other tidal resources represent one of a number choices for the future. It has its pros and it has its cons but to decide whether it represents the best choice for the future we have to ask ourselves what type of electricity system do we want.

Conclusions

In summary, if the funding becomes available, there could be a place for the Severn Barrage in the electricity system although it would make more sense if it were developed in unison with some of the other barrages around the UK to counter its semi-reliable nature. It fits in with the centralized electricity model we have today but it is unclear whether this is the best model for making the transition to a low carbon economy.

Ultimately the Severn barrage should be measured against the governments' goals of de-carbonisation, energy security and affordability. In terms of reducing emissions it can play a part although its significance in the wider context of national targets is limited and the savings envisaged can be made in other areas. It does provide a measure of security to the energy network but this comes at a premium when compared to other technologies and it is not clear whether this makes it cost effective. On its own the Severn barrage does not compliment the UK's current demand profile and may add to the inefficiencies in the electricity system. Finally, the danger of unquantifiable environmental damage is one of the least understood areas yet the one with the longest implications.

The barrage is a huge undertaking and there are serious questions as to whether it represents the best use of taxpayer's money. The high levels of risk and uncertainty combined with a skeptical public has meant no government has yet dared to sanction its construction and it is unlikely one will any time soon.

Contributors: Alice Gunn, Aldon Jasper, Joel Moktar, Thomas Baker, Bertie Readhead (Editor)

Ecosystem Services and their Valuation

Ecosystem services are the services and resources provided by natural systems that are essential to human well-being. We are reliant on these services in our day to day lives, as they provide anything from natural flood protection, without which many areas of human habitation would be regularly inundated, to pollination for our crops, without which we would have no food.

The Millennium Ecosystem Assessment was conducted in order to evaluate the value of these ecosystem services and the potential consequences of ecosystem change for humans. This assessment grouped ecosystem services into four categories:

Supporting

This includes crop pollination, nutrient cycling and photosynthesis.

Provisioning

Such as the provision of food, water, and materials such as timber.

Regulating

For example, the control of climate and disease. This category also includes the provision of natural protection from flooding and the regulation of water quality and waste.

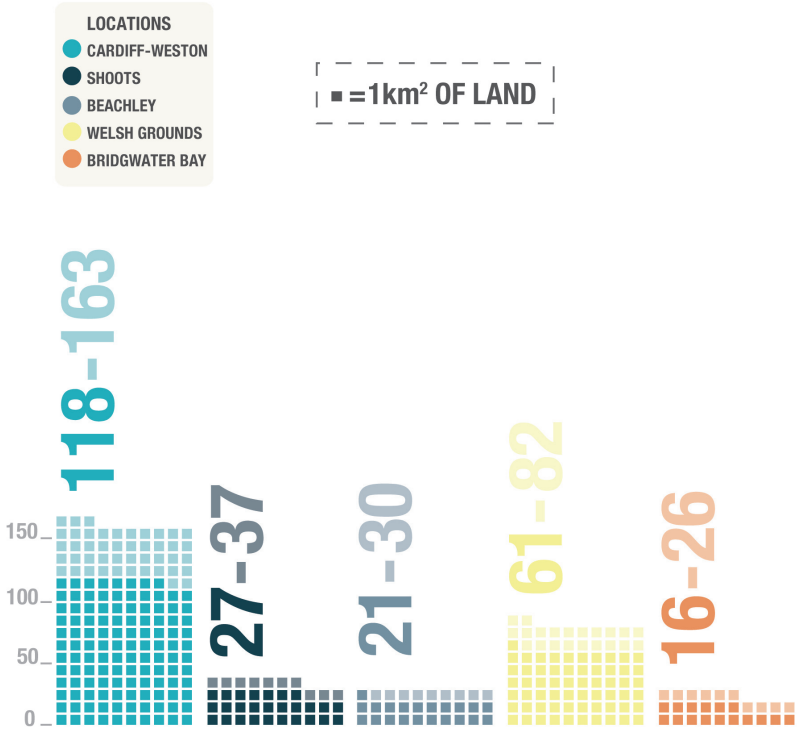
Cultural

The recreational, aesthetic, educational, and spiritual aspects of natural ecosystems. For example, recreational fishing, walking, birdwatching, and ecotourism. These acknowledge also that the natural world is important to our cultural heritage and identity.

KEY INDICATORS OF BARRAGE SCHEME

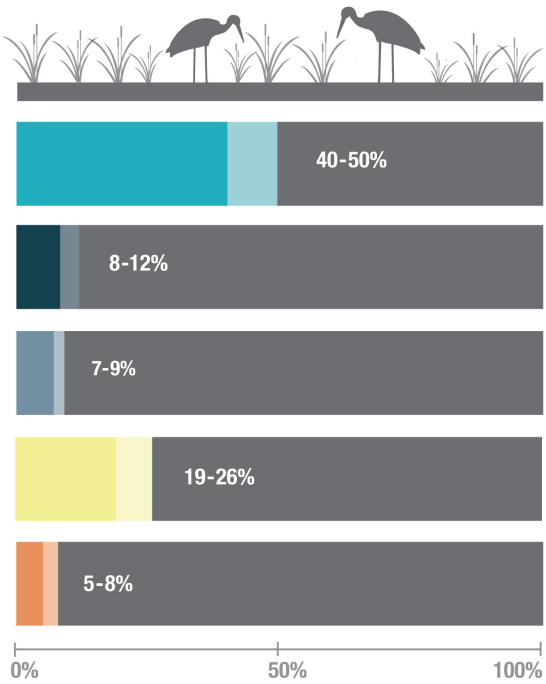
INTERTIDAL HABITAT LOST

MEASURED IN KM²



% INTERTIDAL HABITAT LOST

OCTOBER 2010 PROJECTION



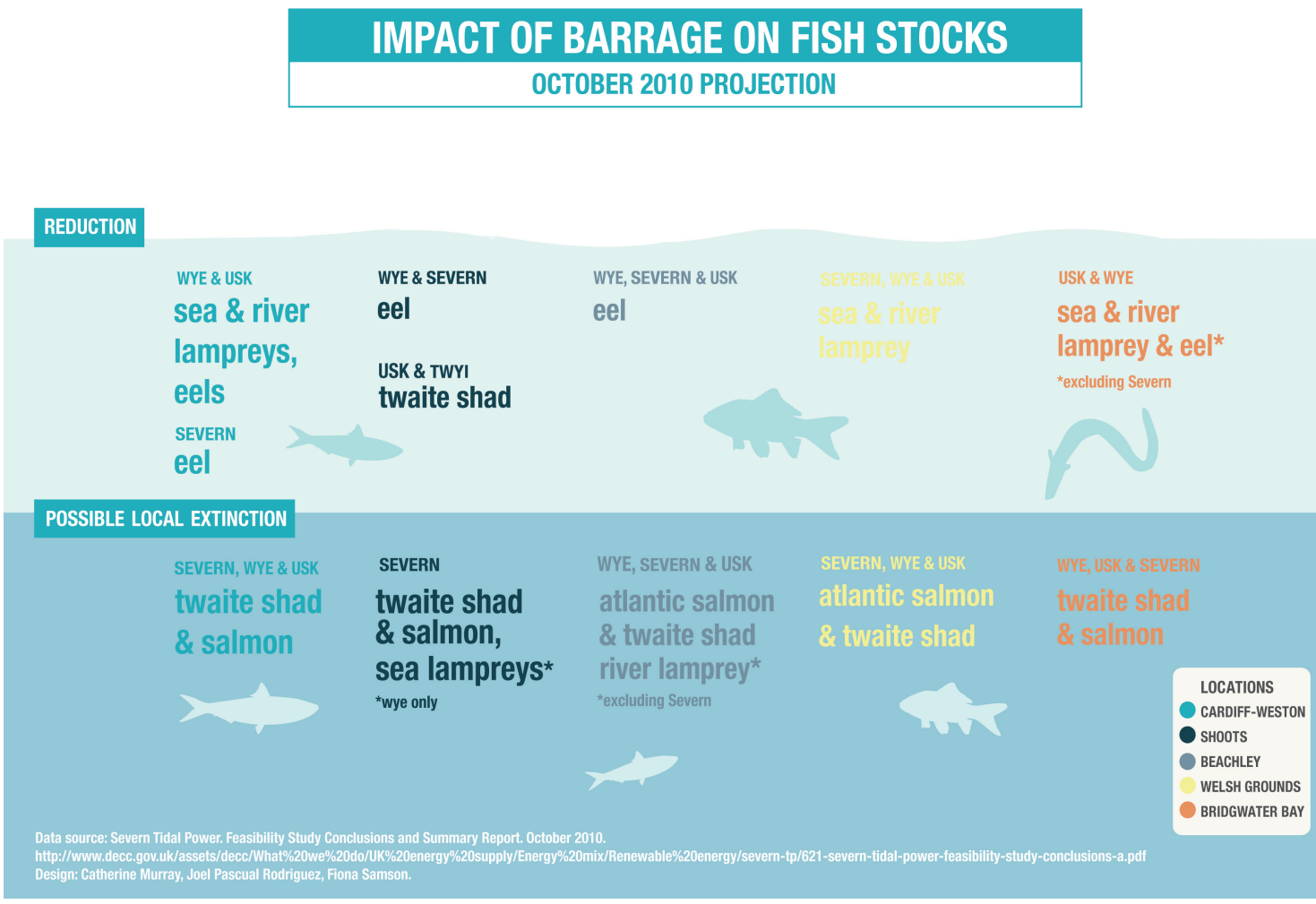
Data source: Severn Tidal Power. Feasibility Study Conclusions and Summary Report. October 2010.
http://www.decc.gov.uk/assets/decc/What%20we%20do/UK%20energy%20supply/Energy%20mix/Renewable%20energy/severn-tp/621-severn-tidal-power-feasibility-study-conclusions-a.pdf
Design: Catherine Murray, Joel Pascual Rodriguez, Fiona Samson.

The Severn Estuary contributes a great deal to each category of these services, and it is extremely important that the value of marine and freshwater ecosystems is not underestimated. For example, the Severn's sediment is involved in nutrient cycling and storage (a supporting service) but also sequesters carbon (a regulating service), and is involved in the receipt of one million m3/day of sewage and industrial discharges (another regulating service). These services would be extraordinarily expensive to provide without natural systems. In fact, the financial value of the UK's marine ecosystem services has been estimated in the thousands of billions, and as the Severn Estuary alone provides approximately 1/17 of the UK's intertidal habitat, its financial value is likely to be substantial.

Further to its financial value, the Severn also has great cultural value. Some of this value can be expressed in financial terms, for example the value of ecotourism to the area, while some of it can't, for example, the value of the estuary to local people's sense of identity. The Severn Estuary also has distinctive features such as its bore tide, which is a unique attraction to the area. Finally, the Severn Estuary is a diverse biological area, and this is reflected by the amount of conservation legislation that affects and protects it. The Severn is designated as a:

1. Special Protection Area due to its international importance to rare and vulnerable bird species. It supports in excess of 68,000 birds.
2. Special Area of Conservation due to its diverse array of plants, animals and habitats. In addition, the Rivers Wye and Usk that feed into the Severn estuary are classified as Special Areas of Conservation.
3. Ramsar site as it is a wetland of international importance.
4. Location of numerous Sites of Special Scientific Interest.

KEY INDICATORS OF BARRAGE SCHEME



The impact of the barrage on the ecosystem services and biodiversity of the Severn Estuary and surrounding regions is likely to be extensive. There will be a change in tidal regime and range of the estuary, with a 76% loss of intertidal habitat at spring tides and a 59% loss of intertidal habitat at neap tides. There will be increased in coastal erosion in some areas, while there will be inevitable pollution during construction and, to a lesser extent, during operation of the barrage. Furthermore, it will interrupt the migrations of fish, and cause unavoidable mortality of those fish. In fact, the barrage threatens all populations of fish in the area, as well as 30 species of waterbird.
In the face of these threats, we have to consider impacts of climate change if projects like the Severn Estuary barrage do not go ahead. This is the essence of the big dilemma that characterises the barrage, and the aim of this document is to elucidate the pros and cons of the barrage from the point of view of both climate change and the ecosystem services and biodiversity of the Severn region.

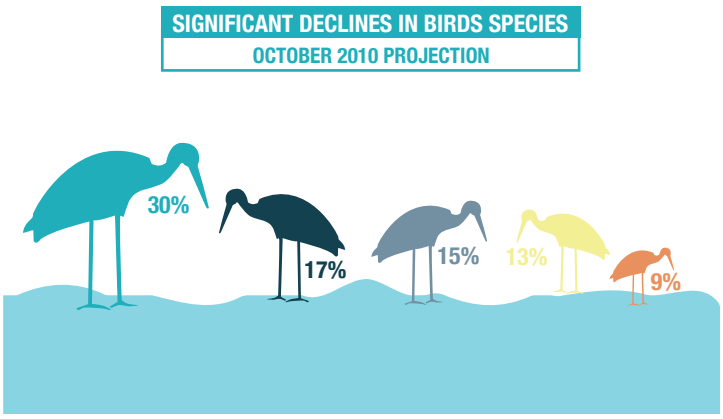
Important wildlife interest of the Severn estuary:

- Reef-building worms such as Sabellaria alveolata
  Important for providing feeding places for migratory birds and fish.
- Migratory waterfowl and waders, approx 85,000 (the estuary is top ranked for numbers of the European white fronted goose whose numbers are in great decline)
- *Waterfowl and waders feed on the mudflats and salt marshes as well as using them for roost ng and loafing. The Gulf Stream means that large areas of tidal mud are clear from ice during the winter making the Severn a vital feeding station for many different species of migratory birds.*
- Migratory fish
  A wide range of migratory fish pass through the Severn's waters each year whilst travelling to freshwater spawning sites in the River Usk and Wye. The fish then pass back through the estuary in their juvenile state to the sea. Some of these fish are listed as species in need of higher levels of protection; hence the Wye and Usk were made SACs.
- Flora and fauna
  The changes in salinity pattern as a result of the barrage will result in redistribution of intertidal faunand adjustments to both the vertical and longitudinal range. There is evidence to suggest there will be a considerable increase in biodiversity as well as far richer and more abundant flora and fauna in the estuary.

Possible effects of the Severn barrage on wildlife:

- Changes to tidal regime and to the tidal range of the estuary
  Could result in changes to the area of intertidal mudflats which under EU-wide wildlife habitat laws would need to be replaced by up to 40,000 of compensatory habitats (marshes and/or mudflats) at huge financial cost (possibly as much as £3 billion)

KEY INDICATORS OF BARRAGE SCHEME



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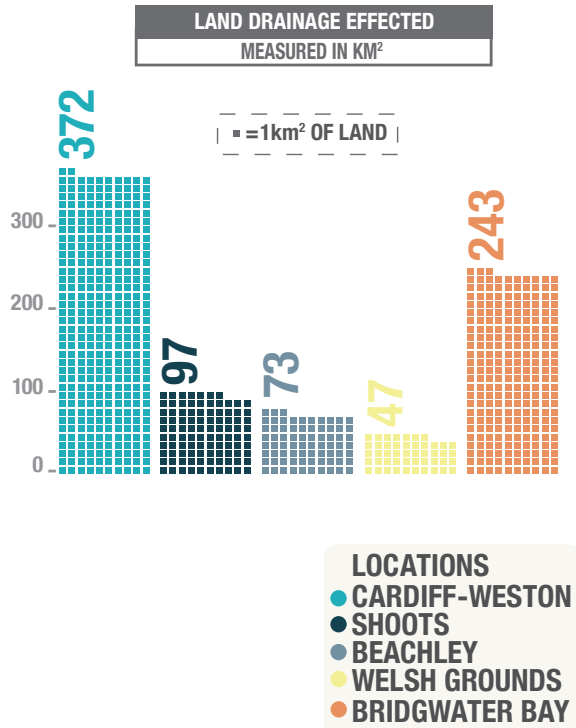


Changes to saltmarsh communities and the behaviour of bird populations

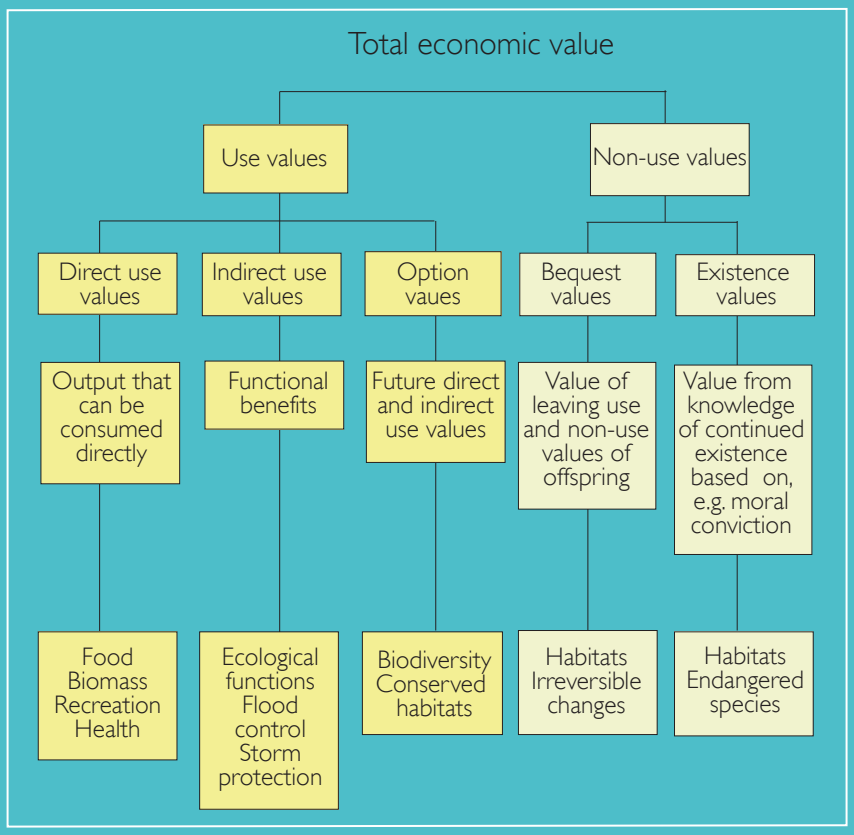
- Increase in coastal erosion in some areas while additional silting would occur in others
  Would affect evolution of mudflats, sandflats and saltmarshes which could result in compensatory habitats having to be found in accordance with EU-wide wildlife habitat laws
- Changes to water circulation
  Will effect water chemistry and water quality, however this will not be so extreme since the water in the Severn contains lots of silt and so near the sea bed there is little marine life.
- Interrupt movement o;f migratory fish
  Could prevent salmon, eels and other migratory fish from returning to spawn
- Increased light penetration through the water column
  Will result in increased primary productivity and changed bio-diversity of benthic fauna and flora

The Valuation of Ecosystem Services

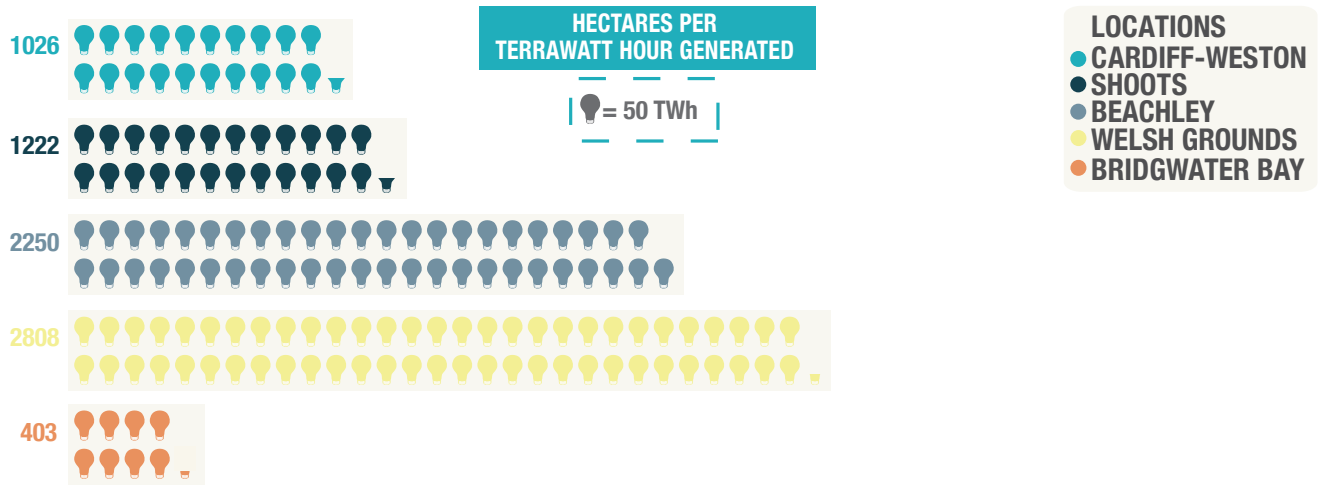
The economic approach to ecosystem valuation provides a way in which the costs and benefits associated with ecosystems can be compared, through expressing them through a common denominator, usually (but not limited to) monetary.

Direct Use Values - This refers to ecosystem goods and services that are directly used by human beings. These can be either consumptive values such as food or non-consumptive values, such as recreation, which do not involve direct consumption of the resources. Generally direct use values are the easiest to value as they involve observable quantities. More difficult is the assessment of the benefits received by visitors, however, travel cost methods, described below, have helped by providing the actual travel costs of tourists or the collection of stated willingness to pay (WTP) of visitors to visit specific sites.

Indirect use values - This refers to ecosystem services that provide external benefits to the ecosystem itself, for example ecological functions, such carbon sequestration.



The main framework used is the 'Total Economic Value' (TEV) approach.



The measurement of indirect use value is more difficult than the measurement of direct use values. One reason for this is that the quantities of the services provided are hard to measure, for example, the amount of carbon stored in soil per hectare.

Option values - This refers to preserving the option of future use of ecosystem goods and services that may not be used at present by ourselves (option value) or future generations (bequest value). One example of this value measure is conserved habitats.

Non-use values - This refers to the happiness that people may experience through the knowledge that a resource exists. This is usually described as an existence value. Non-use values are the most difficult to estimate as the value is not reflected in peoples behaviour and thus is almost wholly unobservable, however, methods such as stated WTP offer some measurement.

Valuation Techniques

All Economic Valuation methods are founded in the theoretical assumptions and principles of welfare economics. Most valuation methods measure the demand for a good or service in monetary terms, that is, consumers willingness to pay (WTP) for a particular benefit, or their willingness to accept (WTA) compensation for its loss.

Revealed Preference Techniques.

This is based on observed behaviour. These include methods that deduce values indirectly from peoples behaviour in surrogate markets, which are hypothesized to be related to the ecosystem service of interest. Examples include:

The Production Function method - This method explores the impact of changes in ecosystem services on produced goods. For example, loss of forest results in a depletion of timber products, fuelwood and non-timber products such as fruit, herbs and mushrooms.

The Cost of Illness and Human Capital method - This method examines the impact of change in ecosystem services on morbidity and mortality.

The Replacement Cost method - This method estimates the cost of replacing the lost good or service.

The Travel Cost method - This method relates to valuing environmental amenities deriving demand for recreation from data on the cost of travel.

Hedonic pricing methods - This method involves extracting the effect that an environmental factor has on the price of goods that include these factors. An application would be the value of scenic beauty.

Stated Preference Techniques

Here information is collected based on hypothetical rather than actual behaviour, where peoples responses to questions describing hypothetical situations are used to infer their preferences. Examples include:

Contingent Valuation (CV) - This method is carried out by asking consumers directly about their WTP to obtain an environmental good.

Choice modelling - This method involves asking respondents to choose their preferred option from a set of alternatives with particular attributes.

The Benefits Transfer Technique

Benefits Transfer is not a method so much as it takes estimates using one of the methods above from one context and uses them in another context. For example, an estimate of the benefit provided by mudflats in one estuary might be used to estimate the benefit obtained in the severn estuary. There are of course considerable risks with this technique as for many reasons the measurements in one area can be inappropriate in another. However, consensus is emerging that benefit transfer is a valid and reliable approach under certain conditions:

- When the service being valued are similar at the site where the estimates were made and at the site where they are applied.
- When the populations affected are similar.

Key Issues when examining the impact of environmental changes in the context of the Severn Estuary

The impacts of many environmental changes, whether positive or negative, are often only felt in the future, long after the activity which caused the change has ceased. Similarly, effects are often felt far beyond the boundaries of the project itself. Special attention must be given, therefore, to the temporal and spatial boundaries of the analysis and further research needs to be carried out in this area if the barrage scheme is considered again.

Temporal Boundaries

Since environmental impacts extend long beyond the normal life of the project, it is important to extend the time horizon of the analysis so as to include all the benefits and costs associated with environmental impacts, even if they go further into the future than the normal life of a project. One of the arguments against a two way tidal barrage, even though this technology would limit the environmental damages substantially and increase the energy it produces, is that Bristol port would become redundant. However, it is expected that as a result of climate change and increases in the size of shipping tankers that Bristol port will become redundant in the next 50-100 years anyway. Given that the length of the Severn Tidal Schemes is 100-150, the costs and benefits of the project need to be extended tremendously in comparison to usual project appraisals. The effective length of the time horizon of an analysis is determined by both the number of actual years included in the analysis and the discount rate used. Using too short a time horizon effectively ignores many environmental impacts, both positive and negative.

In addition to this there are the potential effects to other areas of the UK, and other countries, both European and worldwide due to the Severn Estuary's importance as a migratory refuelling point.

Spatial Boundaries

When environmental effects are present, careful thought must also be given to the appropriate spatial boundary of the analysis. The analyst often has to look far beyond the geographical boundaries of the project itself. This relates to determining the importance of the ecosystem itself and the importance for stakeholders in local areas, nationally, regionally, and globally.

Understanding who gains and—in particular—who loses from ecosystem conservation provides important insights into the incentives that different groups have to manage an ecosystem in a particular way.

Threshold Effects

In some cases natural areas may be so unique that it might be felt that they should be conserved at all costs. When loss of these goods and services would be irreversible, cost-benefit analysis may not be appropriate, it may be desirable to choose the strategy that minimizes maximum possible losses due to environmental damage, unless the social cost to do so is unacceptably large; this is known as the safe minimum standard approach.

In discussing the Severn estuary, there is very little known about the substitutability of the services provided, nor the threshold that these services can provide. More research in theoretical and applied ecology needs to be done in these areas in the future to aid in decision making.

Summary

It is clear to see from the data above why the major wildlife charities oppose the Severn barrage so strongly. Although most effects on wildlife are negative, there are some positive impacts such as a potential increased diversity of fauna and flora in the estuary. Since the wildlife in the estuary are protected by such an array of conservation clauses the financial costs of complying with these as a result of a barrage are huge. This creates a weakened incentive for public or private intervention in effectively harbouring the energy in the estuary.

No project is perfectly free of impacts and perhaps a question we should ask ourselves is: 'Is the medium term disruption to habitats in the Severn worth the longer term contribution to stability of the climate, which will protect all ecosystems?'

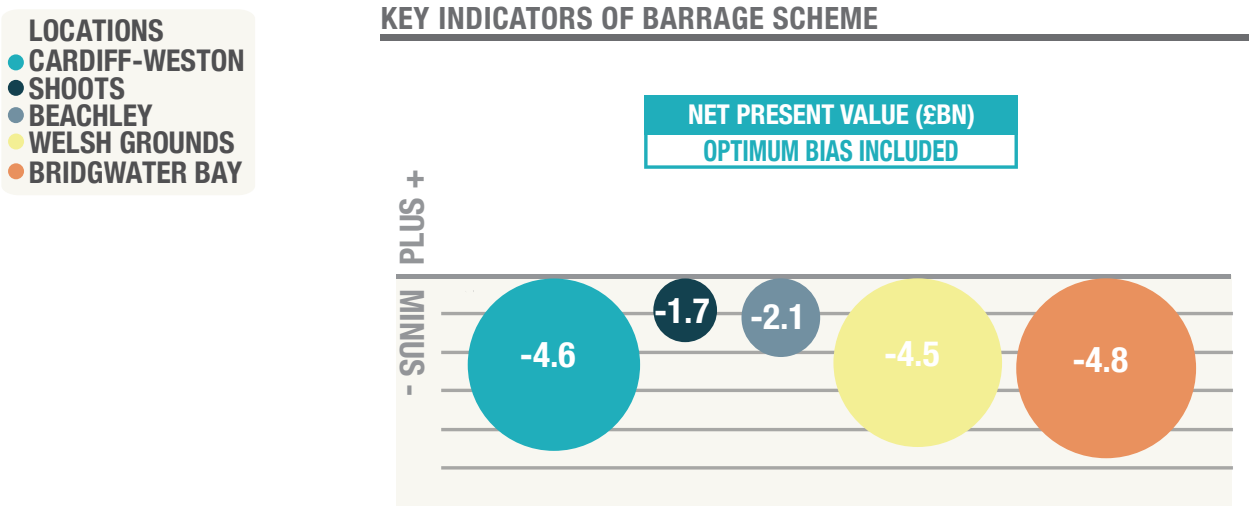
Contributors: James Borrell. Katie Brown, Sammie Buzzard (Editor), Jonathan Colmer, Ben Jackson

References:

Landell-Mills, N. and Porras, I. (2002). Silver bullet or fools gold? A global review of markets for forest environmental services and their impacts on the poor. Instruments for sustainable private sector forestry series, IIED, London.

Dixon, J.A., L.F. Scura, R.A. Carpenter, and P.B. Sherman. 1994. Economic Analysis of Environmental Impacts. London: Earthscan.

Haab TC, McConnell KE (2002) Valuing environmental and natural resources: econometrics of non-market valuation. Edward Elgar Publishers, Northampton



Engagement with publics

Engagement with publics is the involvement of specialists such as energy companies and engineers interacting with non specialists, acknowledging their opinions and ideas.

Why engage with publics?
The UK national co-ordinating centre for public engagement says the process can "bring significant benefits" to the parties involved:
Local residents
- People value being a part of the process
- Empowers publics as a stakeholder, providing them with a tool they can use to be involved with development

The wider society
- Legitimises the planning process
- Builds trust and mutual understanding

The development organisation
- Cost effective engaging before rather than after plans
- Opportunity to gain valuable information from publics.

Public acceptance is often seen as a key reason why a plan is accepted or rejected. A common assumption is that projects can fail because the general public cannot understand specialist information and if only they were better informed, they would accept change. It has been suggested that this idea is counterproductive , reinforcing a split between experts and the publics. Instead, institutions should create opportunities for productive publics engagement.

Types of engagement
Information Provision – Informing publics of proposed plans and details
Consultation – publics are provided with a choice of two or more options to decide between
Deliberation – not discussing plans made but asking publics for help with their development

How has engagement with the publics occurred within the Severn Barrage Project?
There have been at least two independent consultations run by independent parties.
• DECC – Department of Energy and Climate Change
• SDC – Sustainable Development Council
These found out that 32/40 locals were in favour of tidal power and 97% of the public learnt something new. However, only 54% of stakeholders thought that the information was fairly presented. The SDC also produced a booklet entitled 'On Stream' that attempted to enhance publics knowledge of tidal energy as it was found that there was little understanding.

There has been high public support for renewable energy in European and UK polls. However actual projects have regularly been met with local opposition3. Local incentives have been proposed for renewable energy projects, including cheaper energy prices for locals, and there are many examples of consultation between the developers and independent parties (such as the SDC) and the public, yet opposition in some cases is still increasing.

Consultation

Although consultations seek to find out the publics opinion on plans, they only ask for a decision between a variety of options. This form of public engagement has a variety of flaws:

- *'Misleading' consultation process* - often the public believe that their participation is minimal and that their concerns will not be taken into consideration. For instance, in the Ladymoor Wind Project, Scotland 26.9% of the public strongly disagreed that the developer had made an effort to listen to local people.

Pre-existing negative beliefs - about the 'consultation' method of engagement, preferring leaflets and media articles as more effective and less imposed. These methods would raise the exposure of the Severn Barrage Scheme, increasing the likelihood of public responses to engagement.

- *Exposure of the scheme in the press* - Minimal before SDC consultation, in comparison to other projects such as wind farms. The stakeholders and publics in general would not have felt as attached to the scheme, simply because the project was less important and less relevant. This potentially calls for more media coverage and local awareness of new schemes.

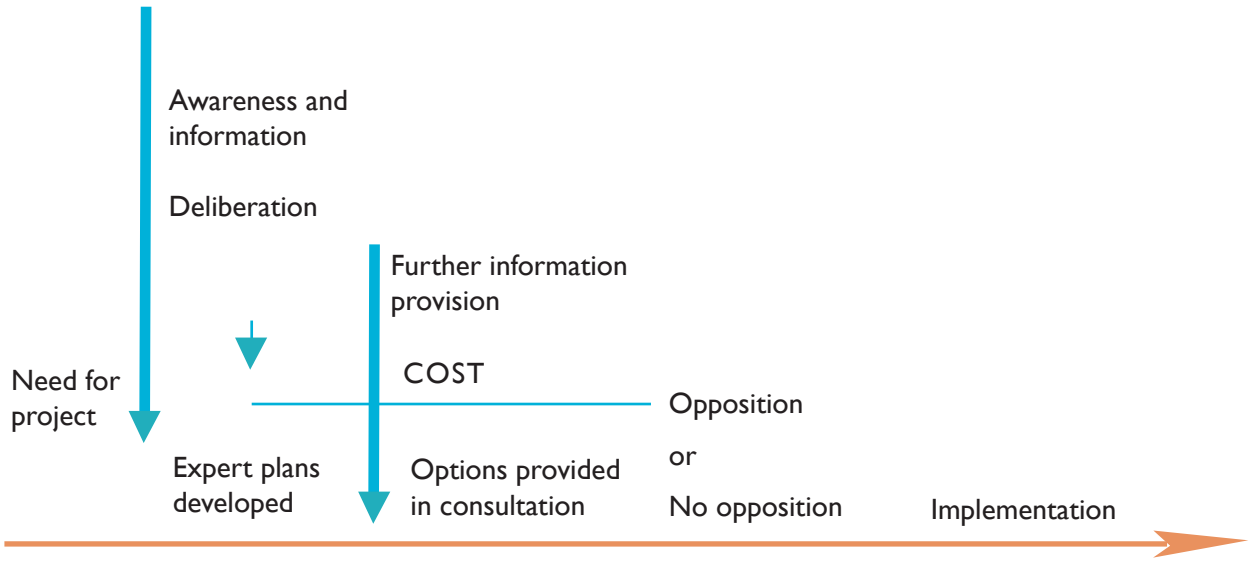
Novel Engagement

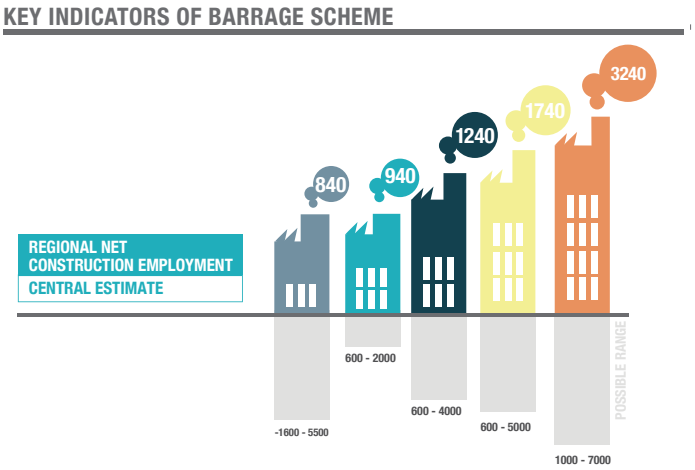
Development of a model to promote public engagement in projects such as this in the future.

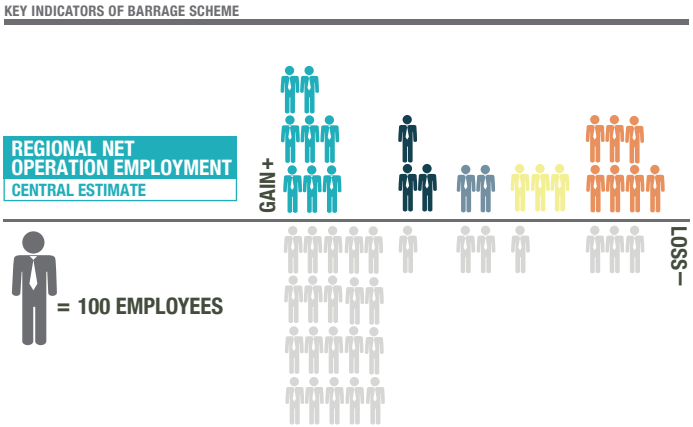
Suggestion – Deliberation

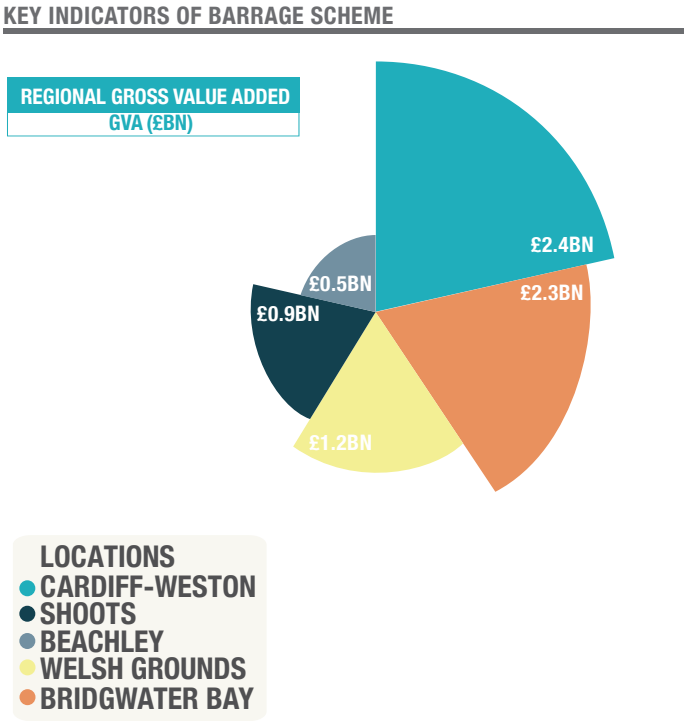
However, we suggest that information provision and consultation is not effective enough to ensure maximum engagement and encourage ideas from the publics, for that to occur we suggest deliberation (see diagram below).

• Information should be provided about what is required of a certain area as well as an increased awareness of the profile of a potential project. For example, the publics should be informed that more renewable energy is required, including government targets and









previous methods to produce renewable energy.

• A deliberation should be held where stakeholders such as publics, engineers and renewable energy companies come together to discuss potential ideas.

• Initial plans can then be drawn up, leading to further information provision about such plans. Following this, the plans will be shown in a consultation, providing stakeholders the opportunity to chose between the plans drawn up by all those involved in the deliberation.

This way of doing things has the potential to save governments and energy companies money by avoiding opposition to plans and developing novel ideas that may not have been possible without the publics input. For example, local knowledge of an area could help to produce more efficient renewable energy sources.

For this method to work, we would have to ensure that sufficient deliberation had occurred. As a result we would suggest using an independent party moderate and analyse whether an adequate deliberation phase had occurred.

Costs of Deliberation

Although deliberation could lead to better engagement with the publics there are no doubt some concerns. Firstly, it is a high risk option; abstract ideas in the early stages in development coming from all stakeholders could lead to arguments and little resolution. It also could be very time consuming in the early stages, ensuring that all stakeholder groups are represented fairly and have put their ideas across. Also, there is the issue of who would pay for the deliberation; would it be the energy company, independent bodies or taxes?

Proposal

Despite deliberation being a high risk form of engagement, many low risk options concerning the Severn Barrage have not paid off, perhaps this is the chance to try something new, that could lead to a very successful result. We suggest that deliberation concerning projects such as the Severn Barrage should be tested and if successful should be embedded into policy and made a legal requirement. They should be led by an independent party to ensure that the process is run fairly. This form of engagement could save all those involved time and money, potentially entirely cutting out projects being opposed by the publics as they were involved in making them. Good communication with the publics can reinforce their belief that they have a say in developments and that they can and should be involved with the process.

Contributors: Emma Barker (Editor), Julia Glover, Daniel Goodchild, Jessica Plumb

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Authors

Anthony Jones, Thomas Baker, Emma Barker, James Borrell, Katie Brown, Samantha Buzzard, Jonathan Colmer, Laura Daniels, Julia Glover, Daniel Goodchild, Alice Gunn, Ben Jackson, Aldon Jasper, Joel Moktar, Jessica Plumb, Finn Raven, Gabriel Rawlings, Bertie Readhead

Design

John Butterworth (butterworthjon@gmail.com)
Jack Gibbons (gibbonsj@hotmail.co.uk)
Josh Gowen (Josh.Gowen@gmail.com)
Niall Kerry (niallrkerry@aol.com)
Catherine Murray (cath.rose.murray@gmail.com)
Sarah Poole (saz396-uni@yahoo.co.uk)
Joel Pascual Rodriguez (iamjoelpascual@gmail.com)
Fiona Samson (fsamson87@gmail.com)
Chris Thomas (christ1000@hotmail.com)

Design coordination

Sarah Poole (saz396-uni@yahoo.co.uk)

Project leaders

Professor Peter Cox, Harriet Sjerps-Jones

Project coordination

Anka Djordjevic

Academic leads

Dr Stewart Barr, Dr Peter Connor, Prof Peter Cox, Prof Patrick Devine-Wright, Professor Michael Finus, Prof Brendan Godley, Prof Stephan Harrison, Dr Tim Kurz, Prof Catherine Mitchell, Dr Robert Wilson, Dr Bridget Woodman,

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