

Social perception and acceptance of Tidal Current Turbines (TCTs) Energy project: A case study of the Gulf of Morbihan, France.

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Abstract - In 2019, renewable energies counted for 11,7% of primary energy consumption in France, behind nuclear power (40%), petroleum products (29%) and natural gas (16%). The production of renewable energies reaches 320 TWh in 2019, only 0,2% of which comes from renewable marine energies.

What about renewable marine energies and the social acceptance of their development in France and specifically in the Gulf of Morbihan site (GM) in Brittany? This paper aims at providing empirical data for the deliberation of Tidal Current Turbines (TCTs) Energy development and its perception and acceptance by the GM residents and users. A survey aiming to reveal some understanding about the extent of knowledge and awareness related with renewable energy in general and the development of TCTs in particular was designed and realized. Around 727 participants spread over the 20 municipalities of the GM and representing all the socio-economic activities in this basin responded to an online survey and / or direct individual interview for 13 weeks from May to July, 2017. The overall outcome of the conducted survey indicates that TCTs is not a technology known by the majority of the population, their answers and remarks highlight the need to communicate about the TCTs project and about the technology itself. Although 55,9% of those surveyed gave a favorable opinion for the development of a TCTs project in the GM, the citizens interviewed requested to be actors in this project and to be informed in full

"transparency" of the stages of the project's development.

Keywords - Gulf of Morbihan (GM), Tidal energy potential, Perceptions of Tidal Current Turbines (TCTs), Favourable.

I. INTRODUCTION

THE Gulf of Morbihan (GM) is an inland sea with an east-west length of about 20 Km dotted with numerous islands and islets. The GM only communicates with the Atlantic Ocean through a narrow gully one kilometre wide. As a result, there are very strong tidal currents between Berder and Jument islands that can reach up to 4 m/s, making this site a potential one for tidal energy development. The GM is an ecologically sensitive site as it contains a dozen of bird species of world importance. It is also the object of multiple uses with: 112 oyster farms, 60 fishermen on board, 9 shipping companies with 40 shuttles and an average of 700,000 passengers per year, 7,000 anchorages, 12 ports, 31 nautical clubs (including diving) and finally about 10,000 leisure fishermen. All these activities are represented by more than a hundred associations (environmental, civic, patrimonial, professional...) for a population of 165,000 inhabitants per year spread over 20 municipalities and about 2 million tourists per year, and all these are on a water body of about 11,500 hectares. As a matter of fact, the diversity of these activities sometimes leads to real conflicts of use in terms of resource exploitation and/or spatial occupation [1][2]. An activity such as on-board fishing for instance leads to conflicts of use

in the Gulf related to space sharing between recreational and professional fishers; these conflicts are particularly accentuated in the summer, a period during which the waterbody is saturated due to the increase in the number of recreational fishers [3]. However, the development of marine renewable energy (MRE) will increase pressure on existing marine sectors representing a challenge for Maritime Spatial Planning (MSP) [4]. Therefore, it is important and convenient to better understand GM residents' views towards the development of tidal energy.

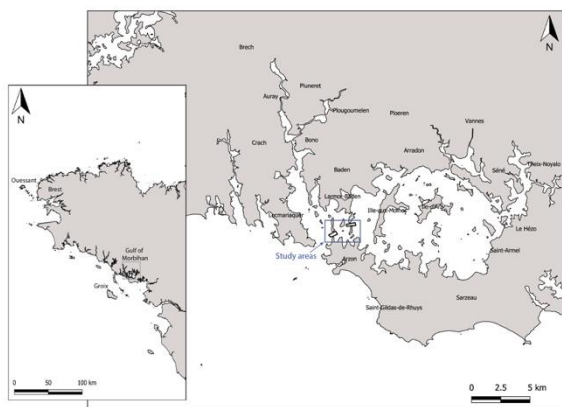


Figure 1. Map of the GM with the two sites position with tidal energy potential (south of Longue island and south of Berder island).

This is the first study to address this need with a survey of a random sample of GM residents.

Succeeding an initial identification study of sites with high tidal energy potential in the Morbihan, the Laboratory Ocean Geosciences UMR CNRS 6538, University of South Brittany (UBS), in partnership with Morbihan Energy, carried out complete studies on two sites in the GM (South of Berder island and South of Longue island).

The first study revealed the existence of bathymetry and currentometry favorable to the installation of tidal current turbines (TCTs). The energy potential is estimated to $\sim 7\%$ of the electricity consumption of the 130,000 inhabitants of the territory (541 GWh) [5]. The second study [6] concerns the characterization of the initial state, the environmental and socio-economic assessment of the potential impacts of a TCTs development in the GM [7], as well as the social perception and acceptance of TCE project by

stakeholders and users around two sites of tidal energy potential in the GM, which is the objective of the hereafter paper. These studies subsequently made it possible to integrate the Tidal Stream Industry Energiser Project (TIGER project). The TIGER, is the biggest ever Interreg project that will prove game-changing for the European tidal stream energy sector. It will drive the growth of tidal stream energy in France and the UK (Channel Manche region) with significant economic benefits for coastal communities (website: <https://interregtiger.com/fr/>). Throughout the following sections, we will introduce a brief overview of the tidal energy potential in the GM, followed by our methods and results. We will then discuss our findings in light of the literature and present our conclusion.

II. PROCEDURE AND SAMPLE

Three main survey techniques were selected to conduct this study: the practice of semi-directive interviews, dissemination by e-mail and on the Internet, and the constitution of a corpus of documents (two types of documents accompanying the questionnaire, a socio-professional category sheet to fill in the questionnaire and an information sheet on the current study). Around 320 interviews were carried out with a variety of stakeholders from the site studied and actors-decision-makers organizers of the sector: sea users (fishermen, shellfish farmers), representatives of shipping companies, people in charge of recreational activities (sailing, diving, surfing, etc.), local population (main or secondary residents), tourists, local associations, local authorities (mayors of municipalities, ports, etc.).

Nearly 200 e-mails, containing the link to fill in the on-line questionnaire and a corpus of documents, were sent to almost all the actors and decision-makers of the Gulf. To this list we added the e-mails sent by the UNAN (National Union of Navigators Associations), the ones sent by CRC (National Committee of Shellfish Culture) to all their members and committee members. Other associations such as Auma-Bouline, Les Amis du Golfe, Union des Plaisanciers des Ports du Morbihan (UPPM), Fédération Nationale des Associations de Plaisanciers de L'Atlantique (FNPA), and some nautical clubs (Subaquadique les Vénètes and Club Subaquadique Alréen) sent the questionnaire to their members. The link of the

questionnaire and its documentary corpus were also published on the website of some local authorities (Sarzeau, Ambon, Arz island city halls, the Regional Directorate for the Environment, Planning and Housing of Brittany (DREAL Brittany), Association (UPPM) and on the website: Vitrine de l'Ile d'Arz.

Information posters on the current study and the perception survey were displayed in town halls, some tobacco shops, pharmacies and bakeries in the 20 communes bordering the Gulf in order to inform and invite citizens to participate to the survey. Also, few hard copies of the questionnaire were deposited at the harbor office of the port of Vannes.

The investigation lasted 13 weeks from May 2nd to July 31st, 2017. A total of 727, citizen, users and decision-makers at the GM were surveyed, 320 of which were surveyed through face-to-face interviews and 407 completed the online questionnaire. The survey study was held with the assistance of a laboratory of Psychology: Cognition, Behavior, Communication (LP3C) EA 1285, in order to have a high academic quality and reliability.

The questionnaire includes 24 items that cover the degree of information provided by the participants on the Gulf of Morbihan's tidal current potential, their vision and apprehension of the GM marine environment, perception of renewable energy in general and their apprehension of the development of a TCT project in the GM. Only part of them was used for the purpose of this paper. It took the participants about 25–35 min to complete the questionnaire.

III. RESULTS

The average age of the surveyed population was 53 years with an age range from 15 to 97 years. The sample is composed of 73,52% men (n = 508) and 26,48% women (n = 183) (Figure 2).

The participants are free to answer or not and to withdraw at any time. The numbers of each question answered vary and therefore to be taken into consideration. For each question, there are also some participants who did not wish to communicate their answer ("No answer") due to lack of information, disagreement or for confidential reasons.

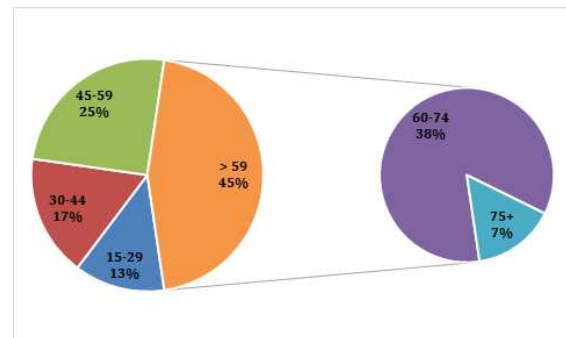


Figure 2. Age distribution of the surveyed population of the 20 communes bordering the GM.

To the questions: Are you aware of the existence of this perception survey? Are you aware of a characterization study of the tidal energy potential in the GM? Among the 722 people who answered these questions, only 27% (n = 197) were aware of the existence of the social perception survey (TABLE 1). Only 37% (n = 266) of the population questioned had heard of the study to characterize the tidal energy potential. The majority of the people questioned who were aware of the social perception study were informed via their professional and/or associative structure (43%). Word of mouth is also an important intermediary (28%). Whereas, for the study to characterize the tidal energy potential in the GM, the respondents were informed through the media (34%) and again for a large part of them through their professional and/or associative structure (33%).

TABLE 1. THE MEANS OF KNOWLEDGE OF THE STUDIES CARRIED OUT IN THE GM. Q1: ARE YOU AWARE OF THE EXISTENCE OF THIS PERCEPTION SURVEY? Q2: ARE YOU AWARE OF A CHARACTERIZATION STUDY OF THE TIDAL ENERGY POTENTIAL IN THE GM?.

		N	Media	Professional and/or associative structure	Word of mouth	Mail	Others
Q 1	n	722	--	85	55	9	48
	%		--	43	28	4,5	24
Q 2	n		90	88	48	--	40
	%		34	33	18	--	15

A. Apprehension of the TCTs project

The general trend for the TCTs project in the GM is rather positive with a total of 55,9% (n = 407) (TABLE 2). Around 34,9% of the population interviewed said they were "favorable" to the project and 21% "very favorable", whereas 30,30% of the population is against the project (19,40% of individuals saying "very unfavorable" and 10,9 % saying "unfavorable").

7,30% of respondents said they were "indifferent" and 6,50% preferred not to take any position as they are lacking information at this stage.

TABLE 2. APPREHENSION OF THE TCTS PROJECT BY THE GM RESIDENTS.

		n	% (N=727)
55,9% n=407	Very favorable	153	21
	Favorable	254	34,9
30,30% n=220	Un-favorable	79	10,9
	Very un-favorable	141	19,4
13,80% n=100	Not concerned	53	7,3
	No answer	47	6,5
Total (N)		727	100

a. Apprehension of the marine environment.

Around 47,6% of the participants (N = 727) consider that the marine environment is currently of a good quality, 36% consider it to be of average quality (TABLE 3). Urban planning, agriculture and tourism were considered by the participants as the three main sources of deterioration of the marine environment. From another perspective, 74% of the participants advocate a sustainable management of the environment and could thus consider accepting a limitation of human activities.

On the other hand, activities related to professional fishing or shellfish farming are considered as less harmful. These activities are also the least frequently classified, which could reflect a tendency to consider them not harmful to the environment or a tendency to avoid criticizing them.

B. Conflicts of use

The majority of people surveyed (63%, n = 457) think that the installation of tidal turbines can interfere with certain activities in the GM (TABLE 3). Fishing, traffic (commercial and pleasure boating) and diving are the activities that, according to the participants, would be the most impacted by the installation of TCTs.

IV. DISCUSSION

In general, all surveyed participants expressed acceptance for the concept of marine renewable energy regardless of age or gender. The main reasons behind this were the hope for reducing fossil-fuel dependence and tackling climate changes. The main concerns identified were conflicts in shared-use sea areas and the potential adverse environmental effects of TCTs project. Indeed, The TCTs project in the GM could possibly be categorized in the theme of conflicts of use when considering the existing uses in the GM with which the project could potentially compete: professional and leisure fishing activities and diving. The definition of a conflict of uses according to Melé [8] can then be applied: *"potential competition between certain practices, forms of appropriation of spatial subsets or use of natural resources"*. This competition can result in oppositions between actors denouncing more than simple competition, but an incompatibility. Then we can read *"the area is very busy, there are already a lot of "restrictions", it must not hinder leisure activities"* or *"I am a member of the 'vénètes' diving club and have been diving for more than 30 years in the Gulf and knows a very large number of diving sites in the Gulf also the location in the South of longue Island is a big mistake other sites are more suitable"*.

Classifying the human activities contributing to the deterioration of the environment may have been a difficult exercise for the participants (TABLE 3). The most highly ranked activities are those that are generally not directly linked to the water body (urbanization, agriculture, tourism) or that are not professional activities. Professional activities related to the small sea are often defended: *"they have to live"*. The exercise may also have been poorly accepted because participants may have refused to evaluate activities and compare them, thus refusing to take part in the conflict of use. The discussions of this issue during the face-to-face interviews highlighted the strong conflict of use in the Gulf. Similarly, the cultural

nature of some activities in the GM makes it difficult to evaluate/criticize them. Although the participants were aware of the potential environmental degradation they may generate, the inking of these professional and leisure activities (such as shellfish farming and yachting) in the territory, both from a physical and cultural point of view, could influence the participants' responses. Indeed, several concepts have been used to explain the link between people and places. [9] and [10], for example, discussed the emotional connection people develop to the physical environment through the activity of attributing meaning to places. That relationship has also been looked at via the lens of "place identity", which defines how certain sites and their natural and/or symbolic characteristics impact people's sense of identity [11], as well as with the concept of "place attachment" [12].

Some opposition movements began as soon as the project was announced. Associations representing civil society, economic actors of the territory, as well as citizens, expressed their fears about the installation of tidal turbines in the Gulf. Indeed, boaters' associations are concerned about the impact on the marine environment and the ecological balance of the seabed and, to a less extent, navigation disruption.

The National Union of Navigators Associations (UNAN-Morbihan), for example, informed through a formal written note that it would be against the project if one of these three criteria is not satisfied: 1) *maintaining the free movement of ships and the safety of navigation*; 2) *respect for fishing activities (leisure or professional)* and 3) *preservation of the natural marine environment and its biodiversity*. Fishermen and shipping professionals seem to be afraid of stopping or disrupting navigation.

Despite these worries, participants tend to have a positive opinion of this potential project. However, it is necessary to mention that participants with "favorable" opinion indicated that they were favorable to the technology itself, but their position regarding this project within the territory will depend on the results of the impact studies and future information on the technology that will be introduced. This positive opinion is therefore "conditional". Some participants, on the other hand, chose not to position themselves. They think they lack information or prefer to wait for the results of the impact studies. Finally, some people who defined themselves as "indifferent", also chose this response option because they did not want to take part in this issue either.

According to Van der Horst [13] the public responses to energy projects change over time, with the likelihood of more positive responses post- installation in comparison to those beforehand when project outcomes are less uncertain. Other authors have noted that support for renewable energy often follows a 'U' shaped curve. Attitudes range from very positive (that is when people are not aware of a renewable energy project in their neighborhood), to much more critical (when a project is announced), to positive again (some reasonable time after the construction, perhaps even to higher than pre-development levels) [14][15]. As such, it appears that besides any preconceived notions harbored by the public, opposition to renewable energy developments may be more related to the planning and decision-making processes than to the projects themselves [16].

Proposed solutions to this pattern of support and opposition include open communication between developers and local communities and greater public engagement in the planning stage [17][18]. Public engagement through communication, consultation, or participation can speed up the decision-making process and lead to greater level of support for the project [19][20]. This dataset was collected before the TCTs deployment. Follow-up research can demonstrate if concerns about ecological and economic impacts have dissipated. This outcome may be contingent upon how the developer feeds back results of ongoing environmental monitoring to residents and users.

V. CONCLUSION

Renewable energies are having a good image in Morbihan's public opinion. However, as a result of this survey, we were able to observe that the project is facing certain obstacles: conflicts of use, doubts about the real efficiency, impact on the environment, etc. Working on the social acceptability of such a project makes it possible to evaluate the project's appropriation probability in order to limit the risks of rejection. Acceptability then works as a kind of conflict management. It is not only a matter of making the new infrastructure desirable, but also about capturing and orienting perceptions and behavior in a technical sense [21]. Indeed, citizens need to be able to understand the technology and measure its advantages and

TABLE 3. STATISTICAL SUMMARY: THE APPREHENSION OF THE MARINE ENVIRONMENT.

Questions		N		Very good quality	Good quality	Average quality	Poor quality	Very poor quality			
Q1. How would you describe the quality of the marine environment today?	n	727	43	346	262	48	5				
	%		6	47,6	36	6,6	0,7				
Q2. In your opinion, which human activities contribute most to the deterioration of this environment?											
Rank the following activities from the most to the least degrading for the environment, with "1" being the activity that causes the most damage among the seven suggested and "8" being the activity that you think causes the least damage.											
			Professional fishing	Recreational fishing	Shellfish farming	Agriculture	Tourism	Yachting	Town Planning	Navigation	
1	n	474	22	22	34	191	89	27	219	93	
	%		4,64	4,21	6,61	31,31	14,54	4,78	35,78	12,65	
2	n	523	76	23	45	160	123	64	154	46	
	%		16,03	4,40	8,75	26,23	20,10	11,33	25,16	6,26	
3	n	514	59	27	51	105	139	54	115	93	
	%		12,45	5,16	9,92	17,21	22,71	9,56	18,79	12,65	
4	n	610	65	28	50	51	90	94	66	143	
	%		13,71	5,35	9,73	8,36	14,71	16,64	10,78	19,46	
5	n	612	55	59	65	47	89	80	28	152	
	%		11,60	11,28	12,65	7,70	14,54	14,16	4,58	20,68	
6	n	565	72	96	73	30	48	92	18	132	
	%		15,19	18,36	14,20	4,92	7,84	16,28	2,94	17,96	
7	n	612	74	105	107	16	24	92	8	76	
	%		15,61	20,08	20,82	2,62	3,92	16,28	1,31	10,34	
8	n	735	51	163	89	10	10	62	4	0	
	%		10,76	31,17	17,32	1,64	1,63	10,97	0,65	0	
			Yes	NO	No answer						
Q3. Do you think the installation of TCTs could interfere with certain activities?											
	n	727	457	224	46						
	%		63	31	6,3						

disadvantages. It is therefore necessary to communicate about the technology; meaning, reliability, productivity, risks and cost are all elements that will fuel acceptability. Communication must be based on well-founded results that will help gaining the citizens' trust and involvement. The information exchange must also be continuous along the different stages of the project, with quality, objective and true information. This will help to better understand the project's impact on the territory and the project's sensitivities, and hopefully eliminate conflicts and make the project accepted. In fact, almost all of the population surveyed asked to be involved in this project and confirmed readiness to get fully involved with the project leaders.

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