Options for Cooperation between Commercial Fishing and Offshore Wind Energy Industries

A Review of Relevant Tools and Best Practices

Prepared by:

Stephanie Moura

Andy Lipsky

Molly Morse

Table of Contents

I.	Introduction	1
II.	Background	1
III.	Scope, Methods and Framework	2
	Scope.....	2
	Methods.....	3
	Problem Solving Framework	5
IV.	Observations and Discussion	7
	Parties' Evolving Roles	7
	Best Practices Matrix	9
V.	Conclusion.....	16
VI.	Appendices.....	17
	Appendix 1: Acknowledgements	17
	Appendix 2: Case Studies	18
	Appendix 3: Expanded Best Practices Matrix	31
	Appendix 4: Resources on Offshore Wind Farm Compatibility with Fisheries of Various Gear Types.....	41

Acknowledgements

SeaPlan would like to thank the numerous agency and industry representatives and other colleagues whose expertise and perspectives—through informal interviews, consultation and/or document review—contributed significantly to this work. (See [Appendix 1](#) for more details.)

This report was made possible by funding from the [Island Foundation](#).

About SeaPlan

SeaPlan is an independent nonprofit ocean science and policy group offering pragmatic strategy, applied science and effective stakeholder engagement to address pressing ocean management issues. Operating as a neutral broker of ocean planning services and tools since 2006, SeaPlan collaborates with governmental, non-governmental and private sector clients and partners to support state and regional-scale ocean planning efforts.

One focus of SeaPlan's practice is marine and coastal human use characterization to better understand the spatial and socioeconomic components of ocean uses and the compatibilities and potential conflicts among them. SeaPlan has previous and ongoing experience with offshore wind energy and commercial and recreational fisheries use compatibility, including assisting the U.S. Bureau of Ocean Energy Management (BOEM) in its 2013 report on offshore wind-fisheries mitigation best practices and, since 2012, managing collaborative initiatives between developer Deepwater Wind and local fishing interests at the pilot Block Island Wind Farm in Rhode Island.

I. Introduction

Offshore wind energy is a source of clean energy used increasingly in many parts of the world, and is an emerging sector for the U.S., particularly in southern New England. Off the coast of Rhode Island, the Block Island Wind Farm—the nation’s first demonstration offshore wind project—began construction in July 2015. Now, as other offshore wind developments in the region proceed, government authorities and ocean stakeholders are increasingly interested in ensuring the industry’s compatibility with existing ocean uses. Among these, commercial fishing is a well-established and valuable industry and way of life in New England. This coincidence of significant renewable energy resources with a premier fishing hub highlights the importance of successful coexistence between the offshore wind and fishing industries.

This paper is a compilation of potential and current best practices for addressing interactions and supporting successful cooperation between commercial fishing and offshore wind interests. It is intended, generally, to contribute to the growing knowledge base on this important topic and, specifically, to serve as a resource for discussions among industry and government parties in New England. Information for the paper was gathered from the United Kingdom—where the historically strong fishing industry and the offshore wind industry have a long track record of interactions—the Block Island Wind Farm, and other locations with relevant experience. The resulting compendium of best practices identifies a set of commonly-held concerns and offers corresponding tools and practices for addressing them.

II. Background

Spurred by the need to increase energy security, combat climate change with renewable energy sources, and reap benefits for local and regional economies, federal agencies and states in the U.S. are actively pursuing offshore wind development. Estimates of the untapped potential of offshore wind in the U.S. indicate more than 1,000 Gigawatts (GW) available from Virginia to Maine.¹ Though the nation has decades of experience with oil and gas development on the Outer Continental Shelf (OCS), it has yet to tap its offshore wind resources. By contrast, the United Kingdom (U.K.) has already installed a combined 1,450 turbines that generate about 4.5 GW to the electrical grid,² and has more projects consented or in planning.

Along the U.S. Atlantic coast offshore wind farm development is underway. The Block Island Wind Farm (BIWF) pilot project in Rhode Island (RI) began construction of the first in-water turbines in August 2015. On a commercial scale, between 2013 and 2015, the federal Bureau of Ocean Energy Management (BOEM), together with Massachusetts (MA) and RI, awarded leases to three developers in two Wind Energy Areas (WEAs) in federal waters for a combined total of over 520,000 acres.³ Development is also moving forward in the Mid-Atlantic, as energy generation company Dominion and the Virginia Offshore

¹ “Large-Scale Offshore Wind Power in the United States: Assessment of Opportunities and Barriers,” *National Renewable Energy Laboratory (NREL)*, (2010), <http://www.nrel.gov/wind/pdfs/40745.pdf>.

² “Offshore Wind Operational Report 2015” (London: The Crown Estate, 2015): 19.

³ “State Activities,” *The Bureau of Ocean Energy Management*, accessed November 6, 2015, <http://www.boem.gov/Renewable-Energy-State-Activities/>.

Wind Technology Advancement Project (VOWTAP) conduct initial engineering, design, and permitting for the WEA off the coast of Virginia.⁴

While offshore energy developers are an emerging user group in U.S. waters, the long-established commercial fishing industry already occupies these spaces and represents considerable social and economic value as a central component of coastal communities' maritime heritage. Most recently, overall national commercial landings were valued at \$5.4 billion for 2014.⁵ In New England, where fishing activities include scallop dredges, groundfish trawls and lobster traps, the value of landings was \$1.2 billion in 2014.⁶ By definition, fishing and offshore wind rely on use of, and access to, ocean and coastal space. In addition to possibly competing for space and access, their respective operations may present other actual and perceived incompatibilities as well as opportunities for mutual benefit. For example, wind farm construction, including turbine installation and cable laying, may negatively impact fish habitat, present navigational safety hazards for commercial fishing vessels, and pose risks of gear fouling on submarine transmission cables. On the other hand, the industries may also find ways to collaborate, such as using wind farm infrastructure to enhance the profitability of local fisheries or aquaculture operations, and cooperating to ensure mutually beneficial improvements to port facilities. Thoroughly examining perceptions of incompatibilities can help the industries better understand respective operational requirements, thereby focusing attention on the most tangible issues and developing options for mutual benefit.

As joint state and federal offshore wind energy initiatives in the U.S. move beyond preliminary stages, it is important and timely to ensure that the fishing industry, offshore wind industry, government agencies, and port communities establish strategies and apply best practices to effectively address the range of potential at-sea and shore-side use compatibility challenges with a goal to support coexistence. Particularly cognizant of the evolving wind energy development processes off the MA/RI coast, yet also useful more broadly, this paper seeks to explore compatibility issues and aims to identify a range of options, tools and best practices available for parties' consideration.

III. Scope, Methods and Framework

Scope

Drawing on SeaPlan's experience, this paper was developed to identify best practices for addressing potential use conflicts and optimizing opportunities for mutual benefit, and to present them in a useful and relevant format to support dialogue among interested parties involved in wind energy development off the coast of New Bedford, MA. Based on the demonstrated need of local and state government and industry parties in MA and RI, this paper focuses on three particular sectors: the commercial fishing industry, offshore wind developers and government. Though the ports sector is also a central party in this landscape, particularly regarding shore-side interactions, the scope of this paper does not include

⁴ "Virginia Offshore Wind Technology Advancement Project," *Dominion*, last modified 2015, <https://www.dom.com/corporate/what-we-do/electricity/generation/wind/virginia-offshore-wind-technology-advancement-project>.

⁵ National Marine Fisheries Service, "Fisheries of the United States, 2014," U.S. Department of Commerce, NOAA Current Fishery Statistics No.2014 (2015).

⁶ Ibid.

in-depth analysis of ports-related issues. With the intent of providing useful information for parties particularly in the southern New England context, the paper draws upon relevant experiences nationally, in particular from the BIWF project, and a large volume of information from past experiences in the U.K., a nation whose first offshore wind farm was completed in the year 2000, and that now has a total of 1,450 turbines and 5,048MW of offshore energy capacity, and many more in the planning phase.⁷ The U.K. also has a historically strong fishing industry, and subsequently a significant record of interactions between the two industries.⁸

The public and private parties involved in this issue represent a broad range of objectives and perspectives. States like MA and RI are working to meet their renewable energy policy targets, while simultaneously minimizing use conflicts and balancing marine conservation and development under their respective marine spatial plans.^{9,10} Local officials and community leaders have an interest in addressing potential socioeconomic conflicts. The city of New Bedford, home to the highest grossing fishing port in the U.S. (valued at \$329 million for annual fishery landings)¹¹ and also the location of a marine commerce terminal designed to support commercial-scale offshore wind farm construction, has a keen interest in the beneficial coexistence of its time-honored commercial fishing industry with the emerging wind sector. Commercial fishing sectors want to operate safely and profitably with continued access to fishing grounds and suitable port facilities. Wind developers, also interested in safety and profitability, must anticipate and manage a variety of risks throughout the leasing, construction, and operation and maintenance phases.

With wind energy development progressing in the two southern New England WEAs, local parties have an interest in proactively addressing potential incompatibilities toward successful coexistence of the established commercial fishing and the emerging offshore wind industries. In November 2015, the MA Office of Coastal Zone Management facilitated a convening of the MA Fisheries Working Group on Offshore Renewable Energy (FWG), a consultative body established early in the wind energy planning phase, as an opportunity to initiate discussions among fishing interests, the wind developers recently awarded leases, and New Bedford leaders. SeaPlan presented preliminary observations and findings from this project to help facilitate continued constructive dialogue among participants as offshore wind development progresses.

Methods

To gather information for this project, SeaPlan drew from experience with the BIWF, reviewed relevant literature and conducted informal interviews with knowledgeable industry and government parties. The latter two methods are briefly described below. Subsequent analysis of the information led us to an overarching framework for the paper, described in the next section.

⁷ "Offshore Wind," *RenewableUK*, accessed November 23, 2015, <http://www.renewableuk.com/en/renewable-energy/wind-energy/offshore-wind/>.

⁸ This project focuses specifically on direct interactions between offshore wind and commercially-targeted species; it does not address broader ecosystem impacts, such as offshore wind interactions with marine mammals.

⁹ *Massachusetts Ocean Management Plan*, Massachusetts Executive Office of Energy and Environmental Affairs (2015).

¹⁰ *Rhode Island Ocean Special Area Management Plan*, Rhode Island Coastal Resources Management Council (2010).

¹¹ National Marine Fisheries Service, "Fisheries of the United States, 2014," U.S. Department of Commerce, NOAA Current Fishery Statistics No.2014 (2015).

Literature Review

Preliminary desktop research identified numerous government and industry association reports and guidance documents, academic journal articles, and materials from the gray literature. Examples of two particularly relevant reports are the 2014 *Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Liaison* by the Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW) in the U.K.,¹² and the 2013 *Development of Mitigation Measures to Address Potential Use Conflicts between Commercial Wind Energy Lessees/Grantees and Commercial Fishers on the Atlantic Outer Continental Shelf* by BOEM.¹³ We also consulted reports on fisheries mitigation options¹⁴ and offshore renewable energy¹⁵ published by the RI Ocean Special Area Management Plan (Ocean SAMP), and a selection of other key sources.^{16,17}

Case Examples and Informal Interviews

To ground the literature research in concrete examples, we identified initiatives where parties have previously or are currently addressing interactions between similar kinds of offshore infrastructure (e.g., wind energy and transmission cables, oil and gas, and telecommunications cables) and commercial fisheries. Focusing on North America and Europe, examples ranged from organizations formed specifically to address use conflicts (e.g., Oregon Fishermen's Cable Committee, U.S.) to several extant and planned offshore wind developments (e.g., Thanet Offshore Wind Farm, U.K.). We reached out to over 40 parties involved in these initiatives—from the offshore wind, fishing, governmental and port sectors—and conducted over a dozen informal interviews to learn more about their perspectives. Interview participants from the following organizations provided insights about successes and key challenges in deploying tools and best practices to manage fisheries and offshore wind interactions. The essential elements of each of these examples are summarized in case study descriptions in [Appendix 2](#).

- The Crown Estate, U.K.
- DONG Energy, U.K.
- Fishing Liaison With Offshore Wind and Wet Renewables Group (FLOWW), U.K.
- Holderness Fishing Industry Group, U.K.
- Mainstream Renewable Power, U.K.
- National Federation of Fishermen's Organizations, U.K.
- Oregon Fishermen's Cable Committee, U.S.
- Port Hill Marine Ltd., U.K.
- Port of Esbjerg, D.K.

¹² [*FLOWW Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Liaison*](#), Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW) (2014).

¹³ [*Development of Mitigation Measures to Address Potential Use Conflicts between Commercial Wind Energy Lessees/Grantees and Commercial Fishers on the Atlantic Outer Continental Shelf: Report on Best Management Practices and Mitigation Measures*](#), Bureau of Ocean Energy Management (BOEM), U.S. Department of the Interior (2013).

¹⁴ [*Fisheries Mitigation Options – A Review*](#), Rhode Island Coastal Resources Management Council, Rhode Island Ocean Special Area Management (Ocean SAMP) (2012).

¹⁵ [*Chapter 8: Renewable Energy and Other Offshore Development*](#), Rhode Island Coastal Resources Management Council, Rhode Island Ocean Special Area Management Plan (Ocean SAMP) (2010).

¹⁶ R.E. Blythe-Skyrme, [*Options and opportunities for marine fisheries mitigation associated with windfarms*](#), Collaborative Offshore Wind Research into the Environment (COWRIE) (2010).

¹⁷ [*BWEA Recommendations for Fisheries Liaison*](#), The British Wind Energy Association (BWEA) (2004).

- RedPenguin Ltd., U.K.
- Revill Nation Ltd., U.K.
- Scottish Fishermen's Federation, U.K.
- Subsea Cables UK, U.K.
- Thanet Fishermen's Association, U.K.
- Vattenfall Wind Power, U.K.
- West of Morecambe Fisheries Ltd., U.K.

Problem Solving Framework

Drawing from this research and SeaPlan's experience, we adopted a problem solving lens focused on two simple questions:

What are the parties' main concerns?

What are the range of options available to address these concerns?

Each offshore wind development sits within its own political, social and economic context with regulatory authorities, local communities, ports, wind developers and affected commercial fishing groups each with particular interests and histories. Yet, despite this uniqueness, certain consistencies are evident when looking across numerous examples of interactions between offshore wind and commercial fishing. By comparing and distilling information from our research and interviews, we developed a simple problem solving framework. It begins with assumptions about common aspirational goals, posits that all potential interactions can be grouped into five general types of concerns, and identifies three main strategies and eight primary kinds of tools to address the concerns. The framework is illustrated graphically in [Figure 1](#) and described further below.

Figure 1. Problem solving framework for interactions between commercial fishing and offshore wind energy industries

At the framework's broadest level, we asked the question: *What are the parties ultimately trying to achieve?* By definition, each party has its own particular interests—some of which are divergent. Nonetheless, it is generally understood that certain aspirational socioeconomic and environmental **goals** and **interests** are broadly embraced and can provide a common reference point for the framework.

Next, we asked: *What are the kinds of problems that may interfere with realizing these goals?* We posit there are five general kinds of **concerns** the parties may face: **spatial conflict and access, human safety risks, property damage risks, diminished economic opportunity**, and **ecological resource impacts**. These concerns arise out of potential and perceived use incompatibilities among the parties, both at-sea and shore-side. They may be anticipated during the planning phase and may also arise at any phase of wind farm development.

To address these concerns, we suggest there are three general **strategies**. First, parties may participate in **mutually beneficial cooperation** in which they jointly seek opportunities through which each party gains. Second, parties may also **avoid** potential negative impacts by identifying options for preventing conflicting interactions wherever possible. Third, parties may **mitigate** remaining impacts in numerous ways, including operational accommodations and financial compensation to affected parties for demonstrated impacts.

Finally, we posit there are eight primary types of **tools** for addressing the concerns. These tools manifest as specific applied actions—or best practices—garnered from literature review, interviews and direct experience. Many of these best practices are established on a case-by-case basis as wind developers translate formal regulatory requirements, typically expressed in broad terms (e.g., “consult with affected stakeholders” or “mitigate negative impacts to affected stakeholders”), into specific compliance measures, often in consultation with the fishing industry.

IV. Observations and Discussion

Parties' Evolving Roles

Our observations affirmed a dynamic that bears highlighting: the respective roles of key parties evolve during the course of offshore wind development processes. While not surprising, these shifts in roles and responsibilities may offer useful perspective to inform options for offshore wind and commercial fisheries coexistence. These general observations are summarized below and illustrated in [Figure 2](#). This paper uses the following terminology for the four main phases of offshore wind development: planning; leasing; site assessment, project design and permitting; and construction and operations.¹⁸

- Generally, **governmental authorities** have the lead role in the planning and leasing phases, during which they undertake analyses to identify broad geographic areas suitable for offshore wind development, potentially refine those areas based on stakeholder and industry input,

¹⁸ Derived from a crosswalk of terminology from BOEM (U.S.) *Wind Energy Commercial Leasing Process* (2015), <http://www.boem.gov/Commercial-Leasing-Process-Fact-Sheet/>; and The Crown Estate and the Department of Energy & Climate Change (DECC) (U.K.) *The Crown Estate Role in Offshore Renewable Energy* (2014), <http://www.thecrownestate.co.uk/media/5411/ei-the-crown-estate-role-in-offshore-renewable-energy.pdf>.

conduct the leasing process, and manage the public input and stakeholder engagement associated with those phases.

- Typically, offshore wind **developers** are interested stakeholders during the planning phase and then become actively engaged as applicants during the leasing phase. Once specific offshore wind developers are identified for particular areas as a result of the leasing process, those wind developers become project proponents during regulatory review accompanying the site assessment, project design, and construction and operations phases. The developer is responsible for conducting site-specific analyses and consultation with affected stakeholders—notably the fishing industry—typically as part of compliance with regulatory requirements.
- As affected stakeholders, **fishermen** are typically involved in various informal and formal ways throughout the offshore wind development process. Governmental authorities may consult with the sector during the planning and leasing phases, usually with representation from fishing associations and industry leaders. These consultations range from formal working groups to more ad hoc processes. The fishing sector may perceive participation during these early phases as burdensome, in part because the issues and potential locations are still only generally defined. Once lease areas have been more specifically delineated and wind developers have been identified, fishing sector engagement tends to become more direct. At this point, industry-to-industry discussions can focus on particular operational practices and needs relevant to particular at-sea locations and shore-side facilities. Overall, consultations with the fishing industry tend to occur in reaction to a planned or existing project instead of being established proactively by either party in anticipation of potential future need. Though uncommon, the fishing industry might benefit from actively seeking out opportunities to engage early on with offshore energy interests for the parties’ mutual benefit, such as the employment of fishermen as developers’ industry liaisons or guards.

Figure 2. Four main phases of the offshore wind development process and the corresponding evolution of parties’ roles

Best Practices Matrix

Guided by the problem solving framework ([Figure 1](#)), we synthesized information and observations into a compendium summarizing the growing body of formal and informal best practices that illustrate specific ways the eight tools can be applied to address one or more of the five concerns. The intent of the matrix is to offer parties an at-a-glance graphic summary of a wide range of best practices as options to support their discussions and consultations about offshore wind and fisheries coexistence.

The matrix ([Table 1](#)) is organized with the five concerns as the column headers and the eight tools for addressing them as the row headers. We exercised best professional judgement to populate the cells with examples of specific best practices reflecting the relationship between particular tool types and the kinds of concerns they can address. These classifications are intended to illustrate one way the information may be organized within a problem solving framework; they are neither definitive nor exhaustive. Narrative discussion and observations follow [Table 1](#).

A few explanatory notes about [Table 1](#) may be helpful. Particular best practices appear more than once within the matrix, as they may address multiple concerns. For example, the *fisheries liaison* best practice appears under every concern. For the sake of brevity, [Table 1](#) represents summary information; see [Appendix 3](#) for the full matrix, including brief definitions of each best practice and source references.

Table 1. Matrix of best practices for interactions between offshore wind and commercial fishing industries

CONCERNS						
TOOLS		Spatial conflict and access	Human safety: risk and liability	Property damage: risk and liability	Diminished economic opportunity	Ecological resource impacts
	Communication	<ul style="list-style-type: none"> • Agreements (MOU, Coexistence Plan, etc.) • Port operational interface group • Government-to-industry and industry-to-industry groups • Fisheries liaison • Fisheries representative 	<ul style="list-style-type: none"> • Cable communication and awareness system • Navigational chart updates • Safety communication systems • Government-to-industry and industry-to-industry groups • Fisheries liaison • Fisheries representative 	<ul style="list-style-type: none"> • Navigational chart updates • Safety communication systems • Agreements (siting/liability) • Environmental Monitoring Plan • Operational Inspection and Maintenance Plan • Government-to-industry and industry-to-industry groups • Fisheries liaison • Fisheries representative 	<ul style="list-style-type: none"> • Port operational interface group • Government-to-industry and industry-to-industry groups • Fisheries liaison • Fisheries representative • Fishing industry capacity building 	<ul style="list-style-type: none"> • Environmental Monitoring Plan • Government-to-industry and industry-to-industry groups • Fisheries liaison • Fisheries representative
	Ocean planning	<ul style="list-style-type: none"> • Offshore wind compatibility assessment (e.g., important fishing grounds) 				<ul style="list-style-type: none"> • Offshore wind compatibility assessment (e.g., important fishery areas)
	Facilities design, construction and operations	<ul style="list-style-type: none"> • Optimizing wind and cable facilities siting, routing and design • Vessel transit considerations • Turbine micro-siting • Coordinating construction schedule • Maximizing fishing access • Port-/shore-side improvements • Minimal impact cable routing 	<ul style="list-style-type: none"> • Turbine markings • Vessel transit considerations 	<ul style="list-style-type: none"> • Turbine markings • Vessel transit considerations • Cable burial • Cable maintenance • Overtrawl surveys • Minimal impact cable routing 	<ul style="list-style-type: none"> • Port-/shore-side improvements • Overtrawl surveys 	<ul style="list-style-type: none"> • Bubble curtain • Scheduling of noise-generating activities
	Fisheries resource enhancement					<ul style="list-style-type: none"> • Habitat enhancements (<i>no examples yet</i>)
	Fisheries management				<ul style="list-style-type: none"> • Fisheries management measures 	

CONCERNS						
		Spatial conflict and access	Human safety: risk and liability	Property damage: risk and liability	Diminished economic opportunity	Ecological resource impacts
TOOLS	Business improvements		<ul style="list-style-type: none"> • Fisherman personal safety • Insurance support 	<ul style="list-style-type: none"> • Insurance support • Fishing vessel improvements (e.g., engines, maintenance) • Gear development or modification support • Lost/damaged gear fund 	<ul style="list-style-type: none"> • Fishing community fund • Fuel subsidies to fishermen • Local fisheries promotions • Lost/damaged gear fund • Training for new fisheries opportunities • Business venture: fuel infrastructure/sales • Fishermen and/or vessel employment • Tourism, recreation, and other roles • Local biodiesel production facilities • Insurance support • Fishing vessel improvements (e.g., engines, maintenance) • Gear development or modification support 	
	Cooperative research				<ul style="list-style-type: none"> • Joint data collection/impact studies 	<ul style="list-style-type: none"> • Joint data collection/impact studies
	Compensatory mitigation				<ul style="list-style-type: none"> • Compensation agreements (individual and/or collective) 	

The discussion below offers two general observations followed by particular observations organized by the five main types of concerns. In-text references to specific concerns, strategies, tools, and best practices are italicized.

General Observations

An observation supported in the literature and raised by most interview participants is the paramount importance of timely and effective *communication*, a tool which encompasses a range of activities, including engagement, consultation, coordination and information exchange. Communication best practices are found in all phases of the development process and support both government-to-industry and industry-to-industry interactions. For example, authorities may establish representative fishing industry working groups to support government-to-industry engagement and consultation during planning, leasing, and regulatory phases. In the U.K., industry-to-industry communication forums, such as commercial fisheries working groups and *port operational interface groups*, provide formal avenues for industry representatives to voice respective concerns and to collaborate on identifying and implementing solutions. Parties may also choose to develop official documentation of agreed-upon communication, safety, environmental monitoring, or dispute resolution protocols, such as *Coexistence Plans*, *Memorandums of Understanding* and *Environmental Monitoring Plans*.

A number of interview participants noted that communication tools are necessary for developing and deploying all other tools and also function as an essential aspect of successfully addressing all five main concerns, suggesting a cross-cutting quality of communication. For example, although *port-/shore-side improvements* fall more directly into the *facilities design, construction and operations* tool category, parties still rely on communication to agree on the scope of improvements before implementing them.

The prevalence of using *fisheries liaisons* and/or *representatives*, in one form or another, to conduct outreach, facilitate information exchange and enhance coordination between the two industries, and in some cases “speak” for fishing interests, stands out as a particularly high value communication practice. The liaison and/or representative role can functionally provide supplemental capacity needed to stay informed and engage effectively with offshore wind developers in ways that the fishing community is unlikely to have the capacity to orchestrate on its own. Many interview participants agreed that the most effective fisheries liaison and representative positions tend to be filled by knowledgeable, respected people with direct experience in the fishing industry, and are structured with a degree of flexibility, autonomy, and sufficient access to information to facilitate meaningful two-way consultation and information exchange.

Practices in the U.K. demonstrate the importance of communication as a keystone to offshore wind and commercial fisheries cooperation. Through the Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW), a body chaired and funded by The Crown Estate, the U.K. has institutionalized communication and coordination between the offshore wind and fishing industries. FLOWW is comprised of individuals representing various fishing industry bodies, offshore renewables developers and consultants, government agencies, and The Crown Estate, and serves as a national forum for facilitating discussion on the interactions among the industries and promoting and sharing best practices. FLOWW operates on the premise that, through open communication and collaborative problem solving, the group can serve as a resource for sharing voluntary best practices that allow the industries to coexist and learn from past experiences. In 2014, FLOWW released an updated version of its original 2008 guidance document, titled *Best Practice Guidance for Offshore Renewables*

Developments: Recommendations for Fisheries Liaison,¹⁹ which offers best practices for successful coexistence between the offshore wind and fishing industries. The updated guidance accounts for recent developments in the U.K. offshore wind sector, and also considers the wave and tidal energy sectors. According to an interview participant, FLOWW has recently become a higher-profile entity engaging in work that is increasingly relevant in the U.K., and it is reported that the guidance document has been widely accepted and used by not only the fishing and offshore wind industries, but also the wave and tidal industries.

Another general observation is that, although the *mitigation* strategy has generated the greatest number of best practice activities to-date, this does not appear to indicate a belief that mitigation is the most effective path to successful coexistence in the long run. A number of interview participants noted that conflict *avoidance*, a strategy typically associated with the planning and early leasing phases, and *mutually beneficial cooperation*, a strategy typically associated with the post-leasing phases, can provide significant value for parties in a variety of forms, including cost savings, time efficiencies, and improved cross-sector relationships. For example, as in the BIWF, industry-to-industry collaboration on impact studies can create supplemental economic opportunity for fishing communities, yield trusted data, and contribute to efficiencies in permit compliance for the developer. As another example, through the best practice of *optimizing wind and cable facilities siting, routing and design*, the developer consults affected fishing interests early on key project design issues (e.g., turbine siting and cable configuration) making it possible to avoid potential space and access conflicts that might otherwise have arisen. Generally, it appears that government, wind developers and fishing interests are increasingly exploring strategies for conflict avoidance and mutually beneficial cooperation.

Spatial Conflict and Access

The majority of best practices that address *spatial conflict and access* concerns fall into three tool categories: *ocean planning*; *facilities design, construction and operations*; and *communication*. Ocean planning presents opportunities for regulatory agencies to address competition for space on a broad scale by accounting for current, and anticipating future, spatial needs. Before leasing to developers, agencies may screen potential WEAs by identifying and mapping important fishing grounds, co-locating wind farms with marine protected areas, and/or establishing buffers around existing use areas, such as fishing grounds.

At a site-specific scale, *facilities design, construction and operations* best practices include *coordinating the construction schedule* to account for fishing seasonality and routing submarine transmission cables in a configuration that accounts for mobile fishing gear. As a cross-cutting tool, parties viewed various communication practices as an important part of addressing spatial conflict and access concerns. For example, *fisheries liaisons* are engaged to address concerns over access to fishing grounds by negotiating access options in and around a wind facility during construction or operations. Other communication practices, such as written *agreements* and *government-/industry-to-industry groups*, establish protocol and provide a forum for collaborative problem solving and dispute resolution.

¹⁹ [*FLOWW Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Liaison*](#), Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW) (2014).

Human Safety: Risk and Liability

Although we identified a relatively limited number of best practices that address human safety, the majority fall into the *communication* tool category, demonstrating the importance of basic awareness about the timing and location of turbine construction and cable installation activities and the industries' respective safety protocols. It is common for working groups, liaisons, and representatives to play a role in facilitating this communication.

Beyond communication, *business improvements* and *facilities design, construction and operations* tools are also associated with addressing human safety concerns. The former points to the importance of capital investments in the latest *fisherman personal safety* equipment and the latter encompasses a range of navigational safety measures, such as *turbine markings* and *vessel transit considerations*. While some of these safety measures are mandated, others are established as best practice in the field. For example, marking wind farm infrastructure with lighting and issuing radio broadcasts (e.g., notice to mariners) with important construction and operation developments and safety information have become core practices to help ensure fishermen's awareness of potential risks.

Property Damage: Risk and Liability

The majority of best practices that address concerns related to damage to wind farm infrastructure and/or fishing vessels and gear are *communication* and *facilities design, construction and operations* tools. Similarly to human safety, property damage may be avoided or mitigated with effective avenues of communication for dealing with risks to physical capital, such as ensuring the *fisheries liaison* conveys important navigational or cable routing information to fishermen, and establishing written *agreements* that address liability.

Many fishing industry interview participants voiced concerns about the damage that submarine cables may cause to mobile fishing gear, particularly trawls and dredges, which have the potential to snag on cables. A number of best practices address fishing gear-specific property damage related to cable routing, burial, and awareness. The literature and interviews point to a suite of cable installation and maintenance measures that appear to be widely adopted as best practice. These include cable routing that favors soft sediment vs. hard substrate and, where feasible, avoids areas used by bottom trawl or dredge fishing gear; installation techniques with sufficient burial depth; and maintenance protocols for regular and post-storm inspection to identify potential cable exposure. *Overtrawl surveys*, post-installation test fishing over cable routes, appears to be a well-received practice by both industries. As demonstrated by the OFCC, cable configurations can be the most widely-accepted and practicable when wind developers and submarine cable companies have consulted fishermen—who have intimate knowledge of seafloor conditions—about optimal cable routes. In instances of demonstrable damage to fishing gear as a result of cable snags, the OFCC has also collaborated with telecommunications cable companies to establish a cable company fund for compensating fishermen for lost or damaged gear.

Diminished Economic Opportunity

A priority interest of fishing communities is continued opportunity to make a living by fishing. Beyond that, many fishermen are increasingly embracing options to employ their knowledge, experience and vessels in diversified ways that supplement economic opportunity. Several of the eight tools address economic opportunity concerns, with an overall majority of best practices in the *business improvements* tool.

In general, *business improvements* best practices allow fishermen to either decrease operating costs or take advantage of additional employment opportunities. For example, developers may contribute funding to outfit fishing vessels with more efficient engines or conduct yearly vessel maintenance, thereby reducing operating costs. The increasingly common practice of supplemental employment for fishermen and their vessels (e.g., as guards or surveyors) shows promise to help address several issues including fishermen's "downtime" during the off-seasons and alternatives to ameliorate lower earnings related to fisheries management requirements and market conditions (e.g., low fish prices). Another practice on the rise is programs through which wind developers provide support for *local fisheries promotions* and marketing campaigns to bolster demand for locally-produced seafood products. Developers may also support fishing communities through multi-party ventures such as the establishment of *fishing community funds*, such as the West of Morecambe Fisheries Fund, used to finance projects aimed at improving the fishing industry. Fishing community funds may be established as a gesture of goodwill on the part of developers or established as part of indirect impact mitigation measures through the recognition that some impacts of wind farms may be difficult to quantify or unknown.²⁰

Another interesting, but seemingly rare, opportunity is creating related *business ventures* that provide alternative revenue streams for fishing interests, such the operation of onshore fuel facilities and resulting patronage by wind developer vessels, as practiced at the Port of Ramsgate for the Thanet and London Array offshore wind farms in the U.K.

Fishery management best practices can result in management options that help sustain the ability of fishermen to make a living off target fisheries, such as setting up quota or permit programs or certifying sustainable fisheries or vessels.

It is worth noting that some interview participants remarked on the relative ineffectiveness of strict monetary compensation as a successful long-term solution for mitigating lost economic opportunity. They emphasized that, while *compensatory mitigation* payments will remain an important practice, more proactive, cooperative approaches that hold promise for mutual benefit are increasingly appealing to fishermen and can be effective at addressing not just economic issues, but also retaining their priority of carrying on fishing as a tradition.²¹

Ecological Resource Impacts

Though conclusive research and evidence to date is limited, some fishermen have expressed concern that offshore wind farms could have a negative impact on ecological resources by, for example, disturbing marine habitats or increasing submarine noise. There are a number of options for avoiding, enhancing or mitigating impacts to the fishery resource or habitat, ranging from stock or habitat enhancements to installation of substrate that encourage species growth and aggregation. *Fisheries*

²⁰ "Fishing Community Projects funded so far (an overview)," last modified 2015, West of Morecambe Fisheries Limited, accessed November 9, 2015, <http://www.westofmorecambe.com/64/fishing-community-projects-funded-to-date-an-overview>.

²¹ [FLOWW Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Disruption Settlements and Community Funds](#), Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW) (2015).

FLOWW published this guidance document for establishing compensation agreements, or "disruption settlements," and community funds between commercial fishing and offshore wind interests.

resource enhancement tools appear to be underutilized in the examples we examined, likely because of incomplete understanding of both potential causal relationships between wind farm impacts and fishery resources and the relative efficacy of various enhancement tools. *Cooperative research* programs offer one way to improve parties' understanding of possible resource interactions.

To gain a better understanding of wind farm impacts on fishery resources, developers Deepwater Wind and DONG Energy have employed local fishermen and scientists to conduct fishery surveys before, during and after construction in and around the sites of Block Island Wind Farm and Westernmost Rough Offshore Wind Farm, respectively. *Joint data collection* in some cases has been shown instill greater confidence in the findings and build relationships among the parties.

Additional Options for Identifying Coexistence Practices

While the various concerns, tools, and best practices discussed in this paper have broad relevance, it is also important to note the finer distinctions among the specific operational needs of different types of fisheries and their interactions with different kinds of offshore wind installations. At a basic level, fishery operations differ by fixed or mobile gear, vessel class and other key factors. There are further subdivisions of specific gear types, including traps, gill nets, and pots (fixed) and trawls, longlines, and dredges (mobile). Each of these fisheries interacts with the water column and substrate differently, and by extension, also interacts differently with the various aspects of wind farm construction and operations, such as grounded versus floating substructure designs. These many operational and infrastructure differences suggests opportunity to identify nuanced practices to enhance coexistence that might be overlooked with a one-size-fits-all approach. Existing resources on this topic may be found in [Appendix 4](#).

V. Conclusion

The problem solving framework, narrative discussion and summary matrix offered here compile and examine options for addressing key concerns about potential interactions, and identify options for cooperation, between the commercial fishing and offshore wind industries. The information is also intended to support constructive dialogue among government and fishing industry leaders locally, as offshore wind development progresses off the coast of New Bedford, and more broadly in other locations. As parties around the world continue to address compatibility challenges and create beneficial coexistence opportunities, their efforts will contribute to this important growing body of knowledge, tools and best practices.

VI. Appendices

Appendix 1: Acknowledgements

SeaPlan would like to thank the numerous agency and industry representatives and other colleagues whose expertise and perspectives—through informal interviews, consultation and/or document review—contributed significantly to this work:

- City of New Bedford
- The Crown Estate
- Deepwater Wind
- DONG Energy
- Fisheries Liaison with Offshore Wind and Wet Renewables
- Holderness Fishing Industry Group
- Mainstream Renewable Power
- Massachusetts Clean Energy Center
- Massachusetts Fisheries Work Group
- Massachusetts Office of Coastal Zone Management
- National Federation of Fishermen’s Organizations
- Oregon Fishermen’s Cable Committee
- Port Hill Marine Ltd.
- Port of Esbjerg
- RedPenguin Ltd.
- Revill Nation Ltd.
- Scottish Fishermen’s Federation
- Subsea Cables UK
- Thanet Fishermen’s Association
- Various Rhode Island fishing interests
- Vattenfall Wind Power
- West of Morecambe Fisheries Ltd.

This report was made possible by funding from the [Island Foundation](#).

United States

Block Island Wind Farm

Background

In July 2015, Deepwater Wind began construction of the pilot-scale Block Island Wind Farm (BIWF), which will be a 5 turbine, 30MW offshore wind generation project located approximately three miles southeast of Block Island, RI. Power will be exported to the mainland electric grid via a 21-mile, bi-directional Block Island Transmission System submarine cable.²² The wind farm was sited through the comprehensive ocean planning process known as the 2010 RI Ocean Special Area Management Plan (Ocean SAMP), which is a federally recognized management and regulatory tool that promotes ecosystem-based management as well as reasonable coastal dependent economic activity.²³ In order to promote positive relations with the fishing industry, Deepwater Wind has held numerous meetings with fishing industry groups, and created and disseminated a “Summary of Commercial and Recreational Fishing Outreach and Proposed Mitigation” plan in 2013 to outline planned mitigation measures for addressing potential conflicts with the fishing industry.²⁴

Tools & Best Practices Exemplified

Communication

Cable communication and awareness system

Developer has developed protocol for navigational warnings regarding cable operations, and hosts information regarding location of cable routes on website.

Fisheries liaison

Between 2012 and the onset of project construction, the developer employed a local fisherman as liaison to assist in project outreach efforts, meet with fishermen, and provide two-way communication between the developer and fishermen.

Fisheries representative

Developer funds a third-party Fishery Liaison in accordance with the RI Ocean SAMP. This Fishery Liaison would function as a fisheries representative as defined in this report, and work on behalf of the RI Coastal Resources Management Council (CRMC), be knowledgeable about fisheries, and facilitate direct communication between fishermen and developer.

Fishing industry capacity building

The local fishing industry body, Commercial Fisheries Center of RI, is expected to hire an Executive Director—a position functionally similar to a fisheries representative and funded by the developer for four years—to bolster the industry’s capacity to operate effectively and communicate with other interest or industry groups.

²² “Block Island Wind Farm,” Deepwater Wind, last modified 2015, <http://dwwind.com/block-island/block-island-project-overview>.

²³ *Rhode Island Ocean Special Area Management Plan*, Rhode Island Coastal Resources Management Council (2010).

²⁴ Aileen Kenney, “Block Island Wind Farm and Block Island Transmission System – Summary of Commercial and Recreational Fishing Outreach and Proposed Mitigation, CRMC File No. 2012-09-065,” *Deepwater Wind* (2013).

Safety communication system

Developer established emergency response protocol and emergency contact information, operates two wind farm-specific VHF radio channels, one for project work and the other for protected species concerns, and posts daily updates on the project website.²⁵ Developer also published a marine communications plan for the construction phase, and submits project updates to the U.S. Coast Guard Broadcast Notice to Mariners.²⁶

Government-to-industry and industry-to-industry groups

The RI Ocean SAMP established a government-to-industry Fisheries Advisory Board to facilitate effective measures for engaging with the offshore wind industry. In addition, as part of its fisheries outreach and engagement plan, the developer has convened regular industry-to-industry open meetings with local fishermen.

Ocean planning

Offshore wind compatibility assessment

Government used a marine spatial planning process with stakeholder involvement and scientific input to inform wind area siting.

Facilities design, construction and operations

Cable burial

Developer will bury transmission cables 6 ft below the seafloor.

Maximizing fishing access

Though the developer requested that no fishing occur in the wind farm work area during the three month construction period, once foundation installation activities are completed, access to the wind farm area will not be restricted to fishermen.

Minimal impact cable routing

Transmission cable route planned to avoid hard bottom substrates known to be used by some finfish species throughout various life stage. Developer plans to coordinate with local fish trap operators to minimize impacts during construction.²⁷

Business improvements

Local fisheries promotions

Developer is developing an agreement to fund a marketing campaign to mitigate impacts to the local charter boat industry associated with the three month construction closure of the wind farm area.

Fishermen and/or vessel employment

Developer employs local fishermen to aid in conducting environmental impact studies and to serve in other positions suitable to their qualifications and needs of the project.

Cooperative research

Joint data collection/impact studies

Developer is conducting before-after-control-impact studies on local finfish and lobster populations and has hired fishermen to participate in the design and execution of these protocols.

Compensatory mitigation

Compensation agreements (individual and/or collective)

Through an application and review process, fishermen claiming financial losses due to wind farm construction closures may receive monetary compensation as deemed appropriate by a steering committee comprised of representatives from various stakeholder groups.

²⁵ "Marine Communication and Emergency Response Field Guide," Block Island Wind Farm (2015).

²⁶ Aileen Kenney, "Marine Communications Plan: Construction Phase," Deepwater Wind Block Island LLC (2015).

²⁷ "Scarborough Beach Alternative Modification to ER," Deepwater Wind (2013).

Port-Related Concerns

The Port of Davisville in the Quonset Business Park in North Kingstown, RI, has housed the majority of local construction work done on the BIWF.

Interviews

SeaPlan's ongoing work with parties involved in the BIWF afforded ample familiarity, therefore no specific interviews were conducted for this paper.

Cape Wind

Background

With preliminary permitting steps beginning in 2001, Cape Wind was projected to be the U.S.'s first offshore wind farm. Cape Wind would be located in Nantucket Sound off the coast of Cape Cod, MA, reputedly the most optimal offshore wind power site in the U.S. As a part of widespread controversy among local coastal communities, the Martha's Vineyard Dukes County Fishermen's Association (today renamed Martha's Vineyard Fishermen's Preservation Trust) filed a lawsuit with Cape Wind in 2010. The case ended in a 2012 settlement in which Cape Wind committed to assisting in the establishment of a permit bank and developing a local seafood marketing campaign, Vineyard Wild Caught. However, despite legislative support for the wind farm, in early 2015 the backing-out of two electric utilities companies from plans to purchase the power has put the Cape Wind project on hold indefinitely.²⁸

Tools & Best Practices Exemplified

Facilities design, construction and operations

Maximizing fishing access

Developer assured fishermen of access to wind farm site.

Fisheries management

Fisheries management measures

Developer funded a permit bank for fishermen to make fishing more affordable for permit owners.

Business improvements

Local fisheries promotions

Developer supported local seafood marketing program, Vineyard Wild Caught.

Port-related Concerns

None identified

Interviews

None

²⁸ *Cape Wind*, Cape Wind Associates, accessed October 27, 2015, <http://www.capewind.org/>.

Oregon Fishermen's Cable Committee

Background

In 1995, commercial trawl fishermen in the state of Oregon expressed concern about loss of access to productive fishing areas and liability for interactions with submarine cables laid by telecommunications corporation AT&T Inc. In response, trawl fishermen collaborated to form the Oregon Fishermen's Cable Committee (OFCC) and negotiated an agreement to limit fisherman liability for damaging seafloor fiber optic cables and to compensate fishermen for damages to fishing gear. The OFCC's reach extends from Washington to California, and is responsible for conducting ongoing collaboration and information sharing with cable-laying entities, providing a 24-hour hotline for fishermen who experience potential cable snags, upholding a cable damage liability waiver for OFCC-registered vessels, and chartering vessels as guards or patrols to cable companies. The OFCC also aids cable companies in identifying ideal sites for cable installations through cable route surveys and knowledge of seafloor topography, and has organized a fund financed by the cable companies for compensating fishermen who have sacrificed snagged gear in order to minimize damage to cables.²⁹

Tools & Best Practices Exemplified

Communication

Cable communication and awareness system

OFCC facilitates cable companies' consultation of fishermen about cable siting and developments.

Agreements: Memorandum of Understanding

OFCC establishes Memoranda of Understanding with cable companies on agreements about cable siting.

Facilities design, construction and operations

Optimize wind and cable facilities siting, routing and design

OFCC fishermen advise cable companies on cable siting, and fishermen conduct cable route surveys and propose potential sites to companies.

Business improvements

Lost/damaged gear fund

OFCC oversees cable company fund to compensate fishermen for lost gear due to cable snags.

Fishermen and/or vessel employment

OFCC provides cable companies with personnel and vessels as guards and patrols.

Port-related Concerns

None identified

Interviews

Interviews with persons involved in the OFCC indicated it is valuable for fishermen with a common goal and interest (in this case, trawlers) to unite in a coalition to have constructive relations with developers. In the case of the OFCC, successful mitigation and avoidance are accomplished through early consultation between the two industries and collaboration on determining optimal sites for cable laying that have minimal impact on fishing activities.

²⁹ *Oregon Fishermen's Cable Committee*, Oregon Fishermen's Cable Committee, accessed October 27, 2015, <http://www.ofcc.com/>.

Thanet Offshore Wind Farm

Background

Thanet Offshore Wind Farm (TOW) was one of 15 wind projects The Crown Estate announced in 2004. The project was initially purchased by Christofferson, Robb & Co and Warwick Energy, but in 2008 the Swedish energy company Vattenfall acquired it. TOW became fully operational in 2010 and is located 7 miles off the coast of Thanet in Kent, England. TOW is currently the third largest wind farm in the world, consisting of 100 turbines with a maximum energy capacity of 300MW. Developer Vattenfall has worked with fishing industry stakeholders, particularly the Thanet Fishermen's Association (TFA), a fishing industry association that represents local fishermen to outside interests, to inform its decision making.³⁰

Tools & Best Practices Exemplified

Communication

Cable communication and awareness system

Developer notifies fishermen of submarine cable locations.

Fisheries liaison

Developer employs a Fishing Liaison Officer.

Fisheries representative

Developer funds the employment of a Fishing Industry Representative.

Port operational interface group

Representatives from local fishing, offshore wind, shipping industry, and port interests meet regularly to discuss port operations and concerns.

Facilities design, construction and operations

Cable burial

Developer or cable company buried submarine cables.

Maximizing fishing access

Developer allowed fishermen to transit through wind farm site during construction to save time and fuel.

Port-/shore-side improvements

Developer has actively invested in upgrading waterfront infrastructure.

Business improvements

Business venture: fuel infrastructure/sales

TFA constructed and operates an onshore fuel facility, TFA Fuel Services, at the association's co-op docks in the Port of Ramsgate. TOW support vessels purchase fuel from TFA Fuel Services, the profits from which are shared by TFA members, which allows TFA members to purchase fuel at a reduced price.

Fishermen and/or vessel employment

Developer hires fishing vessels for support services.

Compensatory mitigation

Compensation agreements (individual and/or collective)

Developer agrees to directly compensate fishermen for hindering fishing access or ability.

³⁰ "Thanet," Vattenfall, Vattenfall AB, last modified October 14, 2014, <http://corporate.vattenfall.co.uk/projects/operational-wind-farms/thanet/>.

Port-related Concerns

Conflict between the two industries appears to have been minimal at the ports of Harwich, Ramsgate, Dunkirk, which service TOW. The Port of Ramsgate has convened an Operational Interface Group (OIG) comprised of representatives from offshore wind developers, vessel operations contractors, and fishermen's associations that meets monthly to discuss operations and any relevant changes.

Interviews

Individuals involved with TOW noted that many of the conflicts that have arisen were avoidable but had not been foreseen at the early stages of planning and construction. They concluded that it is important for conflict mitigation actions to be written into industry-to-industry contracts before commencement of the project, otherwise they may never come to fruition.

London Array

Background

London Array Offshore Wind Farm was one of 15 wind projects The Crown Estate announced in 2004. The Crown Estate awarded the lease to London Array Ltd., a consortium of E.ON UK Renewables, Shell WindEnergy, and CORE Limited. Through a series of permit transfers, London Array Ltd. now consists of DONG Energy, E.ON UK Renewables, La Caisse, and Masdar. London Array became fully operational in 2013 and is located in the outer Thames Estuary, 12 miles off the coast of Kent, England. London Array is currently the largest offshore wind farm in the world, consisting of 175 turbines and a maximum energy capacity of 630MW.³¹

Tools & Best Practices Exemplified

Communication

Cable communication and awareness system

Developer notifies fishermen of submarine cable locations.

Fisheries liaison

Developer employs a Fishing Liaison Officer.

Fisheries representative

Developer funds employment of a Fishing Industry Representative.

Safety communication systems

Developer notifies fishermen at least 7 days in advance of construction activities, publishes regular operations updates for fishermen on the developer's website, and disseminates a weekly stakeholder report via email documenting support vessels on site and ongoing and scheduled upcoming operations developments.

Port operational interface group

Representatives from local fishing, offshore wind, shipping industry, and port interests meet regularly to discuss port operations and concerns.

Facilities design, construction and operations

Cable burial

Developer or cable company buries submarine cables.

³¹ London Array, London Array Limited, accessed October 27, 2015, <http://www.londonarray.com/>.

Port-/shore-side improvements

Developer provided 25% of funding to TFA Fuel Services for the construction of a larger pontoon and additional high speed pumps at the co-op docks. Developer built an additional fuel facility in the Port of Ramsgate, and employs TFA Fuel Services to run it.

Business improvements

Business venture: fuel infrastructure/sales

TFA constructed and operates an onshore fuel facility, TFA Fuel Services, at the association's co-op docks in the Port of Ramsgate. London Array made a contract with TFA Fuel Services as its fuel provider for support vessels, and also provided a grant for funding 25% of construction of a larger pontoon and high speed pumps at the co-op dock. Developer also signed an agreement for TFA Fuel Services to operate a separate fuel facility the developer constructed.

Fishermen and/or vessel employment

Developer hires fishing vessels for support services, such as conducting mapping and cable drift surveys for environmental assessments.

Port-related Concerns

Conflict between the two industries appears to have been minimal at the ports of Harwich and Ramsgate, which service London Array. The Port of Ramsgate has convened an Operational Interface Group (OIG) comprised of representatives from offshore wind developers, vessel operations contractors, and fishermen's associations that meets monthly to discuss operations and any relevant changes.

Interviews

Individuals involved with London Array emphasized that early communication and collaboration between the developer and fishing industry is critical; however, even in cases when industries agree on best practices, barriers to their implementation may arise. For example, in 2013 London Array Ltd. was required to divest the electrical transmission assets of the wind farm because they had reached a capacity threshold. However, due to lack of awareness, the new owner did not maintain the communication best practices regarding transmission cables that London Array Ltd. had previously established with TFA.

Greater Gabbard Offshore Wind Farm

Background

Greater Gabbard Offshore Wind Farm was originally developed by Greater Gabbard Offshore Winds Ltd. (GGOWL), a joint venture between Airtricity and Fluor. Since then, Scottish and Southern Energy (SSE) and RWE Innogy have acquired the project in a 50/50 joint venture. Construction began in 2008 and the facility became fully operational in 2012. The wind farm is located 14 miles off the coast of Suffolk, England. Greater Gabbard consists of 140 turbines with a maximum energy capacity of 504MW. Developer SSE has engaged with the local community throughout the construction and operations processes, including employing the local workforce at Lowestoft Harbor, which services the wind farm.³²

³² "Greater Gabbard," RWE Innogy, accessed October 27, 2015, <http://www.rwe.com/web/cms/en/310132/rwe-innogy/sites/wind-offshore/in-operation/greater-gabbard/>.

Tools & Best Practices Exemplified

Communication

Fisheries liaison

Developer employs a Fisheries Liaison Officer.

Government-to-industry and industry-to-industry groups

Developer has established a commercial fisheries working group that meets regularly with representatives of the local fishing industry.

Facilities design, construction and operations

Cable burial

Developers buried cables and covers cables on hard substrate with mattresses to avoid entanglement of fishing gear.

Business improvements

Fishermen and/or vessel employment

Developer indirectly employs local fishermen on work boats through Wildcat Workboats.

Compensatory mitigation

Compensation agreements (individual and/or collective)

Developers paid disturbance allowances to fishermen in the form of cash settlements for economic losses in the construction phase.

Port-related Concerns

Greater Gabbard is serviced by the ports of Harwich, Great Yarmouth, and Lowestoft. While Lowestoft used to be a successful fishing port, the fishing industry has since declined to an annual income of only £885,000 in 2013 and offshore wind support has provided employment opportunities to former fishermen. One such opportunity has been for fishermen to serve as skippers operating crew transfer vessels.

Interviews

None

Neart na Gaoithe Offshore Wind Farm

Background

In 2009, as part of the Scottish Territorial Waters offshore wind program, The Crown Estate awarded development of the Neart na Gaoithe (NNG) wind farm site to global wind and solar company Mainstream Renewable Power Ltd (MRP). The commencement of construction has been pushed back by MRP's engagement in a court case, and is expected to begin in 2016/2017. The proposed site for the wind farm is 10 miles off the coast of Fife, Scotland. NNG is proposed to consist of 64 to 75 turbines with a maximum energy capacity of 450MW. Although NNG is still many years away from construction and operations, MRP has already engaged with fishing industry stakeholders, particularly the Scottish Fishermen's Federation (SFF), and developed preliminary mitigation plans.³³

³³ *Neart na Gaoithe Offshore Wind Farm Online Consultation*, Mainstream Renewable Power, accessed October 27, 2015, <http://www.neartnagaoithe.com/>.

Tools & Best Practices Exemplified

Communication

Government-to-industry and industry-to-industry groups

MRP, through the Forth and Tay Offshore Wind Developers Group, holds ongoing dialogue with local fishing interests through a Commercial Fisheries Working Group throughout all stages of project development and ensures the dissemination of important information.

Fisheries liaison

Developer plans to employ a fisheries liaison on vessels during construction.

Safety communication systems

Developer plans to transmit operations information to fishermen via radio.

Facilities design, construction and operations

Cable burial

Developer plans to bury cables where possible, and utilize other cable protective measures otherwise.

Overtrawl surveys

Developer plans to conduct “overtrawl ability” surveys to ensure cables are sufficiently buried.

Turbine markings

Facility infrastructure will be properly marked and lit.

Business improvements

Fishermen and/or vessel employment

Developer employs fishermen from the SFF as personnel for surveys. Developer establishes a dropped-object protocol for employing fishermen as guard vessels to respond to objects dropped during construction.

Cooperative research

Joint data collection/impact studies

Developer has worked with and employed SFF fishermen to conduct environmental assessments, including marine mammal observations.

Compensatory mitigation

Compensation agreements (individual and/or collective)

Developer plans to form an agreement with fishermen about appropriate amount for compensation for reduced access during construction.

Port-related Concerns

MRP has not yet selected ports for direct service of NNG. One nearby port, Eyemouth Harbor, supports a fishing industry worth £2.9 million, and has begun to develop offshore wind operations and maintenance support infrastructure that may potentially service NNG.

Interviews

According to individuals involved in NNG, the project may be too early in the development phase to assess the effectiveness of mitigation efforts. Thus far, most efforts have gone into establishing effective lines of communication between the offshore wind and fishing industries. Dealings with the fishing industry are apparently complex, given the disparate goals and interests of the various local fisheries (e.g., trawlers, dredgers). Interview participants also noted that high insurance premiums for wind farm sites, rather than restricted access, may keep fishermen from operating in and around wind farm areas.

Westermost Rough Offshore Wind Farm

Background

As part of the Round 2 U.K. offshore wind leasing process, DONG Energy was awarded the lease to develop a wind farm at Westermost Rough in 2007. DONG sold a 50% stake in the wind farm in equal parts to Marubeni Corporation and the UK Green Investment Bank to create a joint venture. The project commenced construction in 2013, and in May 2015 the wind farm reached full power generation capacity at 210MW. Westermost Rough Offshore Wind Farm comprises 35 6MW turbines, and is located 5 mi off the Holderness coast in the North Sea.³⁴ In order to address concerns voiced by local fishing interests, who are primarily lobstermen, DONG took steps to avoid and mitigate potential conflicts with the local fishermen throughout construction and operations by establishing a well-managed and proactive relationship with the fishing community. The developer has implemented a number of best practices for cooperation, including facilitating meaningful and collaborative communication through a fisheries liaison and representative, supporting joint data collection and monitoring efforts, and other practices such as supporting fishing community funds.

Tools & Best Practices Exemplified

Communication

Fisheries liaison

Developer has employed a commercial fisheries manager/fisheries liaison, who has significant experience working within the fisheries community, to establish a platform for communication between the industries. This has resulted in development of trust and establishment of effective means for communicating and addressing fishing industry concerns.

Fisheries representative/Fishing industry capacity building

To address the lack of capacity within the fishing industry to identify, communicate, and address collective fishing industry concerns, the developer provided resources to support a fisheries representative leader from a local fishing industry group. This individual has been instrumental in bringing collective concerns to the table for resolution and ensuring continuity in communications between the developers and fishing industry interests.

Business improvements

Fishing community fund

Developer contributes resources to the West of Morecambe Fisheries Fund, which financially sponsors fishing community projects. The projects supported by the Fisheries Fund have been successful in contributing to a positive response from fishing interests, and have resulted in direct enhancements to the fishing industry, such as enabling fishermen to purchase a research vessel to conduct lobster and crab impact and monitoring surveys at the Westermost Rough Wind Farm site.³⁵

Fishermen and/or vessel employment

Developer has hired fishermen to conduct support work for the wind farm, including fishery resource impact surveys.

³⁴ *Westermost Rough Project Summary*, DONG Energy Power (UK) Ltd. (2015) <https://assets.dongenergy.com/DONGEnergyDocuments/uk/Project%20summaries/Westermost%20Rough%20Project%20Summary.pdf>.

³⁵ "Holderness Coast Fishermen," last modified 2015, West of Morecambe Fisheries Ltd, accessed November 13, 2015, <http://www.westofmorecambe.com/61/holderness-coast-fishermen-2014>.

Lost/damaged gear fund

Developer sponsors a gear replacement program in instances of demonstrable wind farm support/transit vessels snagging on lobster pot gear.

Facilities design, construction and operations

Maximizing fishing access

Developer has negotiated access rights to local fishermen.

Cooperative research

Joint data collection/impact studies

Developer funded collaborative impact studies on lobster and crab populations in and around the wind farm site. The study was designed in collaboration with scientists and fishermen, and fishermen collect the data using their own research vessel. The studies have been accepted in the scientific literature as consisting of robust data, and plan to continue at least five years into the operations phase.

Port-related Concerns

The Port of Grimsby is the primary service port for Westernmost Rough. Interview participants have reported that interactions at Grimsby have largely been positive, and fishermen operating out of the port have supplemented their income by providing the wind farm with support.

Interviews

According to individuals representing the developer and local fishermen, Westernmost Rough began as a relatively controversial offshore wind project with local lobstermen, but with proactive measures to establish a solid foundation of communication and collaboration, the relationship between the two industries today continues to be positive and constructive. The establishment of this industry-to-industry communication framework has been central to identifying substantive concerns, vetting solutions, and implementing effective mitigation and cooperation.

First Flight Wind

Background

In 2011, The Crown Estate proposed a 600MW offshore wind farm in the Irish Sea off the coast of Northern Ireland. The Crown Estate granted the lease permit to B9 Energy, DONG Energy, and RES, who formed the First Flight Wind consortium. However, in 2014 the project ceased development due to delays to the design of the new market and renewable incentive arrangements. As part of the permitting process, the First Flight Wind developer consortium carried out extensive stakeholder engagement and conducted survey and zone assessment work. As part of the stakeholder engagement, the consortium created a Commercial Fishing Working Group to advise them on technical matters concerning the Environmental Impact Assessment.³⁶

Tools & Best Practices Exemplified

Communication

Government-to-industry and industry-to-industry groups

Commercial fishermen served on a technical working group to inform developer of relevant issues and to exchange information. Developers published and distributed *Fishermen's*

³⁶ "First Flight Wind," 4C Offshore, updated December 2, 2014, <http://www.4coffshore.com/windfarms/first-flight-wind-united-kingdom-uk88.html>.

Bulletin quarterly to provide fishermen with project information regarding impacts on and opportunities for the industry.

Fisheries liaison

Developers hired a Fisheries Liaison Officer.

Port-related Concerns

None identified

Interviews

None

Sea Source

Background

Sea Source was originally established in 1984 as the Anglo-North Irish Fish Producers Organization, a group dedicated to promoting the fishing industry and preparing fishermen to embrace all opportunities for making a livelihood from the sea, including renewable energy. The organization later renamed itself Sea Source. Today, Sea Source's functions include advocating for the use of fishing vessels for charter in scoping, monitoring, and survey work. The organization works to take advantage of offshore wind energy as an opportunity for fishermen.³⁷

Tools & Best Practices Exemplified

Business improvements

Fishermen and/or vessel employment

Sea Source aids fishermen in taking advantage of opportunities to use their vessels for offshore wind industry work, such as conducting surveys, sharing environmental knowledge, and patrolling.

Port-related Concerns

None identified

Interviews

None

Canada

One Ocean Canada

Background

In 2002 the Canada-Newfoundland Offshore Petroleum Board established One Ocean Canada as a voluntary liaison organization representing the mutual interests of the fishing and offshore petroleum industries in Newfoundland and Labrador. One Ocean provides a neutral forum between

³⁷ *Sea Source*, Sea Source, accessed October 27, 2015, <http://www.sea-source.com/>.

the two industries for facilitating mutual awareness and understanding, identifying and developing best practices and protocols, and addressing areas of potential concern. Quarterly, One Ocean brings together representatives from various industry interest groups to report on information-gathering trips, publish reports, and host workshops. The organization supports the placement of a petroleum industry liaison officer at the offices of the Canadian Fish, Food and Allied Workers Union (FFAW/Unifor). One Ocean partners with Fisheries and Oceans Canada (DFO) to provide fishing Vessel Monitoring System (VMS) information to petroleum industry members.³⁸

Tools & Best Practices Exemplified

Communication

Fisheries liaison

One Ocean Canada uses a Fisheries Liaison Officer and a Petroleum Industry Liaison Officer.

Safety communication system

One Ocean Canada conducts training for oil spill response.

Facilities design, construction and operations

Optimizing wind and cable facilities siting, routing and design

One Ocean Canada facilitates discussion on where, when, and how petroleum exploration or production may be proposed.

Port-related Concerns

None identified

Interviews

None

³⁸ *One Ocean*, One Ocean, accessed October 27, 2015, <http://www.oneocean.ca/>.

Appendix 3: Expanded Best Practices Matrix

Table 2. This table is an expanded representation of all best practices included in this report and provides details relevant for classifying each practice. The “Tool” and “Strategy” columns indicate into which tool and strategy category, respectively, we classified each best practice. The “Description” column provides specific details about what each best practice entails and how it might be implemented. The “Responsible Party” column indicates which party or parties (Government, Developer, Fishing Industry, Port, Cable Company) would most likely be responsible for implementing the best practice. The “Phase of Development” column indicates during which phase(s) of development (Figure 2) the best practice would be the most applicable and/or effective if implemented. The “Literature & Case Study Examples” and “Other Examples” columns provide references to examples in which the corresponding best practice has been or is being implemented. Examples provided in “Literature and Case Study Examples” reference literature sources (see *Literature Review* under [Methods](#)) and case examples ([Appendix 2](#)). “Other Examples” are brief, stand-alone descriptions of best practices implemented in cases that, for the sake of brevity, were not included in the case study descriptions ([Appendix 2](#)), and which were gleaned from interviews or background research.

Tool	Best Practice	Description	Strategy	Responsible Party	Phase of Development	Literature & Case Study Examples	Other Examples
Business improvements	Business venture: fuel infrastructure/sales	Developer purchases fuel directly from a fuel co-op established and operated by local fishermen	Mutually beneficial cooperation	<ul style="list-style-type: none"> Developer Fishing Industry 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> UK: London Array, Thanet Offshore Wind Farm 	<ul style="list-style-type: none"> Fishermen of the Whitehaven Fishermen’s Co-operative Ltd. at Whitehaven Harbor, U.K., were awarded funds by the West of Morecambe Fisheries Fund to build and operate a fuel facility and sell fuel to fishermen and wind farm crew transfer vessels^{39,40}
Business improvements	Fishermen and/or vessel employment	Provision of additional/supplemental employment opportunities to fishermen as guards/patrols, data collectors for research, vessels employed for environmental assessments, and other services	Mutually beneficial cooperation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting Construction / Operations 	<ul style="list-style-type: none"> Lit: FLOWW, RI Ocean SAMP UK: Greater Gabbard Offshore Wind Farm, London Array, Neart na Gaoithe Offshore Wind Farm, Westermest Rough Offshore Wind Farm, Sea Source, Thanet Offshore Wind Farm US: Block Island Wind Farm, Oregon Fishermen’s Cable Committee 	

³⁹ “Whitehaven Fishermen’s Co-operative Ltd,” last modified 2015, West of Morecambe Fisheries Ltd, accessed November 23, 2015, <http://www.westofmorecambe.com/13/whitehaven-fishermen-2014>.

⁴⁰ Anonymous interview participant representing West of Morecambe Fisheries Ltd, interview by Andy Lipsky, November 13, 2015.

Tool	Best Practice	Description	Strategy	Responsible Party	Phase of Development	Literature & Case Study Examples	Other Examples
Business improvements	Fisherman personal safety	Developer supports provision of updated vessel and personal safety equipment to fishermen operating in or near wind farm site. May include radar, GPS, life rafts, Emergency Position Indicating Radio Beacon, and flotation suits. Funds for updating equipment may be procured from developers through low interest loans or grants.	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: BOEM, COWRIE 	
Business improvements	Fishing community fund	Developer pays into a fund that finances community projects aimed at fishing industry enhancements (e.g., installation of new refrigeration/freezer units, provision of seafood processing equipment and safety equipment, safety training and certification for wind farm support work)	Mutually beneficial cooperation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting Construction / Operations 	<ul style="list-style-type: none"> UK: Westermost Rough Offshore Wind Farm 	<ul style="list-style-type: none"> In the eastern Irish Sea, West of Morecambe Fisheries Limited manages the West of Morecambe Fisheries Fund, established in 2013 and paid into by several local offshore wind developers for funding fishing community improvement projects⁴¹
Business improvements	Fishing vessel improvements (e.g., engines, maintenance)	Support for thorough vessel refits may allow fishermen to operate more safely and efficiently near wind farms. Could improve safety by supporting rigorous checks and replacement of essential equipment, such as engines, and improve profitability by minimizing costs associated with unscheduled maintenance. Could be supported through a pre-arranged fund paid into by developers	Mitigation	<ul style="list-style-type: none"> Government Developer 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: COWRIE 	
Business improvements	Fuel subsidies to fishermen	Government provides subsidies in the form of a fixed <i>reduction off fuel</i> prices to reduce fuel costs to fishermen and alleviate potential wind farm impacts to profitability	Mitigation	<ul style="list-style-type: none"> Government 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: COWRIE 	
Business improvements	Gear development or modification support	Developer provides financial support if there is a need for conversion to wind facility-safe fishing gear. Could also be funded through government incentive/research programs	Mitigation	<ul style="list-style-type: none"> Government Developer 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: BOEM, COWRIE 	

⁴¹ “About West of Morecambe Fisheries Ltd,” last modified 2015, West of Morecambe Fisheries Ltd, accessed August 11, 2015, <http://www.westofmorecambe.com/24/what-we-do>.
Options for Cooperation: Commercial Fishing and Offshore Wind – November 2015

Tool	Best Practice	Description	Strategy	Responsible Party	Phase of Development	Literature & Case Study Examples	Other Examples
Business improvements	Insurance support	Financial support for potentially higher insurance premiums required of fishermen choosing to fish within wind farms	Mitigation	<ul style="list-style-type: none"> Government Developer 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: COWRIE 	
Business improvements	Local biodiesel production facilities	Installation of biodiesel production units at ports to reduce use of conventional diesel by fishermen; supports development of sustainable fishing industry practices. May utilize fish waste by-products for raw material. Potentially reduces fuel costs to both fishermen and developers	Mutually beneficial cooperation	<ul style="list-style-type: none"> Government Port 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting Construction / Operations 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: COWRIE 	
Business improvements	Local fisheries promotions	Developer assists in providing capital/funding for marketing campaigns to promote fishery products to increase demand for locally-produced food and increase fisheries' viability and profitability	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Lit: COWRIE US: Block Island Wind Farm, Cape Wind 	
Business improvements	Lost/damaged gear fund	Developer pays into a fund for compensating fishermen who sacrifice gear that snagged on submarine cables. Fund manager would either write checks or provide new gear to fishes	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> UK: Westernmost Rough Offshore Wind Farm US: Oregon Fishermen's Cable Committee 	
Business improvements	Tourism, recreation and other roles	Promotion of opportunities for fishermen to supplement income through guiding sight-seeing tours, recreational fishing, diving, and other activities	Mutually beneficial cooperation	<ul style="list-style-type: none"> Fishing Industry 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: COWRIE, RI Ocean SAMP 	
Business improvements	Training for new fisheries opportunities	Promotion of knowledge exchange of existing fishing opportunities and development of new fishing opportunities	Mitigation	<ul style="list-style-type: none"> Fishing Industry 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: COWRIE 	

Tool	Best Practice	Description	Strategy	Responsible Party	Phase of Development	Literature & Case Study Examples	Other Examples
Communication	Agreements (e.g., Coexistence Plan, Memorandum of Understanding, Statement of Common Ground)	Developer and/or submarine cable companies and fishing industry representatives develop written agreements, such as <i>Coexistence Plans</i> (agreed-upon communication protocols; measures for avoidance, mitigation, and cooperation; and dispute resolution), <i>Memoranda of Understanding</i> (MOU; articulate goals for engaging with fishermen, for example, on routing cables in nonessential fishing areas), and <i>Statements of Common Ground</i> (summarize discussions on areas of agreement and remaining/unresolved conflicts)	Avoidance	<ul style="list-style-type: none"> Developer Cable company Fishing Industry 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting Construction / Operations 	<ul style="list-style-type: none"> US: Oregon Fishermen's Cable Committee 	<ul style="list-style-type: none"> The UK National Federation of Fishermen's Organizations (NFFO) has developed a Coexistence Plan for interactions with wind developers, and as of June 2015 it is in review by the FLOWW group⁴² As of June 2015, developer Vattenfall has been developing a Coexistence Plan with fishermen at several wind farms⁴³ As of June 2015, Subsea Cables UK has established MOUs with the Scottish Fishermen's Federation and NFFO⁴⁴ In June 2013, Vattenfall and ScottishPower Renewables in the joint venture East Anglia ONE Limited established a Statement of Common Ground with fishing industry representatives operating near the East Anglia ONE Offshore Wind Farm in the UK⁴⁵
Communication	Cable communication and awareness system	Developer establishes system to ensure fishermen/other mariners have access to information about cable placement, especially to avoid gear fouling (e.g., website, updated navigational charts)	Avoidance	<ul style="list-style-type: none"> Developer Fishing Industry 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Lit: FLOWW UK: Thanet Offshore Wind Farm, London Array US: Oregon Fishermen's Cable Committee, Block Island Wind Farm 	<ul style="list-style-type: none"> Seafish, a UK public body set up to improve efficiency and raise standards across the seafood industry, created a publicly-available online resource in 2012 called KIS-ORCA that provides fishermen with maps of submarine cables and wind farms with cable-specific emergency contact information⁴⁶

⁴² Anonymous interview participant representing the National Federation of Fishermen's Organizations, interview by Stephanie Moura, June 11, 2015.

⁴³ Anonymous interview participant representing Vattenfall Wind Power, interview by Stephanie Moura, June 18, 2015.

⁴⁴ Anonymous interview participant representing Subsea Cables UK, interview by Stephanie Moura, June 11, 2015.

⁴⁵ Anonymous interview participant representing Vattenfall Wind Power, interview by Stephanie Moura, June 18, 2015.

⁴⁶ "About Us," last modified 2015, KIS-ORCA, accessed August 31, 2015, http://www.kis-orca.eu/about-us#.VeSiu_lVhBc.

Tool	Best Practice	Description	Strategy	Responsible Party	Phase of Development	Literature & Case Study Examples	Other Examples
Communication	Environmental Monitoring Plan	Development of a plan that includes measures for monitoring and incident reporting environmental damage, and conveys procedures regarding routine inspections and communication with fishing community	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: BOEM 	<ul style="list-style-type: none"> Beginning in 2001, developer E.ON Climate & Renewables established an ongoing Marine Environment Monitoring Program for the Robin Rigg Offshore Wind Farm in Scotland to establish protocol for recording any changes to the physical and ecological environment due to wind farm operation and construction⁴⁷
Communication	Fisheries liaison	A position or function, typically <i>employed directly or contractually by the developer</i> , that provides fisheries community outreach, communication and coordination services	Avoidance, Mitigation, Mutually beneficial cooperation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting Construction / Operations 	<ul style="list-style-type: none"> Lit: BOEM, FLOWW UK: First Flight Wind, Greater Gabbard Offshore Wind Farm, Thanet Offshore Wind Farm, London Array, Neart na Gaoithe Offshore Wind Farm, Westernmost Rough Offshore Wind Farm US: Block Island Wind Farm CA: One Ocean Canada 	
Communication	Fisheries representative	A position or function, <i>often funded by but not employed by the developer</i> , to "speak for" the fishing communities' interests and to conduct outreach/ communication	Avoidance, Mitigation, Mutually beneficial cooperation	<ul style="list-style-type: none"> Developer Fishing Industry 	<ul style="list-style-type: none"> Planning Leasing Site Assessment/ Project Design/ Permitting Construction / Operations 	<ul style="list-style-type: none"> Lit: BOEM, FLOWW UK: Thanet Offshore Wind Farm, London Array, Westernmost Rough Offshore Wind Farm US: Block Island Wind Farm 	
Communication	Fishing industry capacity building	Support for the fishing industry by enhancing the capacity of fishing interests to engage on fish/wind or other related issues. This has taken the form of supporting industry-representative staff, who dedicate time and resources to addressing sources of conflict or other issues	Mitigation	<ul style="list-style-type: none"> Fishing Industry 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting Construction / Operations 	<ul style="list-style-type: none"> UK: Westernmost Rough Offshore Wind Farm US: Block Island Wind Farm 	

⁴⁷ Richard Walls, Sarah Canning, Gillian Lye, Laura Givens, Claudia Garrett, and Jane Lancaster, "Analysis of Marine Environmental Monitoring Plan Data from the Robin Rigg Offshore Wind Farm, Scotland (Operational Year 1)," Report by E.ON and Natural Power (2013).

Tool	Best Practice	Description	Strategy	Responsible Party	Phase of Development	Literature & Case Study Examples	Other Examples
Communication	Government-to-industry and industry-to-industry groups	Establishment of formal and informal groups (e.g., working groups, advisory bodies, committees) with representation from local fishing industry groups, offshore wind developers and/or government for voicing concerns and facilitating discussions on collaborative problem-solving. The establishment of both government-to-industry and industry-to-industry bodies in tandem for a given offshore wind project has been shown to be effective.	Avoidance, Mitigation, Mutually beneficial cooperation	<ul style="list-style-type: none"> Government Developer 	<ul style="list-style-type: none"> Planning Leasing Site Assessment/Project Design/Permitting Construction / Operations 	<ul style="list-style-type: none"> Lit: BOEM UK: First Flight Wind, Greater Gabbard Offshore Wind Farm, Neart na Gaoithe Offshore Wind Farm US: Block Island Wind Farm 	<ul style="list-style-type: none"> As of June 2015, developers Mainstream Renewable Power and Vattenfall have established Commercial Fisheries Working Groups with fishermen operating locally to their wind farms in the UK.^{48,49} Early in the state-federal offshore wind planning process for MA, the Commonwealth established the Fisheries Working Group on Offshore Renewable Energy (FWG). Since 2009, this government-to-industry group has been a forum for information exchange and consultation during the offshore wind planning and leasing phases. With the 2014/15 award of leases to developers, the FWG indicated its interest in continuing as forum for both government-to-industry and industry-to-industry consultation as the site assessment and construction and operations phases proceed.⁵⁰ The RI Ocean SAMP established a government-to-industry Fishermen's Advisory Board (FAB), which provides advice to the RI Coastal Resources Management Council on the siting and construction of other uses, including offshore wind, in marine waters.⁵¹

⁴⁸ Anonymous interview participant representing Vattenfall Wind Power, interview by Stephanie Moura, June 18, 2015.

⁴⁹ Anonymous interview participant representing Mainstream Renewable Power, interview by Stephanie Moura, June 1, 2015.

⁵⁰ *Massachusetts Ocean Management Plan*, Massachusetts Executive Office of Energy and Environmental Affairs (2015).

⁵¹ Chapter 5: Commercial and Recreational Fisheries, Rhode Island Coastal Resources Management Council, Rhode Island Ocean Special Area Management Plan (Ocean SAMP) (2010).

Tool	Best Practice	Description	Strategy	Responsible Party	Phase of Development	Literature & Case Study Examples	Other Examples
Communication	Navigational chart updates	Update navigational charts to reflect changes that wind farms may have on navigation to ensure safe passage in the vicinity of wind farms	Mitigation	<ul style="list-style-type: none"> Government 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: BOEM 	
Communication	Operational Inspection and Maintenance Plan	Development of a plan that includes measures for incident reporting of structural damage; and conveys procedures regarding storms, routine inspections, maintenance, communication with fishing community	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: BOEM 	
Communication	Port operational interface group	A group of developers, fishermen's associations, and vessel operations contractors that meets regularly (e.g., once a month) to discuss port operations and any need for changes	Mutually beneficial cooperation	<ul style="list-style-type: none"> Developer Port Fishing Industry 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> UK: London Array, Thanet Offshore Wind Farm 	
Communication	Safety communication systems	Input from fishermen on development of a safety management system, including clear communication protocols with the fishing industry, such as use of Radio Navigational Warnings (via dedicated VHF channel) and Notices to Mariners to provide continuous updates	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting Construction / Operations 	<ul style="list-style-type: none"> Lit: BOEM UK: London Array, Neart na Gaoithe Offshore Wind Farm US: Block Island Wind Farm CA: One Ocean Canada 	
Compensatory mitigation	Compensation agreements (individual and/or collective)	Financial compensation in instances of demonstrable loss. Amount of compensation usually pre-determined in an agreement between the developer and fishing industry representatives	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Lit: RI Ocean SAMP UK: Greater Gabbard Offshore Wind Farm, Neart na Gaoithe Offshore Wind Farm, Thanet Offshore Wind Farm US: Block Island Wind Farm 	

Tool	Best Practice	Description	Strategy	Responsible Party	Phase of Development	Literature & Case Study Examples	Other Examples
Cooperative research	Joint data collection/ impact studies	Developer commissions studies for assessing potential fishery-specific impacts from wind farms, including protocol design and execution of before/after construction marine resource surveys. Developer may employ fishermen for conducting surveys	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting Construction / Operations 	<ul style="list-style-type: none"> Lit: COWRIE, RI Ocean SAMP UK: Neart Na Gaoithe Offshore Wind Farm, Westernmost Rough Offshore Wind Farm US: Block Island Wind Farm 	<ul style="list-style-type: none"> At least since 2009, developer Vattenfall has engaged fishermen in conducting before/after construction surveys of fish and shellfish near the Kentish Flats Offshore Wind Farm in the UK⁵² A 2015 BOEM report suggests cooperative approaches for measuring impacts of wind farms on fisheries resources⁵³
Facilities design, construction and operations	Coordinating construction schedule	Consideration of temporal factors in scheduling construction activities to minimize impact to fishery and fishing activities: high-use areas, seasonality, and closure periods	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: BOEM, RI Ocean SAMP 	
Facilities design, construction and operations	Bubble curtain	Generation of an underwater wall of bubbles to decrease submarine noise, particularly during construction/pile driving, to reduce negative impacts on marine life, particularly mammals	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Construction / Operations 		<ul style="list-style-type: none"> As of June 2015, select offshore wind farm developers in Denmark have used bubble curtains while conducting underwater construction to reduce submarine noise, particularly for marine mammals⁵⁴
Facilities design, construction and operations	Cable burial	Submarine transmission cable (trunk and/or inter-array) burial to depth that minimizes risk of gear and cable damage	Avoidance	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting 	<ul style="list-style-type: none"> UK: Greater Gabbard Offshore Wind Farm, London Array, Neart na Gaoithe Offshore Wind Farm, Thanet Offshore Wind Farm US: Block Island Wind Farm 	
Facilities design, construction and operations	Maximizing fishing access	Fishing access to wind farm site allowed/maintained to maximum extent practicable during any/all phases of wind farm development and operation	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting Construction / Operations 	<ul style="list-style-type: none"> Lit: BOEM UK: Thanet Offshore Wind Farm, Westernmost Rough Offshore Wind Farm US: Block Island Wind Farm, Cape Wind 	

⁵² “Kentish Flats Offshore Wind Farm: FEPA Monitoring Summary Report,” Vattenfall A/S (2009), http://www.vattenfall.co.uk/en/file/1_Kentish_flats_FEPA_monitoring.pdf_16403566.pdf.

⁵³ Margaret Petruny-Parker, Anna Malek, Michael Long, David Spencer, Fred Mattera, Emerson Hasbrouck, John Scotti, Kristen Gerbino, and Jacqueline Wilson, “Identifying Information Needs and Approaches for Assessing Potential Impacts of Offshore Wind Farm Development on Fisheries Resources in the Northeast Region,” U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, (2015).

⁵⁴ Anonymous interview participant representing Port of Esbjerg, interview by Stephanie Moura, June 8, 2015.

Tool	Best Practice	Description	Strategy	Responsible Party	Phase of Development	Literature & Case Study Examples	Other Examples
Facilities design, construction and operations	Minimal impact cable routing	Taking into account fishing grounds bottom-type/other characteristics to minimize interaction with mobile fishing gear	Avoidance, Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Planning Site Assessment/ Project Design/ Permitting Construction / Operations 	<ul style="list-style-type: none"> Lit: COWRIE, RI Ocean SAMP US: Block Island Wind Farm 	<ul style="list-style-type: none"> The 2015 MA Ocean Management Plan identifies areas to avoid and areas of concern for siting offshore wind transmission cables⁵⁵
Facilities design, construction and operations	Optimizing wind and cable facilities siting, routing and design	Developer consults fishermen to inform project siting, turbine location, spacing and design, and inter-array and transmission cable routes and design. The earlier in the process the better	Avoidance	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting 	<ul style="list-style-type: none"> Lit: BOEM, RI Ocean SAMP US: Oregon Fishermen's Cable Committee CA: One Ocean Canada 	
Facilities design, construction and operations	Overtrawl surveys	Upon completion of submarine cable installation and burial, and/or regularly during operations and after significant storms, developer conducts trawl surveys to ensure cables are sufficiently buried for fishing safety, i.e., fishing gear does not snag on cables. Developer may hire fishermen to conduct surveys	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> UK: Neart na Gaoithe Offshore Wind Farm 	<ul style="list-style-type: none"> As of June 2015, developers Mainstream Renewable Power and Vattenfall have conducted overtrawl surveys on their wind farms^{56,57} As of June 2015, fishermen represented by the Scottish Fishermen's Federation have been employed by developers to conduct overtrawl surveys⁵⁸
Facilities design, construction and operations	Port-/shore-side improvements	Developer—potentially supported by the port—funds improvements to onshore infrastructure associated with fishing and wind facility	Mitigation	<ul style="list-style-type: none"> Developer Port 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Lit: BOEM, COWRIE UK: Thanet Offshore Wind Farm, London Array 	
Facilities design, construction and operations	Scheduling of noise-generating activities	Conducting noise-generating activities in closed fishery season	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: RI Ocean SAMP 	
Facilities design, construction and operations	Turbine markings	Use of warning lights (including marine navigational lighting [MNL] and avian obstruction lighting [AOL]), radar beacons, and reflective tape on turbines for navigational safety	Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Lit: BOEM UK: Neart na Gaoithe Offshore Wind Farm 	

⁵⁵ “Appendix 5 – Areas to Avoid and Areas of Concern for Siting Analysis for Offshore Wind Transmission Cable Corridors,” *Massachusetts Ocean Management Plan*, Massachusetts Executive Office of Energy and Environmental Affairs (2015).

⁵⁶ Anonymous interview participant representing Mainstream Renewable Power, interview by Stephanie Moura, June 1, 2015.

⁵⁷ Anonymous interview participant representing Vattenfall Wind Power, interview by Stephanie Moura, June 18, 2015.

⁵⁸ Anonymous interview participants representing Scottish Fishermen’s Federation, interview by Stephanie Moura, June 8, 2015.

Tool	Best Practice	Description	Strategy	Responsible Party	Phase of Development	Literature & Case Study Examples	Other Examples
Facilities design, construction and operations	Turbine micro-siting	Particular placement of turbines within wind farm site taking into account fishing ground characteristics and access issues for various vessel/gear types	Avoidance	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Site Assessment/ Project Design/ Permitting 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: COWRIE 	
Facilities design, construction and operations	Vessel transit considerations	Developer sets up routing options to improve navigational safety in areas where freedom of vessel movement is inhibited by restricted ocean space and obstructions to navigation	Avoidance, Mitigation	<ul style="list-style-type: none"> Developer 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: BOEM 	
Fisheries management	Fisheries management measures	Fisheries managers develop management measures with agreed management principles to increase overall fishery functioning and profitability (e.g., catch shares, permit discount programs, fisheries/vessel sustainability certifications)	Mitigation, Mutually beneficial cooperation	<ul style="list-style-type: none"> Government Developer Fishing industry 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Lit: COWRIE US: Cape Wind 	
Fisheries resource enhancement	Habitat enhancements	Design of ecosystem habitat enhancements, such as the creation of artificial reefs on wind farm infrastructure, for attracting commercially-targeted species. Also, enhancement of shellfish and finfish stocks from transfer of hatchery or wild juveniles or mature animals to wind farm area	Mitigation, Mutually beneficial cooperation	<ul style="list-style-type: none"> Government Developer Fishing industry 	<ul style="list-style-type: none"> Construction / Operations 	<ul style="list-style-type: none"> Identified only in literature; no known examples in practice Lit: COWRIE, RI Ocean SAMP 	<ul style="list-style-type: none"> In 2010, the Shellfish Association of Great Britain conducted a small scale aquaculture trial cultivating blue mussels on the seabed at the North Hoyle Offshore Wind Farm, which demonstrated the viability and practicality of the operation⁵⁹
Ocean planning	Offshore wind compatibility assessment	Use of best available data on fishing activities, fishery resources, and feasible energy development areas to identify candidate wind energy areas with no- to low-conflict with fishing	Avoidance	<ul style="list-style-type: none"> Government Developer 	<ul style="list-style-type: none"> Planning 	<ul style="list-style-type: none"> Lit: BOEM, COWRIE, RI Ocean SAMP US: Block Island Wind Farm 	

⁵⁹ *Shellfish News*, Centre for Environment Fisheries & Aquaculture Science and Department for Environment Food & Rural Affairs, no. 36 (2013): 26,34, accessed August 31, 2015, <http://www.cefasc.defra.gov.uk/publications/shellfishnews/sfn36-v2.pdf>.

Appendix 4: Resources on Offshore Wind Farm Compatibility with Fisheries of Various Gear Types

- Rodmell, D. P. and M. L. Johnson. *The Development of Marine Based Wind Energy Generation and Inshore Fisheries in UK Waters: Are They Compatible?* Scarborough Centre for Environmental and Marine Sciences, University of Hull (2005): 38.
- SeaPlan. *Commercial Fishing and Offshore Wind Energy Working Session*. Meeting summary, New Bedford, MA, June 10, 2011.