

Stakeholder Perceptions of the Wave Hub Development in Cornwall, UK

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Abstract

Despite a growing body of research examining stakeholder perceptions of offshore wind-farms, little social research has focused on offshore wave energy devices. With the Wave Hub project proposed for Hayle Bay, Cornwall, in 2010, it is apparent that even developments that are 'out of sight, out of mind' still require extensive stakeholder engagement if opposition is to be reduced. Findings from ongoing research into stakeholder perceptions of marine renewable energy suggest that the science underpinning these devices needs to be more robust and clearly articulated, with baseline data accounting for temporal shifts in marine environments, to allay stakeholder concerns. There also needs to be realistic information by project proponents on the local benefits of the Wave Hub project, as many stakeholders feel the public will be disappointed if benefits are artificially inflated. The Wave Hub also creates a quandary for some stakeholders who see supporting the Wave Hub as paving the way for widespread deployment of marine renewables, leading to significant impacts on marine environments. The more general findings from the study are that it cannot be assumed that 'out of sight' means 'out of mind' or that the same opposition factors identified for offshore wind developments apply to wave and tidal devices.

Keywords: Perceptions, renewable energy, stakeholders, Wave Hub

1. Introduction

With near global scientific consensus that climate change poses major social, economic and environmental threats [1], it is becoming increasingly accepted that renewable energy will play a large part in creating a low carbon future [2]. The UK government has created a number of policies and funding streams to encourage a greater deployment of renewable energy. However, even with these targets and incentives, the take-up of renewable energy in the UK remains slow, and currently accounts for only about 4 per cent of total energy supply [3]. It is suggested that accelerating the take-up of renewable energy will depend on the development of new technologies and further research into a range of social, technical, economic, regulatory and political factors that may inhibit the expansion of renewables [4-6]. Public and stakeholder perception has been identified as one such barrier in the UK [4].

Although numerous studies have identified widespread support for renewable energy in principle, opposition towards new developments is still regularly encountered, with often aggressive lobbying by groups or individuals [6]. Such opposition and more general public antipathy have been demonstrated to increase the chances of projects being rejected by local planning authorities [7]. The most commonly documented reason for opposition to renewable energy is the visual impacts of developments [6]. Public apathy towards installing renewable energy and mistrust of government motives and incentives are other factors identified as slowing the expansion of renewable energy capacity in the UK [8].

With government targets to deploy ~30GW of offshore wind energy and 2GW of tidal and wave energy by 2020 [9], it might be assumed that many issues and concerns associated with terrestrial energy developments, such as visual impacts, can be avoided, allowing for a smoother consultation and development process. West and Bailey [10] identified that a number of focus group participants felt that offshore marine renewable energy would be more acceptable than onshore renewables, as they are '*out of sight out of mind*'. However, the assumption that offshore renewables could evade public opposition may be optimistic [11-13].

Recent research into perceptions of offshore wind has identified that offshore wind energy developments in fact face similar issues to those associated with onshore developments, such as concern for visual and ecological impacts [11]. Additionally, several case studies have highlighted that offshore wind developments can face additional conflicts with other sea users, such as fishermen and commercial shipping, about the siting of projects [12]. Land use conflicts have not been so widely documented as an issue for the siting of onshore renewable technologies (perhaps because many are situated on exclusively-owned and used land, such as farms), and therefore conflicts in marine areas used as 'common space' add an additional dimension to understanding stakeholder acceptance of offshore renewables.

As marine renewable technologies are currently in their infancy, comparatively little is known about how the public and other stakeholders engage and respond to their deployment compared with terrestrial renewable

technologies. The majority of studies to date on perceptions of offshore renewable developments have focused mainly on wind installations, and there remains a dearth of studies on stakeholder perceptions of wave and tidal technologies. For the reasons outlined above, it is important to gain a greater understanding of differences in concerns, opinions and aspirations stakeholders may hold about marine renewable energy to avoid a similar backlash to that encountered for terrestrial renewables (especially onshore wind [6]).

Although there are some identified similarities between perceptions of off and onshore renewables, developers and policy makers should not assume that best practice for terrestrial developments can simply be replicated in for marine environments. Consideration needs to be given to the way individuals engage with the marine environment because of intrinsic differences in the way terrestrial environments are perceived. Individuals are, thus, likely to have different levels of tolerance for disturbance and alteration to each environment. A study by Arnold [14] identified that the word marine conjured non-emotive, intellectual connotations with the public, whereas, near shore environments conjured familiar emotive responses.

This paper aims to contribute to narrowing this research gap by providing an overview of initial findings from an ongoing study into stakeholder perceptions of the Wave Hub, due for deployment in Cornwall, UK. The Wave Hub is essentially a 'plug in and test' facility owned and managed by the South West Regional Development Agency (SWRDA). It provides developers of various marine renewables devices with a facility to test and ensure effective functioning of new technologies before commercial manufacturing and deployment. There are four different arrays of technology confirmed for deployment at the Wave Hub, and SWRDA suggest that this could increase to 30 if the Wave Hub is successful [15]. The Wave Hub will be located 10 miles from shore in Hayle Bay and a subsurface cable will link the Hub to a disused electricity substation in Hayle. The site will have a designated 8 km² safety zone around it (Fig. 1).



Figure 1, Wave Hub Site, Hayle, Cornwall, UK

The estimated cost of construction is £28 million. SWRDA has approved £21.5 million of funding towards this, subject to UK government and EU approval, and the Department of Trade and Industry has also committed £4.5 million to the project [15]. The construction of the project has been delayed a year after

a disappointing response from markets and the long lead time to design the equipment. In April 2008, high global oil prices (>\$100 barrel⁻¹) led to a boom in oil and gas exploration, which increased the cost of the equipment needed to install the Wave Hub. Volatile markets also resulted in significant increases in the price of copper, which was needed for connecting the cable to Hayle. It is now expected that construction of the project will start in May 2010 and be completed by August 2010, with the first devices expected to be deployed in 2011 [15].

The Wave Hub has received major media coverage, featuring in national broadsheets, local radio and national and local television. Most of the coverage has been informative about the purpose and location of the Wave Hub. The main controversies reported in the media have been concerns among surfers that the Wave Hub will reduce wave size at local beaches [16]. Other concerns raised about the development include; impacts on marine mammals, fish stocks and ecosystems; impacts on fishing incomes due to the creation of a safety zone around the site; navigational issues; and possible impacts on the tourism industry.

2. Methodology

In line with the aim to explore stakeholder concerns and aspirations for the Wave Hub, the paper draws on findings from eight scoping meetings held with representatives from key stakeholder groups that have been active in consultations and discussions on the Wave Hub. As with other scale-scale qualitative projects of this nature, the aim was not to provide a fully representative sample of all stakeholders or to generate numerical trends but, rather, to obtain depth of insight into the range of views held by key groups and the reasoning behind these opinions. The results and discussion therefore focus on highlighting key findings from the initial interviews in order to identify core issues raised by each group, and should be read as indicative rather than wholly generalisable.

The interviews were conducted in July 2008, with the following groups: the Sea Fisheries Committee; CSEP (Cornwall Sustainable Energy Partnership); Hayle Parish Council; Penwith District Council; Cornwall County Council; SAS (Surfers Against Sewage); a local fisherman; and a local surf school. Interviews lasted around an hour on average and were semi-structured to enable each individual's main concerns or aspirations to be identified. Questions were structured to elicit views about the Wave Hub and wave energy generally, rather than guiding respondents to comment on pre-determined themes. The interviews were conducted following the University of Plymouth's standard ethical guidelines, and were held at interviewees' preferred locations. Interviews were transcribed verbatim and coded to identify key opinions and common themes.

3. Findings

The following section summarises the key findings drawn from each of the eight transcripts.

Sea Fisheries Committee

A representative (pseudonym Mike) from the Sea Fisheries Committee (SFC) was interviewed to solicit an indication of the views of an organisation whose main role is to preserve and maintain fish stocks through coordination of fishing activities.

The SFC is generally reserved in its judgement of the Wave Hub. This was highlighted in the following quote: *'We don't support it and we are not anti it either... we do not have any major concerns at this moment in time... it may be in the future that we find conservation issues with our fisheries'*.

Mike felt that the 'science' being undertaken to explore the impacts of the Wave Hub on fisheries and marine ecosystems is "questionable". He stressed the importance of early and high-quality baseline studies for such developments, as marine ecosystems go through cyclical patterns and shifts that can extend over prolonged periods. Mike suggested that as research had only just started at the Wave Hub site, only a snapshot of the areas affected could be achieved, which would not be representative of their temporal characteristics. Mike was also concerned that it would also be several years after the installation before attempts at assessing the full impacts of the development could be made, and so concluded that: *'I have not heard anything that has convinced me that the research will be adequate'*

As the Wave Hub is only a test facility, Mike was concerned that if the project was successful and there was sufficient political will, it could result in many more marine renewable energy devices being deployed around the Cornish coast, resulting in large safety exclusion zones. When questioned whether this could have positive impacts on fish stocks by increasing areas that could not be fished, Mike was dubious, stating that it could have a negative impact, as fishermen would be displaced and over-fish in open areas, leading to other stocks being irreversibly depleted. Mike at this point reiterated the need for good science.

Mike suggested that he had heard some fishermen suggesting that supporting the Wave Hub was *'like cutting your nose to spite your face'*, because if it works, it will mean more marine renewables being introduced with minimal stakeholder consultation. Mike suggested that the fishermen felt the safety zones being created are a back door way of creating a large no-catch zone, an issue that will surface when the UK's Marine Protection Area bill comes into force in a few years.

On the other hand, Mike was concerned that after the time and effort spent on consultations and discussions, the Wave Hub may not even go ahead, as it had experienced a number of delays: *'With two delays in the last year I am sceptical myself that it will happen... by the time they get it in, they [SWRDA] will have decided to do something else that is more cost effective'*.

When Mike was asked whether he knew of concerns among other stakeholders, he responded that he was aware of fishermen's concerns and was also aware that other water users, such as the shipping industry, pleasure boat users, and surfers all had voiced concerns about the likely impacts of the Wave Hub. Mike

suggested that some fishermen from Hayle and St Ives are more supportive than seasonal nomadic ones, as they are optimistic about potential jobs linked to the Wave Hub. Mike believed that only six fishermen will be affected financially by the Wave Hub and the exclusion/safety zone, and that other boats that fish there once a year or seasonally will not be as affected.

When Mike was asked about the consultation process, he argued that *'the public have had many opportunities to be involved in the Wave Hub consultation. Everyone has done a good job keeping people up to date and involved'*. Mike suggested that in most consultations, SWRDA and developers had been *'up front and transparent throughout'*. He further suggested that people had not been interested in attending the events run by developers: *'people have not taken advantage; a number of public meetings were not well attended, even though they have been well advertised... And then you get idiots saying that they have not been told or asked about the development... All stakeholders including fisherman have had opportunity to be involved. All the information is out there if people want it'*.

Hayle Town Councillor

A Hayle Town Councillor (pseudonym- Bob) was interviewed at his home. Bob had been involved in discussions about the Wave Hub for around a year and was now involved with the Wave Hub Partnership Board, attending meetings held by the Cornwall Sustainable Energy Partnership (CSEP) about the project. Bob supports the project but had a number of recommendations and caveats.

Bob was concerned that, although Cornwall has good potential in terms of marine renewable energy resources, if it is over exploited the region would lose its *'natural beauty'*. Additionally, Bob was concerned that if the project was successful and more arrays were deployed, the cumulative effects were likely to far exceed the Wave Hub and the four proposed arrays.

Bob's key concern was that Hayle would not receive the local economic benefits that SWRDA claimed, up to 100 direct and 1000 indirect jobs in the southwest [15]. Bob suggested that *'there will not be nearly as many local economic benefits as the propaganda suggests'*. He claimed to have done his own calculations and concluded that additional employment in Hayle would be minimal, with many technical support jobs going to areas like Falmouth, on the South Cornish coast, because of their expertise in marine fitting and maintenance. Bob reasoned that this was because the harbour in Hayle is not suitable for large ships.

Bob thought that an offset programme from developers should be provided, creating jobs unrelated to the Wave Hub as a way of compensating the town for disruption experienced and the lack of direct employment arising from the project. One suggestion was for developers to pay individuals to do work helping the community.

When asked if he was concerned by the project being delayed, Bob stated: *'the delay is not really a concern, because we are apparently so far ahead that we will not lose our lead'*.

Bob thought that a possible positive outcome for the local community would be that the Wave Hub would give the area kudos, and *'put Hayle on the map'*.

When asked if he was aware of any concerns from other stakeholders, he said that the location of the Wave Hub has been suggested to be in a poor position for the fishermen and it will impact on their income. Bob stated that *'If fishermen realise that there is a small amount of benefit to be made from a situation, they will try [for compensation]. They should not be given direct compensation as it would set a bad precedent, they should instead improve harbour services for them, i.e. a fuel pump'*. According to Bob there had been some issues raised by surfers, but suggested that *'the surfers are not fussed anymore as they have been appeased by a report stating there will be no impact'*.

Reflecting more broadly, Bob was not aware of any stakeholder engagement and was of the opinion that even if there had been, attendance would have been poor: *'It is hard because I would be hard pressed to say that there has been any regarding the Wave Hub, but I think there would only of been 6 people there if there had been'*. He had not heard of any public opposition and suggested that the public would more likely be opposed if it were onshore and had a visual impact.

Cornwall Sustainable Energy Partnership

Fred (pseudonym) a representative of Cornwall Sustainable Energy Partnership (CSEP) has been involved in the Wave Hub project for 4 to 5 years. Its mission statement is *'to bring communities and stakeholders together to solve energy issues'*. CSEP has set up a Maritime Group, which meets to discuss issues regarding marine renewable energy in Cornwall.

Fred states that CSEP gives its full support to the Wave Hub, and adds that- *'it must be remembered that the Wave Hub is research and energy production, they don't have to be mutually exclusive'*.

Fred's main concerns about the Wave Hub were regarding the delays the project had experienced and the possibility that it may not go ahead. Although Fred is of the opinion that SWRDA has slowed the project down with its apathetic approach, he does acknowledge that it was the only organisation willing to take on the project: *'I think that the SWRDA, as a consequence of so many reports, are having to go backwards and look at some subsea stuff, that should have been looked at, at the very start [...], the cabling should have been ordered two years ago, because it will take ages to get here, and the price has gone up... but to be fair SWRDA took on the management of it... they were the only ones willing to take the risk...'*

The interviewer asked Fred if developers had voiced concern over the delay of the Wave Hub and he responded: *'yes we have had developers coming to us and saying that they are concerned...'* Fred was of the opinion that developers were starting to look elsewhere to test their equipment because of the delays and he provided the following quote (read out aloud from a report he had recently written for Cornwall County Council (CCC)): *'the operation of Wave Hub has been pushed back to 2010 to allow for an independent review*

of design and procurement to be undertaken by subsea company consultation.. there has been some concern within CCC that this delay will provide an opportunity for wave energy device developers to move away from the operation to Europe or some of the devolved nations of the UK, where opportunities are being developed'.

Fred also had concerns that the residents of Hayle were thinking that they will get more benefits from the Wave Hub than actually is the case. Fred suggested most of the maintenance for the Wave Hub and its arrays will not be done in Hayle, but in Falmouth or Penzance.

When questioned about other stakeholders and their concerns Fred suggested that the fishermen's concerns over the loss of fishing ground was narrow minded and that: *'[they] need to think of the whole picture, because actually creating no take areas [safety zones] preserves fish stocks in the long run'*.

Fred suggested that there had been negativity from some local surfers, and he suggests that two key surfing organisations hold opposing opinions to one another regarding the development, Surfers Against Sewage are positive about the development, whereas the British Surfing Association is more sceptical.

Fred was concerned that there had been heavy engagement with the public and other stakeholders too early on in the development and he was now concerned that with the delays people will lose interest and support.

Surfers Against Sewage

Surfers Against Sewage (SAS) is a high profile lobby group, whose key focus is to provide environmentally sustainable solutions to water quality issues. SAS has released a statement on its website stating a concern for climate change and the negative impacts that climatic shifts could have on surfing conditions. SAS now act as a sounding board for surfers with concerns about the impact of project.

A representative (pseudonym Tom) states that SAS is in full support of the Wave Hub, although, subsequent marine renewable energy developments will be need to be assessed case by case.

Although SAS were originally concerned about the impact on local surfing conditions, its worries were quickly allayed by a report by Miller *et al* [17]. However, the report did not allay the concerns of all surfers and Tom refers to a quote he read on a surfing website: *'surfers who support the Wave Hub are like turkeys voting for Christmas'*. Tom was of the opinion that the surfers who are most opposed to the development are not local surfers, but: *'those who travel from London and Bournemouth and had a lot of crossed wires and have listened to Chinese whispers'*.

Tom suggests that the Wave Hub will not affect tourism as there are no visual impacts associated with it. However, Chinese whispers may create a situation where people are concerned unnecessarily. Tom's main concern regarding the Wave Hub was the possible backlash by surfers who are currently opposed to the development, as they could potentially have enough power to halt the development.

Tom was very optimistic about the benefits that were going to be brought about by the construction of the Wave Hub and refers to the RDA's statement of creating hundreds of jobs; money coming in to the region; and becoming world leaders in marine renewable energy. Tom was also of the opinion that Cornwall is a good place to be developing marine renewable technologies, as industry in the area is on the decline and as there are people in the area with skills in marine work, he concludes: *'the two seem to pair together'*.

Tom suggests that the public need to be engaged first and then involved in consultations, as they are currently not interested in developments like the Wave Hub, and concludes his statement with: *'those opposed to the WH will not change their mind until it is installed and proven not to be of negative consequence'*.

Cornwall County Council Representative

A representative from Cornwall County Council (CCC) (pseudonym- Matt) was interviewed at County Hall. CCC is on the steering group for the Wave Hub and were originally asked to purchase and manage the project, but its finance advisors concluded that the risk was too high.

Matt states that he personally: *'fully supports the development, it is one of the most exciting developments I have seen in my lifetime'*. Matt suggests that CCC is also fully supportive, although it did stipulate that an EIA had to be done.

Matt's main concern was that opposition from the surfing community could halt the Wave Hub development, suggesting *'if the surfers wanted to they could rally up a lot of opposition very quickly'*. Matt suggests that there is concern from some of the developers about the opposition coming from the surfing community, as they want to install their arrays without aggravation and controversy, as they feel that they are doing a good thing

Matt was of the opinion that some of the science undertaken to identify the likely impacts of the project on wave height and shape was biased and had been influenced by a surfer who was avidly opposed to the development. Matt was also concerned that if the site had been in a more surfing orientated community (i.e. Newquay) the project would have been stopped very early on because of protests from surfers: *'I think if they had gone for Newquay it would have been dead in the water before it even happened... because of the surfing community and businesses reliant on it'*.

Although Matt was fully supportive of the Wave Hub he joked that the development would resemble something along the lines of Robot Wars (a television programme in the 1980s that tested different robots against one another), and that *'things may end up smashed up on the shore'*.

Matt was not concerned about opposition from the fishermen, as there had been a saturation of complaints and calls for compensation from them, and as a result fishermen were no longer taken seriously. Matt was of the opinion the Wave Hub could actually have a positive impact on the fishing industry: *'because the*

seas are over fished and having more safety zones will be better for replenishing fish stocks'. Matt also suggested that the fishermen would have more prosperous job opportunities from the Wave Hub development.

Matt's main aspiration for the Wave Hub was that it would mean an effective array would be developed: *'you know in 10 years time there will be one device that will have proved in survivability and that it is efficient'*.

Matt thought that the residents of Hayle may know of the Wave Hub, but the majority of residents throughout the rest of Cornwall would not have heard of it.

Penwith District Council

An interview was undertaken with a Penwith District Councillor (PDC) (pseudonym- Kate) who had been involved in a number of consultation meetings regarding the development of the Wave Hub. Kate was very supportive of the Wave Hub and conceived that it would bring a wide range of benefits regionally, but was less sure of any local benefits, other than the kudos and recognition of being the host community.

Kate's key concern regarding the Wave Hub was that it was looking like it may not go ahead; *'I am not confident that it is still going to go ahead... I am not confident in SWRDA's drive or ability... to be honest...'*

Kate was of the opinion that SWRDA was repeating a pattern of starting exciting projects and then just letting them peter out. She felt that SWRDA is very inefficient and not dynamic enough to take advantage of windows of opportunity. Kate suggests that the ineptness is due to the fact: *'it's so bureaucratic and hierarchical... no one there can act without their decisions having to go up 25 other people in the link'*. Kate suggested that when SWRDA is finally ready: *'they will have been over taken by other countries... and been superseded in being world leaders...'*

Kate was very concerned about the residents of Hayle having their hopes dashed with the likelihood of the Wave Hub not happening; *'Hayle has been let down so many times with promises of redevelopment and there have been lots of promises and lots of noise about the Wave Hub'*. Additionally Kate suggests that most of the maintenance work will not be undertaken in Hayle, but in places like Falmouth and Penzance; Kate suggested that this is yet to be realised by the majority of Hayle residents: *'I think that Hayle thought they were going to get all the benefits- but they have only just started finding out that there are not so many benefits... also the jobs that are going to be made by the Wave Hub are all highly skilled positions, they are not going to be accessible local jobs..'*, also in this statement Kate points out that there will not be local jobs for people, as the posts will be specialist positions. Kate thought that when the residents from Hayle find out that there is little local benefit: *'the community could be quite aggressive in their opposition if they wanted to'*.

Kate's main aspiration for the Wave Hub was that it should be developed in a sustainable way, and she felt that, as SWRDA had segmented the research to Falmouth, and the boat maintenance to Falmouth and Penzance, the project did not fit within a truly

sustainable ethos. Kate suggests that Hayle should have become a sustainable community through the development.

In Kate's opinion the consultation that has been undertaken about the Wave Hub has not given the whole story to people and has been misleading, especially about the jobs and local benefits.

Anonymous Local Surf School

A local surf school owner (pseudonym- Ash) agreed to an interview at a north Cornwall beach. Although Ash is now in full support of the Wave Hub, when he first heard of the development he was strongly opposed, and when approached by a local radio station to air his views, he did, and now admits; *'I didn't really know much about it... but now I am all for it'*.

Ash's main concern was to what size the Wave Hub could be scaled, if the project proved to be successful, Ash referred to a *'flotilla of arrays'*, which he suggests could have a much more serious effect on surfing conditions compared with the Wave Hub and the four planned arrays: *'it could cut off every bit of surf or wave pattern coming through'*. Additionally, Ash adds that the decision to scale it up *'won't be down to us... it will be a government decision in the end, it won't be down to us, the people...'*

Initially Ash was not convinced by the science that had been undertaken into the impacts of the Wave Hub on wave height and shape. However, he has now read a number of websites and accepts the impacts are not going to be significant on the local wave quality. However, he conveyed concern that even a minimal impact on wave height and size could render some days that are just surfable as *'no go days'* for his surf school, resulting in a detrimental impact on his income. Ash suggested that swell is so unpredictable: *'You will never be able to predict the effects of the Wave Hub, because when it is in knee high here you cannot say that this swell would have been bigger without the Wave Hub being installed, because they cannot measure it, so they are on to a winner'*.

Ash suggested that developers are only interested in maximum profit, not optimum location of the device: *'they are going to make a big profit from these things, these big companies are loaded... they can afford to spend an extra thousand pound a journey once a month or whatever not to effect ten beaches and one hundred small businesses... put it somewhere between the Isles of Silly and Lands End, where it is not going to hurt anyone, and you have got tidal flow as well as swell'*.

Ash suggested that the Wave Hub will help the local economy and offer jobs to those who need them: *'I mean let's look at the economy, I mean if it goes in it is really going to help this area... with jobs... there are lots of people looking for jobs'*. Ash even suggests that the *'Hayle port will thrive off it'*, as all the work is being undertaken locally and the materials will be purchased from local sources. Ash goes on to suggest later in the interview: *'that it will look after itself money wise, it is sustainable isn't it... once it is all set up you probably only have to check it once every six months'*.

Ash even suggested that although there were possible negative impacts on the surf, there could also be positive ones. He suggested that there was a slight possibility that the Wave Hub could *'clean the surf up... like the kelp beds in California'*. Additionally, Ash thought that there was the possibility of getting more accurate swell reports for predicting the surf: *'It will be good because we can tap into the wave buoy readings at Hayle and get better swell predictions for surfing'*.

When Ash was asked if he thought it would impact on any other water users he was of the opinion that no-one would really be adversely affected. When questioned directly about possible impacts on fishermen he responded: *'well they are alright aren't they... it's not going to take up a huge area... it maybe a hazard'*.

When Ash was asked if he had been involved in any consultation or been aware of any public events regarding the Wave Hub his response was *'nope... none at all'*.

Local Fisherman

An interview was undertaken with a local fisherman (pseudonym- John) at Hayle harbour. John was concerned about the Wave Hub and the implications of its development. John suggested that he was going to be directly affected by the location of the Wave Hub, as the area he fished would become a safety zone. John was concerned about losing his normal fishing ground and having to fish elsewhere.

He suggests that the local fishing community are concerned that there has not been a pilot project, and that the site they have chosen will prove too difficult to anchor at: *'quite a few people in the know think that they are not going to find it as easy to anchor as they think... they cannot even anchor a buoy out there...they are going to spend lots of money trying a technology out, I think they should have tested the anchoring first'*.

John was concerned that some of the equipment being installed was very large and that it could break free and damage boats in the area: *'some of these things I have heard are going to be the size of the railway sleepers, if these things break loose... they have to float yeah... well when they break loose... that is a notorious piece of sea down there'*.

John suggests that *'no-one seems to have addressed or considered that the cabling will not be buried in the sea bed it will just be laid across the bottom, and will sit on top of the rocks, which will mean even less land will be available... which will mean 15Km, with 1Km either side that we cannot trawl... that takes a great big bit of land... and that is going to really affect me'*. John also suggests that the cable will be difficult to stay away from in bad weather: *'but when you get bad weather here, it will be hard to keep clear of it... they don't want us pulling it up...'*

John thought that some fishermen were yet to realise they would be affected by the Wave Hub, and that when they do realise this, there will be a backlash. John also felt that there would be no compensation for those affected by the project, as *'the government will fob them off'*.

When John was asked if he could think of any other stakeholders who may be affected by the deployment of the Wave Hub he suggested that Trinity House are not pleased about it, as it is on the 20 fathom line, which is used by all the coasters (coming from France to Milford) as a navigation line. John said he had not been to any consultation events, as the developers had already decided on the site and so there would have been no point in him attending. He also suggested that the timing of some of the events were ridiculous, as it was when most fishermen were out fishing.

4. Discussion

In the following discussion, we explore implications arising from the range of opinions about the Wave Hub expressed in the interviews. From the interviews, there were a number of key areas that stakeholders expressed opinions on. Those discussed in this paper are: cumulative impacts and scientific monitoring; water user concerns and conflicts; economic impacts; engagement and public administration. It is also apparent from the findings that opinions about the likely benefits and impacts of the Wave Hub varied markedly between different groups. Table 1 highlights a number of key differences identified during the interviews.

In overall terms, there was a high level of support for the Wave Hub from SAS, CSEP, PDC, CCC and the local surf school. Although the SFC and the HTC had a number of stipulations about the manner in which the project should proceed, they still generally supported it. The only interviewee that opposed the Wave Hub outright was the local fishermen, who felt he would be financially penalised by the development. The key issues identified above are now discussed in turn.

Cumulative Impacts and Scientific Monitoring

It could be assumed from the interviews that although there is general support from key stakeholders for the Wave Hub, it does not necessarily mean that this will extend to future, larger deployments. There was a general concern that if Wave Hub is successful it will

pave the way for multiple marine renewable energy deployments around the Cornish coast, whose impacts may be more significant and detrimental. As a consequence, interviewees suggested that the cumulative impacts of installing multiple marine renewables are difficult to predetermine and, therefore, that support for widespread deployment would not exist until there is robust science that took account of cumulative impacts.

This suggests the need for the proponents of developments to provide caveats to claims about the effects of moving from demonstration project to large scale developments (i.e. *only if there is adequate science to say there will be no untoward impacts*), as potential over-optimism in statements on issues characterised by uncertainty may affect the level of support that stakeholders are willing to offer to marine renewables. However, according to several stakeholders, such ‘robust science’ may be unachievable because of unclear or long-term ecosystem impacts and connections. A number of interviewees claimed that the science currently being undertaken on the Wave Hub was of questionable quality, raising scepticism as to whether adequate research could or would ever be done given the economic and strategic policy issues at stake. The lack of robust science remains a key concern, fuelled by a lack of reliable baseline data. Although studies have been commissioned to explore the impacts of the Wave Hub on the ecological and surfing environment, it appears these are unlikely to allay stakeholders who feel the research needed to have started many years before. The SFC representative was of the opinion that the research currently being undertaken to monitor the impact of the Wave Hub on fisheries and local ecosystems will always be questionable, due to the temporal/cyclical characteristics of marine life. Similarly, he argued that the lack of preconstruction (i.e. baseline) data from the site meant that current monitoring could not easily identify any

	SFC	Town Councillor	CSEP	SAS	CCC	District Councillor	Surf School	Local Fisherman
Support for Wave Hub	Reserved in judgement	In support, but with caveats	Full support	Full support	Full support	Full support	Full support	Concerned
Opinion of SWRDA	Good	No comment	Good and bad	Good	No comment	Useless	Profit orientated	They do not listen
Local benefits	None	Not enough	None	Lots	None	Not enough	Lots	None
Quality of science	Poor	N/A	Good	Good	At times biased	N/A	Good and bad	N/A
Public engagement	Good	Non-existent	It has been done too early	Good- but public not interested	Poor- but public not interested anyway	Poor- not given the whole story	Non-existent	Pointless and poorly timed
Cumulative impacts	Concerned	Concerned	Hope for more deployment	Concerned	Hope for more deployment	Hope for more deployment	Concerned	Concerned
Concerned about the delay	Concerned	Not concerned	Concerned	Not concerned	N/A	Concerned	N/A	Not concerned

Table 1, Stakeholder perceptions of the Wave Hub

negative impacts occurring.

Additionally some members of the surfing community believe that the impact of the Wave Hub on swell height and size will never be known, due to the unpredictable nature of swell patterns, and a relatively short period of baseline data collection. It appears that the study produced by Millar *et al* [17] has been the most influential in satisfying a number of surfers' concerns about the likely impact of the Wave Hub on local surfing conditions. This could be due to the perceived independent nature of the study, which was produced by the University of Exeter and not linked to the Wave Hub developers or consultants. However, 'independent science' had not satisfied the representatives from CCC and the local surf school of the likely impacts on surf, as they felt that monitoring of local swell patterns should have been undertaken for many years prior to the development.

Therefore, whilst current scientific investigations into the likely impacts of the Wave Hub appear to have appeased some stakeholders, others believe it to be flawed. Future developers considering sites should not, therefore, underestimate the importance of early baseline data for appeasing stakeholder concerns and to avoid scepticism about the robustness of their reports.

Water User conflicts and Concerns

One conflict that concerned many stakeholders was a possible backlash from recreational water users. Although only the surfing community opinions are represented in the interviews, it is reasonable to assume that other groups, like recreational boaters, may also have concerns that both overlap with, and are distinct from, those of the surfing community. Within this paper, there is heavy representation from the surfing community, as it was identified during interviews that a number of stakeholder representatives had professional interests in the marine environment but were also keen surfers. It is reasonable to suggest that other marine renewables developments are likely to experience stakeholders with, at times, conflicting professional and recreational interests in the marine environment.

The representatives from CCC, SFC, SAS and the local surf school are all regular surfers, so expressed views related to wave heights and a hedonic use of the marine environment. However, the economic implications of these conflicts were also aired by companies involved in recreational water-use activities. Given the importance of such uses to the economies of peripheral, tourist-dependent coastal communities, such concerns should not be treated as a triviality. In this instance, Cornwall is the poorest County in the UK and has received structural funds from the EU (including Objective 1) for several years in order to bolster local economic regeneration. A number of stakeholders believed that the surfing community could actually halt the Wave Hub through aggressive opposition, which has already been witnessed to some degree.

There does not appear, however, to be a concerted alliance between different water-user groups collectively to protect areas from the adverse effects of marine renewable energy developments. Rather, the

picture emerging is one of each group considering their own interests/concerns; for example, the concerns of the fishermen were not supported by all the stakeholders.

The local surf school owner and representatives from CCC and HTC all believed that local fishermen would not be severely affected. It was even suggested by the HTC representative that fishermen will only claim to be affected so as to claim compensation, claims that the CCC representative felt would be ignored, as a result of repeating pleas made by fishing groups for compensation. The only representative who empathised with the concerns of the fishermen was from the SFC. Lack of support from other stakeholders for fishing communities in respect of the impacts they may encounter from offshore renewables is also noted by Gray *et al* [12] and Haggett [11], which could suggest that an unsupportive view of the fishing industry could be prevalent as a consequence of long-running disputes and 'preferential treatment' over the Common Fisheries Policy. Another factor that appeared to influence CCC and CSEP representatives' sympathy for the fishing community is the current view that fishing practices are unsustainable and, thus, that curbing fishing would help fish stocks to recover.

Two more general lessons emerge from this analysis. The first is that a failure among water-user groups to recognise overlapping interests and form coherent alliances may be exploited by developers (a Machiavellian view), although the opposite is also true, in that coalitions could be forged between water-user groups to create stronger opposition to developments. The second, drawing on experiences from onshore renewables, concerns the ability of minority groups to hinder developments. The surfing community's demands require careful consideration here, as they are likely to be a stakeholder for many marine renewables developments and can wield strong economic, as well as recreational arguments, in tourist-dependent areas. Developing mechanisms or strategies to allay surfer concerns and void opposition from the surfing community needs to consider the surfer mindset, which combines a passionate and emotional attachment to wave quality, surfing locations and broader concerns about the protection of marine environments (as shown by initiatives like Surfers Against Sewage) [18]. Therefore if test facilities like the Wave Hub record detrimental impacts on the surfing environment of surrounding areas, the findings will likely be used by surfers elsewhere to support opposition.

Engagement

The results indicate a general divide in opinion about the level of stakeholder engagement in the consultation process for the Wave Hub. SAS and SFC felt there had been a good number of open public events about the project, but local fishermen in particular felt consultation had been inadequate. The surf school claimed to have been unaware of any events, while HTC and CCC felt that there had been a minimal number of public events about the development. The fishermen stated that the events organised for fishermen were at inappropriate times, when people were working.

This suggests that although consultation and public events may have been held by developers and were seen as adequate by SFC and SAS representatives, they were not communicated adequately or did not take into account stakeholders' needs. Equally, the stakeholders who felt the consultation process had worked effectively were those who had been involved from the early stages of the development and had been contacted individually for their participation. Had this not happened, they may also have been alienated from the process, stirring up further opposition.

The obvious lesson from this is the need for highly active communication and participation strategies, even if the opinions voiced at such meetings may provide uncomfortable messages for developers. This is especially important for contacting and inviting local businesses whose interests may be affected by developments. This was demonstrated by the local surf school owner, who on hearing about the Wave Hub publicly opposed it on local radio, and only later through independent investigations concluded his business would not be significantly affected. Earlier and more active communication and consultation might have avoided this.

This lesson is one which should again draw upon experiences with onshore developments, bearing in mind that consultation does not necessarily reduce opposition. However, it does help developers to make their case (e.g. about the robustness of science or economic impacts) and incorporate stakeholder concerns, while also helping to identify and engage with minority groups that may be able to add further weight to opposition by claiming lack of consultation.

Economic Impacts

From the interviews a distinct divide emerged in perceptions of the likely local benefits of the Wave Hub. Some groups believed that the Wave Hub would bring more jobs and revenue to the local community; others argued that the benefits would be minimal. Interestingly, all felt that the job creation figures provided by SWRDA were exaggerated, potentially in an attempt to sway opinions in favour of the project. In a follow-on interview with Hayle Chamber of Commerce conducted after the main body of research, representatives were asked '*what are the local benefits of the Wave Hub?*' The response consisted of an interesting analogy about a vet the interviewee knew who tended to give a pessimistic diagnosis of a pet's chance of survival, whereas his colleague would always give an optimistic appraisal. The pessimistic vet was by far the more popular and trusted, as clients became disheartened by the optimistic vet giving false hopes. The interviewee likened SWRDA to the optimistic vet and argued that it is in danger of creating disappointment and a backlash against such developments by offering over-optimistic assessments of the employment and revenue-generating potential of the project. Kate, who had a professional interest in the economic potential of the project, also had concern for SWRDA's over-inflation of local economic benefits, as she was adamant that actual job creation would fall far

short of developers' predictions. The use of economic arguments to overcome environmental or social objections to developments is, of course, a common tactic among developers, particularly at the local level [19]. However, the growing emphasis on post-project appraisal of actual versus predicted benefits increases the chances of over-optimistic predictions leading to cumulative damage to the overall credibility of marine renewable energies.

Public Administration

Although SWRDA have publicly made a statement that assures the project will go ahead [15], it is apparent that some stakeholders are becoming discouraged by the delays, and think that the project may not actually come to fruition. Other stakeholders remain optimistic about the development happening and becoming (and making Cornwall into) a world leader in marine renewable energy. CSEP, PDC and SFC all suggest that the delay in the construction of the Wave Hub is a result of procrastination and poor management by SWRDA, because if they had stuck to the original timeframe the adverse economic situation would have been avoided. Whatever the balance of factors, the delays the Wave Hub has faced has discouraged a number of stakeholders, and raised assumptions about the vulnerability of the project, therefore this finding should be considered carefully by developers and installers when announcing project timescales. The blunt lesson is that the repercussions of recurring delays may aggravate already existing apathy among key stakeholders whose support is needed.

Summary of lessons and conclusions

This paper draws on the perceptions of a small sample of stakeholder groups and, as such, any lessons gained cannot claim to represent the views of other groups potentially affected by the Wave Hub not included in the initial sample because of resource and time constraints. These in particular include navigation organisations, wildlife groups and recreational boat users. Although the views of some of these groups may overlap with those discussed (e.g. fishing groups and recreational boat users' desire to avoid access restrictions), this would need to be verified and other views explored through future research.

The results nevertheless still indicate a wide range of (often conflicting) perceptions about the Wave Hub among different groups. Differences were particularly evident on the success and inclusiveness of consultation processes. Contacting key stakeholders directly and early on during consultations appears to have been successful in involving certain high-profile groups (e.g. SAS, SFC and CSEP), whereas more generalist strategies, such as advertising events through the local press, were less successful in reaching groups outside 'peak' organisations whose interests may still be affected by the Wave Hub. Interestingly, included in this latter category are 'grassroots' members of peak organisations, such as local businesses and fisherman. Greater consideration therefore needs to be given to approaches that actively engage with such groups through more direct approaches and events that cater for

diverse sets of working hours. A second key lesson concerns the need for precaution in promises made about the economic impacts of renewable energy projects. Whereas promising economic benefits can help to win over opponents of developments, exaggeration of these benefits can create disappointment among stakeholders and actually increase levels of opposition.

Finally, the study has drawn attention to the importance and difficulties of providing reliable scientific evidence capable of persuading key stakeholder groups to support marine renewable energies. In this case, several stakeholders identified issues with the impact data provided by developers in terms of the reliability of baselines and long-term. Greater emphasis thus needs to be placed on developing long-term studies to ensure that scientific uncertainties do not provide a justification for opposition to projects, assuming that the negative impacts on marine environments and coastal processes are not, in fact, significant.

Having outlined these general trends, we conclude with two more general observations. First, one of the main reasons for the broad, if not unequivocal, support for the Wave Hub among the stakeholders interviewed was its small-scale experimental nature. However, this does not mean one can presume similar support for larger, future marine renewable developments. Much of this again depends on providing reliable scientific assessment of environmental and other impacts change, but equally important is how these assessments are communicated. Second, our findings suggest that there are severe difficulties in assuming that the same, or even similar, stakeholder objections that have hindered onshore renewable energies will be encountered in relation to marine renewables. Although the marine environment is theoretically 'out of sight' of many stakeholders, it is not automatically 'out of mind', and differences in the interests of the stakeholders involved and the way marine environments are perceived compared with terrestrial ones can have material implications for how developments are perceived. But, even within the marine context, major differences may exist between technologies as a consequence of their different impacts on the marine environment. Further research on stakeholder perceptions of marine renewables (including the importance and nature of public opinions) is, thus, needed to aid understanding of this complex policy issue.

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