Toward Best Practices for Public Acceptability in Wave Energy: Issues Developers Need to Address

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Abstract

At this initial stage of development, opinion toward wave energy is mainly positive. Interviews with developers, presentations about wave energy at local community meetings, and the literature show that there are four main types of issues developers need to address when discussing their projects with local populations: conflict of use of the ocean space, environmental impact, NIMBY (Not in My Back Yard), and community well-being concerns. The importance of these issues is presented and suggestions for best ways to approach them are provided. Examples and case studies from both sides of the Atlantic Ocean illustrate that despite similarities in the types of issues developers typically address at each site, the way of approaching the issues and the priorities given vary.

Keywords: Best practices, opinion, public acceptability and wave energy.

1. Introduction

Provided that wave energy (WE) has a large potential for producing electricity [1] and looking at the proposed WE deployment scenarios [2], it can be assumed that WE may become a significant contributor to the global renewable energy (RE) mix. At this initial stage of development of the WE sector, it is very important not to make the same mistakes that other RE sectors have made in some countries and to gain public acceptability from the early stages. This key period will only occur once, and if it is not dealt with efficiently and proactively, it may take several years to regain pubic trust in the sector. Since when obtaining a permit for a particular site, WE developers can be legally (depending on the nature of the project – demonstration or commercial) or morally, or both, obliged to discuss their development plans and intentions with local communities, the way they approach these communities will leave a long-lasting impression about the sector as a whole. Thus, developers act as good-will ambassadors not only for their own projects, but also for the WE sector. This article focuses on the issues developers need to address when discussing WE projects with local communities to achieve more efficiently public acceptability.

Public acceptability is not a new phenomenon - it has often been encountered with the adoption of new technologies, the placing of architectural monuments and works of art in public locations. Most of it has to do not so much with the form or function of the new development but with its symbolic meaning. Since the majority of wave energy converters (WECs) are in the experimental rather than commercial stage, citizens around the world do not have enough information to form an opinion about their impact yet [3-5]. Coastal communities, who will likely be the most impacted, either positively or negatively by this new technology, wonder how much change will be brought by it regarding conflicts of ocean use, community well-being (including employment, income, electricity rates, property values, and tourism flow), noise, visual, aesthetic, and environmental impact (EI).

Experience from different REs makes it possible for WE developers to learn about concerns that local communities typically have had with RE projects: how they perceived the new technology, the developers' approach to the community, or commitment to engagement practices. Although there is no general and simple formula that guarantees obtaining full acceptability of WE projects, several approaches have turned out to be successful. This paper focuses on the developers' experiences from recent WE projects on both sides of the Atlantic Ocean. To illustrate the major points, three case studies are presented: an European pilot project in Mutriku, Spain, and two US commercial projects from Oregon – the Douglas County Wave and Tidal Energy Project and the Tillamook County - Columbia Energy Partners Project.

2. Public Acceptability of WE Projects

At this initial stage of WE development, the general opinion toward WE is mainly positive. Interviews with local community members and results from national surveys show that respondents are mainly supportive of WE development. For example, a survey carried out in 25 EU member-states reveals that 60% of respondents favor ocean energy use, while 24% have a neutral attitude [8]. Another survey, conducted in Portugal, shows that 71% of respondents support WE development, noting that investment should be further increased [3]. Survey results in the US from Oregon and Washington and British Columbia, Canada reveal that the majority of respondents also have positive attitudes toward WE development [9]. Therefore, since opinion toward WE is mainly positive, what issues may lead the public to oppose WE projects?

Sarmento et al. [10] assert that public acceptability of WE projects can be found in a mixture of societal concerns and competing uses of the area proposed for development. Thus, there are different factors within each project that lead the public to either support or oppose a project. The general consequences of each factor can be identified and addressed within the framework of an environmental impact assessment (EIA) process [11].

2.1 Best Practices

The importance of achieving public acceptability necessitates a discussion about best practices. What are the issues that need to be addressed so that best practices can be achieved?

For the purposes of this paper, *best practices in gaining public acceptability for developing WE projects* refers to achieving the positive endorsement of WE projects among stakeholders without alienating key members of the local to the project communities. Stakeholders are defined as individuals or organizations with a stake in something (in this case –the ocean) [6].In other words, best practices do not center on the speed for going through regulatory hurdles, but on creating a positive environment for effective communication.

Identifying all of the best practices developers have used in other RE projects is a difficult, even impossible task; and besides, those identified may even be subject to debate, particularly when applied to the WE sector [7]. Case studies of pilot and commercial WE projects not only illustrate the applicability of the best practices concept, but also explain its rationale. The case studies are selected based on three criteria: a) They examine distinct issues and look at best practices from different angles; b) They are geographically diverse, and c) They are recent.

3. Issues to be Addressed

The common uses of the deployment area have to be analyzed for each particular project. WE developers typically have to justify and explain the reasons behind project development since often they are seen as intruders into an ocean area with already predefined uses. Despite that, developers should utilize different methods for informing, and moreover, involving local communities in the project development process [11]. They should look at community engagement as a way of establishing long-term relationships and keep up the communication with local communities.

Interviews with developers, participation in community presentations about WE projects, and the literature review show that the issues developers should address with local communities can be summarized in four main areas: conflict of use of the ocean space, environmental concerns, NIMBY (Not In My Back Yard), and community well-being concerns. Table 1 shows a summary of these issues. The four major issues are organized according to type rather than importance. No-go areas, such as military zones, safety zones, and navigation routes are not included inTable 1. It is expected that they would be classified and addressed by the Marine Spatial Planning (MSP) process before commercial WE development starts. In this regard it should be noted that while European countries are working on creating MSP and some already have it completed [12], the US is now in the process of creating spatial maps that can be used for siting and planning by the WE sector [13].

Some of the questions raised by a particular issue belong to more than one issue area; for example, questions about property values could fall either under NIMBY because of the visual impact, or under community well-being, when property values are perceived in economic terms. Because of the complexity of the issues, this may actually be the case with most of the questions presented in Table 1.

3.1 Conflicts of use in the project area

The most common uses of the WECs' deployment area are typically commercial fishing, recreational fishing, and surfing. The main concerns fishermen have are how much space will be taken away from existing fishing grounds and what will that mean in economic and employment terms.

Despite the fact that fishing quotas are declining and fish stocks are being depleted, fishing continues to be an integral economic sector for many rural communities on both sides of the Atlantic Ocean. US Pacific commercial fishing industry data, for example, shows that 2008 commercial sales amounted to about 15B USD for the states of California, Oregon, and Washington, and that recreational fishing contributed 250M USD just in Oregon [14]. Surfing has also been identified as an important economic activity [15, 16].

Because of the substantial economic contribution of the fishing and surfing sectors, developers need to be prepared to answer questions about the WECs' effects on these sectors. They should be able to explain the way WE technologies work and stress the fact that most of them are still in the experimental stage, i.e., studies show that WE is about 20 years behind wind in technological development [17].

Issue:	Description:	Questions developers should be prepared to answer:
Conflicts of use in the project area	• Commercial fishing • Recreational fishing & boating • Surfing	- Why are you interested in this particular site? - What is the footprint of the proposed project or the exclusion area of the WECs? - Is the project going to displace existing (fishing) jobs? - What would the effect be on the surfing waves?
Environmental Impact (EI) Concerns	• Bottom species habitat • Marine mammals & other species, including birds • Entanglement • Reproduction • Migration	-Can you prove that your project is benign to the environment? -Have you done any EI analysis? Have you thought of mitigation measures? Can you guarantee the survivability of your WECs? - Have any of your devices experienced accidents, e.g., sinking, hydraulic leaks, etc. during testing or at another location? What are the lessons learned? - Are you going to remove your devices after the deployment period?
NIMBY issues	• Visual impact • Noise impact • Aesthetic impact	- How does wave energy work? What types of devices are out there? - What type of devices will be deployed and why? - Shall we be able to see or hear the devices during operation? - How big are they – installed capacity and size-wise? - Are they aesthetically pleasing? - How far from the shore will they be located?
Community well-being concerns	• Employment • Income • Benefits /costs • Tourism	- How will the community be impacted? - Is the cost of electricity going to go up? - Is your commercial project going to be economically viable? - Will tourism flow increase or decrease?

Table 1: Issues developers need to address

3.2 Environmental Impact (EI) concerns

Local communities are concerned about the EI of WECs on the marine habitat and species. It is necessary to develop a generic understanding of the interaction betweena few experimental WECs and arrays of WECs, on one hand, and the marine environment, biological communities, and individual species, on the other hand [30]. Although the general impression is that fishermen are not welcoming WE because WECs will displace them, this needs further review. Fishermen also worry about the EI of WECs, because, in the words of a wave and tidal developer, they are like farmers, who want to preserve the habitat and the species they depend on. Therefore, it is really important for developers to address EI concerns. In this respect, developers might find it useful to examine the available research, which focuses specifically on the EI of WECs [31-34]. Developers have to keep informed of scientific findings, which although sometimes inconclusive provide a framework for evaluating EI and could serve as the basis for further discussions.

3.3 NIMBY issues

The NIMBY syndrome describes the theoretical support for RE development but opposition to specific local projects because of the perceived consequences regarding noise and visual impact [18, 19]. Many consider NIMBY to be too simplistic to explain all the variables determining the general and local public acceptance of a specific project [18, 20-25]. Moreover, some researchers have found evidence from the wind industry for exactly the opposite effect - local people becoming more favorable toward wind farms after their construction and the degree of acceptance increasing with proximity to them [26, 27]. How strong will NIMBY concerns be in relation to WE development, remains to be seen.

Noise impact, like visual and aesthetic impacts, depends on the location of the WECs with respect to the shore and distance to populated areas. If WECs are placed near-shore the impact is likely more critical than if placed offshore. Noise from WECs is not expected to cause a negative impact[28]. However, no general assumptions can be made as different factors take place in the discussion.

In any case, to mitigate and avoid possible conflicts due to noise, visual or aesthetic concerns, the offshore wind energy sector, for example, has proposed open to the public planning sessions, where the configuration and the number of the devices in a farm are discussed and analyzed prior to any final decision [29]. This has proved to be a good practice that WE developers might want to adopt.

3.4 Community well-being concerns

Community well-being is a complex term that refers to the “degree to which the needs and wants of a population are being met” [35]. Since coastal communities are economically dependent on fishing and tourism, they are especially vulnerable while sharing a narrow resource base with other sectors, like WE. That is why coastal communities are mostly concerned with access to natural resources, income, and employment.

An under-informed public may generally be unaware of the benefits of nascent RE projects [36]. However, WE deployment will eventually provide relevant benefits such as added value to the local area, especially regarding accumulation of expertise [28], along with improved security of energy supply, an increase of RE sources in the electricity mix, and a

decrease of harmful and undesired emissions. Projections for job creation are also favorable - 19 jobs/MW of installed capacity [37].

Commonly, there is a concern about a rise in electricity rates due to the high costs of WECs. Here, it is essential to remark that investment costs are measured in cost per kW, while the cost of electricity production is measured in cost per kWh. The former costs have been assessed for different WECs to be at about 2 MEUR/MW in 2020 [38]. The latter have been estimated at 10-25 cEUR/kWh for the EU countries[39] and 20-30 cUSD/kWh for the US, going down to 4.5 cUSD/kWh with technology improvements [40, 41].

Conclusions about the impact of WECs on tourism before any devices are operational should not be made. While Danish and UK offshore wind experiences show either no effect or an increase in tourism flow, US research on tourists' perceptions and intentions of visiting certain beaches with visible wind turbines indicates negative attitudes and avoidance [42]. Lilley et al. conclude, "we would not advise developers of offshore wind to claim that there will be no negative impact on tourism" [42]. Only experience will show what the impact of WECs on tourism and property values will be and if there will be regional variations.

4. Case studies

4.1 Mutriku pilot plant, Spain

The WE plant (Fig.1) consists of 16 Voith Hydro Wavegen turbines rated at 18.5 kW each, based on the Oscillating Water Column (OWC) principle.The annual WE potential of Mutriku is estimated at 7.14 kW/m [43]. The Basque Government (BG), the Basque Energy Agency (EVE), along with the European Commission, finance the project.

Mutriku is a coastal fishing village near Bilbao in Northern Spain. For many years the construction of a new breakwater outside the existing harbor has been discussed as a protection mechanism - to tame the swell and increase safety access. Once the City Council agreed on building the breakwater, the BG proposed to integrate a WE plant in it. Some of the advantages of combining the two are shared costs for the civil works and minimized visual impact of the WE plant.

Engagement strategies: Public engagement practices were few. At the beginning, the BG and EVE presented the WE project to the City Council and the public. They provided mainly general technical information and an overview of the benefits the plant would bring to the community. These events did not seek the Council's or the public's input; nevertheless, the majority of the Council members supported the plant, partly because its construction came along with the breakwater.

The major engagement event took place after a severe storm produced a loud swooshing noise as the wind was passing through the moulds of the chambers in construction. The noise was so loud that it could be heard in two villages close to Mutriku, approximately 3 to 10 km away. In order to explain the origin of the noise and mitigate the public fear about further noise, EVE organized an exhibition covering Mutriku's construction works and timeline.

Public opinion: Some locals formed opposition groups to protest the construction of the breakwater. Then, since both the WE plant and the new harbor were a joint project, the initial opposing groups turned also against the WE plant. One of the main voices of those groups came from the Green Party (Berdeak), which now has environmental competences in the City Council.

Figure 1: Mutriku plant in construction. The picture shows columns of water flowing through the holes of the power take-off system.

Fishermen, on the other hand, supported the project from the beginning because they saw it as an improvement to their harbor.

Since the opposition groups were more active than the supportive groups, however, the impression was created that the WE plant was an imposed project, not welcomed by the local public. But when the new BG announced plans to reduce the project budget (due to the financial crisis) and stop the construction works, the local support got active too. People raised complaints, as they did not want the project only partially finished.

EIA: After the screening phase the competent authority concluded that the WE project was not subject of a full EIA. The breakwater (without the WE plant) had its full EIA and the WE plant was a demonstration project. However, the opposition claimed there should be a new EIA for both the breakwater and the WE plant. They took the issue to court against the authority giving the environmental approval.

The plant was expected to be operational by June 2009, but due to some damage in the chambers of the plant during the storms, it will most likely start functioning in late 2010. This delay, however, is not related to the EIA issue, which is still waiting for court approval.

According to a member of the Mutriku City Council, the Council had neither the time nor the resources to deal with public acceptance of the project. He believes public involvement should be a combined effort by the developer and the local authority, although above all, it should be the developer's responsibility. The recommendation is to involve the public from as early as the planning phase. Besides, he also thinks that although the new access to the harbor raised significant opposition at first, people got used to it and welcomed it after its completion. Last but not least, the new WE plant has provided the village with added tourist value,

which unfortunately, the local public is generally not aware of.

4.2 Douglas County Wave and Tidal Energy Project (WTEP) in Oregon, U.S.A.

Douglas County, Oregon has proposed a commercial WTEP near the town of Winchester Bay. The project consists of an OWC device with a total installed capacity of 3 MW[49]. The technology supplier, as in the Mutriku project, is Wavegen.

Location: The OWC device will be constructed on or adjacent to the existing Umpqua River South Jetty, located about 3 km off the Oregon Coast highway, close to a National park and a marina - both attracting tourists, surfers, beach goers, and fishermen (Fig. 2).

Figure 2. Douglas County South Jetty - proposed site for the Wave and Tidal Energy Project (Image obtained from Google Earth)

The project area is sparsely populated - the nearest city is Winchester Bay with 488 inhabitants and the closest big city is Reedsport with 4,378 inhabitants [50]. The area is transitioning from a marine commerce, logging, and commercial fishing to tourism [51]. A survey of visitors to the South Jetty shows that surfers visit the Jetty twice more often than fishermen and three times more often than beach-goers, and that although surfers spend the least amount of money per average visit, they still make a large economic contribution to the area [16].

Engagement strategies: When Douglas County filed for a Preliminary Permit Application to develop the WTEP, it started providing information to regulatory agencies and key stakeholders to better define the issues associated with the proposed project. As part of the first stage consultation, the County and the Federal Energy Regulatory Commission (FERC) held public meetings to identify any information gaps or research areas that needed to be resolved prior to submission of the license application. Some of the identified issues were the WE impacts on: fish and wildlife, seabed and dune habitats, construction and maintenance, electromagnetic fields, potential noise and aesthetic resources, surfing and attenuation of WE, national security and navigational safety, and decommissioning [52, 53].

Besides the FERC required meetings, the County and Wavegen held additional meetings with the general public and with groups with specific interests, one of which was the large surfing community in the area.

Public Opinion: The coastal population of Douglas County has been exposed to the WE concept since 2006, when seven permit applications were filed with FERC for WE development in Oregon. Two of them were in the County waters, the WTEP and the Ocean Power Technology (OPT) Reedsport Wave Park [52]. Since then, local fishing and surfing groups have stated their will to participate in all WE-related discussions. They have been part of the so-called "Settlement Agreement," initiated by the Governor of Oregon to give equal representation to all interests in discussions on coastal issues.

Because of the particular surfing environment near the proposed WTEP, the surfing community has been very active in all discussions, which can be described as "open and up-front" [55]. The Surfrider Foundation has remained engaged throughout the process to ensure that possible adverse effects are addressed appropriately. For example, it has presented some physiographic data and economic analysis of the impact of the surf in the area, and more specifically, the particular surfing spot. Although the surfing community did not welcome the project at first, surfers have been open and supportive of WE, trying to discuss their concerns with the developer. "In general, because the technology is so new, people don't know what to expect from it, so the best thing has been exploring the issues in an open environment, so that they are identified early, which helps finding alternative solutions as well," said the person in charge of permitting for WTEP [55].

After examining the bathymetry, the device design, and the WE potential, the County and Wavegen are conducting feasibility and technology studies. If the cost and engineering continue to support the project, the County will carry additional studies, necessary for a FERC license, which it plans to apply for in 3 years.

4.3 Columbia Energy Partners (CEP) and Tillamook County, Oregon, U.S.A.

Columbia Energy Partners (CEP) is a private investor company fromWashington State. The company's main goal is rather than developing one particular device, to diversify its portfolio with various RE options [44]. It has already invested in one solar and several wind energy projects. In 2009, CEP decided to investigate the possibility of deploying WECs. Tillamook County in Oregon had already obtained a preliminary permit to carry feasibility studies for harnessing WE in its territorial waters and requested proposals from WE developers. CEP responded and signed an Agreement for Cooperation with theTillamook Intergovernmental Development Entity (TIDE) [45].

Location: TIDE has a FERC preliminary permit for developing six sites, each 1.6 km by 4.8 km along the boundary of the Territorial Sea. CEP defined two of the six sites - off Garibaldi and Netarts – to be of particular interest for the company.

Engagement strategies: CEP approached TIDE to see if there would be local community support for WE development first, and then organize town-hall

meetings. CEP had five in-person meetings with members of TIDE and the Fishermen's Advisory Committee for Tillamook (FACT), and two meetings only with FACT members. FACT is a non-governmental body whose purpose is to provide a strong unified voice from the fishing community to TIDE, researchers, and developers by giving input and advice on WE-related issues [45].

Public Opinion: Objections about the two CEP-selected sites came mostly from the fishing community. During the meetings CEP explained that installation was at least five years away. Despite that, fishermen were worried. They appreciated the early discussions with the developer but were concerned about potential conflicts. For example, fishermen worried that at the Garibaldi site, the devices would lie in the middle of important Chinook fisheries, while at Netarts, in prime crabbing grounds, "They can't just come in here and grab up fishing grounds without offering anything in return," the co-chair of FACT said at one of the meetings [46]. In addition, commercial fishermen worried that WE parks would not only cost fishermen money in lost grounds, but would also block central transit routes and crowd North Coast waters with displaced fishermen.

Fishermen had aesthetic concerns as well - they did not particularly like the proposed Pelamis devices because of their size and risk of hydraulic fluid leaks. Fishermen also raised concerns that the undersea cables would produce heat, thus raising bottom sea temperatures, which would diminish fish stocks. Despite the fact that CEP responded to a request for proposals for two of the already six permitted sites, members of FACT objected to the chosen locations and after six-month deliberations proposed others, far from the originally permitted ones, closer to the shore, in the viewshed of an affluent residential community where placing any WECs would have met with strong NIMBY opposition, and where the WE potential would have been significantly less.

When CEP terminated its agreement with TIDE, four reasons were mentioned: the location was not suitable for WE project development, the site was in a high public visibility area, difficulty connecting to the grid, and financial problems. The main reason, however,was the inability to reach a common ground with the local fishing groups. Although members of the surfing community and the Surfrider Foundation were not particularly in favor of WE development in the proposed area, their representatives did not attend any of the CEP meetings and did not raise any objections [48]. Strong fishing opposition was the primary reason CEP withdrew its participation.

5. Discussion

The case studies presented here illustrate the importance of the four issue areas for approaching WE development. Not all issues are of equal importance to the local project communities – the Mutriku project community raises EI and NIMBY concerns,while CEP and WTEP center more around conflict of use and community well-being concerns. Ultimately, in any location, developers need to address all four types of issues; however, the timing of addressing the issues depends on the priorities of each community. One issue (e.g., surfing) might need to be stressed before another (e.g., fishing). Initially, attention should be paid therefore, to groups with specific issues. For example, Douglas County held public meetings not only with the general public, but also with special interest groups like surfing. As a result, members of the surfing community had the opportunity to openly discuss issues important to them, raise their concerns in a non-threatening environment, and eventually contribute to the project development. Moreover, Mutriku case study shows that some important issues may emerge during the project development, and these should be addressed in time.

The way developers approach the four types of issues varies for two main reasons: the regulatory framework in the country where the WE project is deployed and the characteristics of the local population. Regarding the former, the Mutriku case study shows that the project was decided at the county level and the City Council went along with the decision. The City Council was not given the responsibility to either present the project or engage in discussions about the project with the local population. However, members of the City Council see that as a deficiency and make the case that public acceptance campaigns should be mainly the responsibility of the developer.

As far as the second reason is concerned – knowing the characteristics of the local population – the CEP case study is a good example. The company decided to investigate the local “climate,” despite studies published by the Electrical Research Power Institute (EPRI) that defined one of the locations as a “sweet spot” for WE development in Oregon, based on 10 site-selection criteria, among which “minimal conflict with competing uses of sea space (shipping lanes, fishing grounds, and protected marine areas) and likelihood of public acceptance” [17]. What EPRI did not account for when writing the report, was the strong grass roots organization of local communities of interest and place, like TIDE and FACT. The idea about their creation is expressed in these words, "We can either wait until someone runs roughshod over us, or we can make sure we have a say in what happens"[46]. Whether the CEP experience is an expression of “having a say” or rather an example of strong WE opposition, remains to be seen.

For achieving best practices in addressing the issues described here, it is recommended that developers become aware of the experiences their colleagues have had with similar projects. Despite the fact that there are no universal practices, it is logical to expect that neighboring to the proposed project communities will have similar concerns. Yet, this is not a 100%-prove situation either. Examining the geodemographic characteristics of the local population, their values, and the population dynamics (e.g., the presence of trusted leaders or organizations), and the goals of the community (some may be happy with increased

tourism flow while others may not) – would give an indication of the issues that could serve as motivating factors for either support or opposition to the proposed WE project. Once the issues are identified, developers should build engagement programs around the three Cs: connections (within and between people), communication (direct and indirect) and change (support transition through adaptation) [58]. Such engagement strategies have already been successfully applied to many natural resource use and RE projects [59].

6. Conclusion

It is important to discuss best practices in relation to public acceptability of WE because the WE sector has only recently started to be viewed as a RE player and has gotten the attention of both policy makers and investors. While the pressure is on WE developers to move from prototype testing to commercialization, and deploy WECs, local communities feel threatened, under-informed, and scared about what is in store for them, their local environment and their future. As the experience from many RE projects and the case studies presented here show public acceptability needs to be recognized as a critical challenge for the successful implementation of the WE sector. To aide WE development, it is important not only to convince key stakeholders in politics and business, but also to win the hearts and minds of the general public. A strong foundation for that will likely be based on openly addressing the issues that are important to the local communities and involving them in project development from the beginning.

Acknowledgements

This research was made possible in part because of a scholarship provided by the International Collaboration Incentive Scheme (ICIS), awarded by the International Network on Offshore Renewable Energy (INORE). The 1st author would like to thank the Oregon Sea Grant for awarding her the inaugural Malouf scholarship. The 2nd author acknowledges the funding by the EC–Marie Curie program, through the project FP7–PEOPLE–ITN 215414 (Wavetrain2). The authors would also like to express their gratitude to all participants in interviews and conversations for their sincerity and openness in sharing their perspectives and experiences. Special thanks go to: Fred Gardner, David Langston, Félix Azpiazo, Yago Torre-Enciso, Iñigo Agirre, Jon Norling, and Ron Yockim.

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