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Development of cumulative impact assessment guidelines for offshore wind farms and evaluation of use in project making

Abstract:

The offshore wind energy sector in the UK has grown rapidly since the first turbine generators were installed in 2000: by 2016 there were over 1400 installed turbines with combined capacity of 5.1GW. The sector is considered by UK Government as essential to the development of a low carbon economy and to meeting binding targets on carbon reduction and renewable energy generation. The Crown Estate, responsible for licensing development on the sea bed around the UK, has held 3 rounds of licensing since 2000 for wind developments. Some of the projects in the first two rounds suffered long delays due to uncertainty of project level impacts, particularly cumulative impacts. A number of key stakeholders identified a need for cumulative impact assessment methodology to be developed that was definitive and endorsed by regulators and industry to aid unblocking barriers to delivery. This paper explores the background to the development of such guidelines and how they were 'co-created' with industry and regulators. We evaluate to what extent they have been used to shape and develop practice.

Keywords: cumulative impacts; offshore wind farms; guidelines

Introduction

Cumulative impacts (or effects as they are also often interchangeably referred to) have been defined as 'the accumulation of changes in environmental systems over time and across space in an additive or interactive manner' (Spaling 1994). Cumulative impacts can result from multiple impacts from the same project or the combined impact of multiple developments giving rise to multiple impacts. Whilst the impacts from a single development may not be significant on their own, when combined with others the resultant effect could be significant (Broderick et al 2018). Cumulative impact assessment (CIA) is a systematic procedure for identifying and evaluating the significance of the impacts from multiple activities with the purpose of considering the incremental contribution of the project together with impacts from other past, present and reasonably foreseeable future activities. Assessing cumulative impacts is complex; it has been described by Hegmann and Yarranton (2011) as 'like forecasting weather or climate (as) the system under examination is complex and often responds to disturbance in a non-linear fashion'.

CIA attracts a lot of academic interest: a search of the Impact Assessment and Project Appraisal (IAPA) journal alone revealed 310 articles that address the assessment of cumulative impacts. The findings of a review of the international academic peer reviewed literature carried out by Duinker et al (2013) highlighted a number of areas for improvement in CIA practice including that future guidance needed to focus on a range of factors comprising (amongst others) the importance of collaboration of relevant stakeholders and implementation of appropriate governance models (which needs to be acknowledged and addressed). Prior to 2013, a number of studies and reports had

described CIA practice as inadequate and unsatisfactory across all industry sectors, with few assessments at any level adequately considering cumulative impacts (e.g. IEMA 2011, Canter and Ross 2010, Warnback and Hilding-Rydevik 2009). The absence of effective assessments of cumulative impacts had been cited as being a function of (amongst other issues) a lack of guidance (e.g. Cooper and Sheate 2002). Since 2002, a range of CIA guidance from different sectors, countries and industries has appeared (e.g. Cooper 2004, DEAT 2004, Land Use Consultants 2006, Natural England 2014, Canter 2015, Broderick, et al 2018) and practical experience is building internationally (e.g. IFC 2013).

This paper explores the challenges in developing guidance for CIA by focusing on the case of United Kingdom (UK) offshore wind industry. Academic literature that addresses CIA in offshore wind energy developments emphasises the complex challenges in assessing impacts in such a dynamic environment. Much literature attempts to quantify the impacts on specific valued ecological components at project level (e.g. King et al 2013, Masden et al 2010, Maclean et al 2009, Wright and Kyhn, 2009). Others highlight challenges and weakness in addressing issues at a strategic level (e.g. Cooper 2004, Phylip-Jones and Fischer, 2015, Therivel and Ross 2007) and note the need for a better establishment of tiering between strategic level assessments and project level and vice versa (Phylip-Jones and Fischer 2015).

This industry is acknowledged as being of huge potential value to the UK both financially and in decarbonising the economy. The industry has grown exponentially over the last 26 years and as it grew, the consenting process suffered increasing delays due to, amongst other factors, the potential cumulative impacts of developments. As the industry evolved, the need for CIA guidance was increasingly recognised by industry and

other stakeholders, however, how this guidance would be developed to ensure that it was acceptable to the diverse actors involved and how it would be implemented, was of concern. This paper therefore explores two issues: i) how the complexity of projects evolved as the industry developed and an increasing need for CIA emerged and ii) the challenges to developing and implementing guidance within such an evolving complex project environment which also involves diverse stakeholders with potentially conflicting interests.

The paper begins by setting out the evolution of the offshore wind farm (OWF) industry in the UK since its origins in 1992; it explores the challenges with the consenting regime and the increasing recognition of need for guidance in CIA. It then addresses some of the challenges to developing guidance via a brief exploration of practice theory, before setting out how the OWF CIA guidance was developed through stakeholder collaboration. Finally, to evaluate whether the guidance is shaping practice, the findings from a review of the documentation submitted *ex ante* for ten OWF developments registered for consent between 2013 (after the guidance was published) and to-date (mid 2018) in England and Wales are presented. Only one of the OWF developments has reached the stage of being operational at the time of writing (mid 2018) so the paper does not including findings from *ex post* research into the effectiveness of the assessments. An evaluation of the quality of practice of seven of the OWF through content analysis of the *ex ante* documentation using the application of an innovative CIA analytical framework and the generation of case studies of practice, has been undertaken previously and the results are published in Durning and Broderick (2015).

Evolution of the Renewable Energy Offshore Wind Sector

The wind energy generating sector and particularly offshore wind, is considered by the

UK Government as essential to contributing to the development of a low carbon UK economy (HM Government 2013, 2017). The origins of the OWF sector in the UK can be traced back to a demonstration project called the Blyth Harbour Windfarm in the north east of England completed in 1992 (Dawley 2013). The first operational OWF was the Blyth OWF in 2000 which consisted of two 2 megawatt (MW) generating capacity turbines located approximately 1.5km offshore. Since then the size of installed offshore wind has increased substantially (TCE 2017a) and by December 2016 the UK had 1463 operating turbines with combined capacity of 5.1GW (36% of global capacity) and a further 830 turbines under construction. The generating capacity of turbines is also rapidly increasing with the largest to date (8.4MW) being installed in 2018 in the Aberdeen OWF off the east coast of Scotland (Vattenfall 2016).

The drivers for the rapid evolution of the UK OWF sector can be traced back to implementation of European Union (EU) legislation developed in response to the global challenge of climate change. In 2007 the EU set binding greenhouse gas emission levels and energy targets for it to achieve by 2020 (EU 2018). The targets were:

- 20% cut in greenhouse gas emissions (from 1990 levels);
- 20% of EU energy to come from renewable sources; and
- 20% improvement in energy efficiency.

The targets were enacted in legislation in 2009 through the EU Renewable Energy Directive (RED) (2009). The RED set EU Member countries binding national targets for raising the share of renewables in their energy consumption by 2020. To reflect countries' different starting points for renewables production and ability to further increase it, these targets varied from country to country. For the UK the target was to raise the share of energy from renewable sources in gross final consumption of energy from a baseline of

1.3% in 2005 to 15% by 2020 (EU 2009). The EU Directive and binding targets were transposed into UK legislation in 2011 as the Promotion of the Use of Energy from Renewable Sources Regulations.

In terms of progress towards this target, by 2016 renewable energy provision in the UK accounted for 8.9% of final energy consumption, with OWF contributing 19.7% of the share (BEIS 2017) (Table 1).

Table 1 – Renewable electricity generation (source BEIS 2017)

		Renewable source and generation in year (TWh)												
Year	Total generation from renewable in year (TWh)	Onshore wind	**Offshore wind**	Shoreline wave/tidal	Solar photovoltaics	Hydro small scale	Hydro large scale	Landfill gas	Sewage sludge digestion	Municipal solid waste combustion	Co-firing with fossil fuels	Animal biomass	Anaerobic digestion	Plant biomass
2014	64.5	18.6	**13.4**	0	4.1	0.8	5.1	5.0	0.8	1.9	0.1	0.6	1.0	13.1
2015	83.4	22.9	**17.4**	0	7.5	1.0	5.3	4.9	0.9	2.6	0.2	0.6	1.5	18.6
2016	83.2	21.0	**16.4**	0	10.4	1.0	4.4	4.7	1.0	2.7	0.1	0.7	2.1	18.8
% share in 2016		25.2 %	**19.7 %**	0 %	12.5 %	1.2 %	5.3 %	5.7 %	1.1 %	3.3 %	0.1 %	0.8 %	2.5 %	22.6 %

The UK is expected to leave the EU in 2019, however, the current European Commission *acquis* (the 'common rights and obligations') which are binding on all Member states (EC 2016) may not all be discarded in the exit negotiations. Given that the UK is party to other international climate change agreements (e.g. Paris agreement) it is likely that transposed regulations will be retained. The UK Government Committee responsible for issues addressing energy and climate change observed in 2016 that 'if the UK misses, or reneges on its commitment to the 2020 renewables target this will undermine confidence in its commitment to future targets, including the 2050 decarbonisation objectives of the Climate Change Act 2008…both are Government

promises in which stakeholders must be able to trust' (House of Commons, 2016). The Committee recommended that the Government must commit and deliver on its renewables commitments.

So, whilst currently (in 2018) policy is being effective in progressing the UK towards meetings its RED targets, in 2009 when the legislation first came in, it was acknowledged that within the UK the support (political and market based) for renewables did not really exist (DECC 2010). Specific policy measures to encourage renewable energy technologies had only begun to appear after the privatisation of the electricity supply industry (ESI) in 1990 (Carpenter et al 2012) with the introduction of the Non-Fossil Fuel Obligation (NFFO) (replaced by the UK Renewables Obligation (RO) in 2002). However, the overriding motive for privatisation was not explicitly to support the renewable industry consequently other enabling mechanisms such as funding to support research and development and innovation in technology were not put in place at the time. Privatisation of the ESI also did not introduce a landscape of competition between multi suppliers as it had in other countries such as Germany but rather 'remained wedded to the idea of oligopolistic competition with a small number of large scale suppliers' (Simmie et al 2014). In order to promote development of the OWF industry to be able to meet its obligations, the UK Renewable Energy Action Plan (DECC 2010) therefore contained three key components essential to action necessary to stimulate the industry and meet the requirements of the Directive:

(1) financial support for renewables;
(2) unblocking barriers to delivery; and
(3) developing emerging technology.

Unblocking barriers to delivery – challenges with the consenting regime for OWF

The seabed around the UK coast up to 12 nautical miles (nm) (1.84km) is owned by The Crown Estate (TCE) (TCE Scotland was established as a separate body in 2017). The 2004 Energy Act gave rights to TCE to provide licences for the generation of renewable energy beyond 12nm and by 2017, there had been three licensing rounds, each with differing characteristics (BVG 2009, Renewable UK 2011):

- Round 1, announced in December 2000, consisted of 18 demonstration projects in 13 locations with total capacity of 1GW located relatively close to shore in English or Welsh territorial waters and generally small in scale;
- Round 2, announced in July 2003, consisted of 15 sites with potential capacity of over 7GW, all within English and Welsh territorial waters, but generally larger in scale and slightly further offshore the Round 1. A later Scottish leasing Round (in 2009) contained projects similar in size to those in Round 2, but located within Scottish territorial waters; and
- Round 3, announced in June 2008, consisting of 9 zones (rather than individual sites) with potential for further 25GW. These where located in deeper waters.

Between Round 2 and 3 a change in the consenting process for projects in English and Welsh territorial waters began to occur. Prior to 2008, the legislative consenting process for the offshore element (i.e. generation (turbines) and transmission (offshore cables)) was through Section 36/37 of the Electricity Act 1989 (as amended) with the decision made by national government. However, the onshore element (onshore cables above Mean High Water Springs (MHWS) and sub-station compound) was consented under the Town and Country Planning Act 1990 (decision by local government but could be appealed to Secretary of State). In 2008 the Planning Act 2008 (PA 2008) came into

force. Under this legislation offshore windfarms above 100MW (PA 2008 S15 (3)) would be classed as National Significant Infrastructure Projects (NSIPs) with a single consenting process combining both the offshore and the associated onshore element with decision made by an independent commission (Infrastructure Planning Commission). Subsequently this changed in 2011 under the Localism Act to the decision being made by relevant Secretary of State following a recommendation by an Examining Authority. The consenting process in Scotland still maintains the two-stage process. In preparation for Round 3 and the change in consenting processes, Renewable UK (RUK) (the trade association for the renewables industry) carried out a study of 'lessons learnt' from Licensing Rounds 1 and 2 (RUK 2011) which exposed the increasing complex challenges being face by the industry as it evolved.

Round 1 lessons learnt:

A number of concerns repeatedly caused delays across project; table 2 shows the projects consented during this round (ordered in length of time taken) and the cause for delay. Concerns around impact on birds, commercial fisheries and navigation appear on a number of occasions. The time taken to obtain consent - this is taken as the time from the point where documentation is submitted to the consenting authority and a decision is made - for the majority of consents was less than 16 months, although one did take 39 months and one was not consented.

Table 2 – 'Round 1' projects (source RUK, 2011)

Project and coastal location	**Size (generating capacity**	**Consenting period (months)**	**Principal cause for delay**

	Mw)		
North Hoyle (North Wales coast)	60	5	None
Kentish Flats (south-east England)	90	7	None
Ormonde (north-west England)	150	7 (plus 9 months for capacity increase)	Navigation (search and rescue); birds (Pink Footed Geese and Whooper Swans); fish (salmon spawning); underwater noise (piling)
Rhyl Flats (north Wales)	90	9	None
Barrow (north-east England)	90	10	Navigation; birds (Common Scooter); Government (Ministry of Defence); commercial fishing
Gunfleet Sands 1 (east England in Southern North Sea)	108	10	Port of London Authority (PLA) radar update
Burbo Bank (north-west England)	90	10	None
Cromer (east England)	Not constructed – consent 'handed back'	11	Commercial fishing
Scarweather sands (south Wales)	Not constructed – consent 'handed back'	12	None
Robin Rigg (west Scotland, Dumfries and Galloway)	180	12	None. Cross border issue of windfarm in Scotland and onshore cable connection in England
Scroby Sands (east of England)	60	13	None
Lynn & Inner Dowsing (east England)	194.4	14	Birds (Red Throated Diver); aviation (radar)
Teeside (north-east England)	62.1	39	Local planning authority requested a public inquiry. Secretary of State did not hold an inquiry but considered the objections which related to: visual impacts, birds, navigation, beach replenishment, noise, release of contaminants from marine sediments, impact on human environment (regeneration of local community, property prices, recreation and tourism)
Cirrus Shell Flats (north-west England)	Consent not given	-	Birds and military aviation (interference with radar), the latter being the main cause of consent not being given.

Round 2 lessons learnt:

Table 3 shows the time taken for projects consented in this round (in order of time taken) and the main causes of delay. The consent process clearly was longer than in Round 1, which RUK (2011, p8) considered was due to: the larger spatial scale in Round 2; the increase in the number of European Protected sites since Round 1 leading to a greater requirement for Habitat Regulatory Assessments (HRA); a greater requirement to consider the potential cumulative and in-combination impacts with other wind farms and

users of the sea, leading to, for example, more complex HRA processes.

Table 3 ‘Round 2’ projects (source: RUK, 2011, DECC, 2012, National Infrastructure Planning, 2018)

Project and coastal location	**Size (generating capacity Mw)**	**Consenting period (months)**	**Principal cause for delay**
Gunfleet Sands 2 (east England in Southern North Sea)	64.8	8	Birds (Red-Throated Diver)
Thanet (south-east England)	300	13	Fish (spawning); aviation (Manston airport); noise (fish and marine mammals); birds (cumulative impacts on Red-Throated Diver)
Greater Gabbard (east England)	504	18	Noise (spawning fish)
London Array (south-east England)	630	18	Birds (Red-Throated Diver); noise (fish spawning); commercial fisheries (compensation); aviation (compensation); anciliary works
Lincs (east England)	270	19	Birds (Pink Footed Geese); benthic; marine mammals (Grey Seal); aviation (National Air Traffic System)
Walney 1 &2 (north west England)	183.6&183.6	20	Birds
Sheringham Shoal (east England)	315	21	Aviation and Ministry of Defence relating to National Air Traffic System /Greater Wash issue
Westernmost Rough (east England, Yorkshire and Humber region)	240	23 months to Oct 2011 (consented in Nov 2011 – 24 months in total)	None stated
West of Duddon Sands (north west England)	389	29	Birds (Pink Footed Geese and Whooper Swans); commercial shipping objections
Humber Gateway (east England, Yorkshire and Humber region)	300	35	Aviation and Ministry of Defence relating to National Air Traffic System /Greater Wash issue
Dudgeon (east England)	560	27 months to Oct 2011 (consented in July 2012 – 36 months in total)	Cumulative impacts on Sandwich Tern); Ministry of Defence (cumulative); National Air Traffic System (cumulative)
Gwynt y Mor (north Wales)	576	37	Birds (Common Scoter, Red Throated Diver); visual impacts/tourism; navigation (implication of Traffic Separation System)
Race Bank (east England)	620	33 months to Oct 2011 (consented in July 2012 – 39 months in total)	Birds (Sandwich Terns, cumulative); Aviation and Ministry of Defence relating to National Air Traffic System /Greater Wash issue
Docking Shoal (east England)	540	34 months to Oct 2011. Consent refused in July 2012 (43 months in total from submission to decision)	Birds (Sandwich Tern, cumulative); Aviation and Ministry of Defence relating to National Air Traffic System /Greater Wash issue
Triton Knoll (east England)	1200 (proposed)	Submitted January 2012. This application was consented under the Planning Act 2008 regime. Consent for offshore turbine array was given in July 2013 (18 months) and for onshore cable in 2016 (separate consents).	Birds (Gannet); National Air Traffic System and Ministry of Defence (Greater Wash)

At the time the RUK report was published (October 2011) four projects were still waiting consent (Race Bank, Dudgeon, Westernmost Rough and Docking Shoal). Three of the four projects were eventually consented (Table 3 contains the updated consenting period) whilst the fourth (Docking Shoal) was refused. This is an interesting and significant example of decision making taking cumulative impacts into consideration. Docking Shoal, Dudgeon and Race Bank proposed OWF were all located off the Norfolk coast (east England) close to an area designated as a Special Protection Area (SPA) under the EC Birds Directive. For all three OWF, there were concerns for the integrity of the SPA through potential effect on a valued ecological component (the Sandwich terns (bird) *Sterna Sandvicensis*). In setting out the rationale for the final decision made the Secretary of State, in his decision letter (DECC, 2012) set out the decision options as:

i. consent two (Race Bank and Dudgeon) of the three applications (with no phased building constraints); or

ii. consent all three applications (with phased building constraints).

The Secretary of State concluded that:

'Having considered the matter carefully it is the Secretary of States view that refusal of consent for Docking Shoal (and consenting Race Bank and Dudgeon to their full capacities) would be more efficient overall in terms of implementing UK renewable energy generation policies in a way that is consistent with the environmental protection obligations imposed on the Secretary of State by the Habitats Regulations, than granting consent to the proposed Development with restrictions on first phase build (and with similar restrictions for Race Bank and Dudgeon)'.

Justification for the decision was that Docking Shoal OWF was located closest to the North Norfolk Coast SPA and the foraging areas used by Sandwich Terns and was therefore 'predicted to annually kill on average significantly more breeding Sandwich terns from the North Norfolk Coast SPA per turbine (0.84) than the other two sites (0.45 for Race Bank and 0.31 for Dudgeon)'.

Recognising the need for guidance

The outcome for Docking Shoal was based on the cumulative impact from a number of OWF in the same licensing area. Whilst this was acknowledged, there was concern in the industry over the time taken to make this decision (43 months) (WindPowerOffshore, 2012). The challenges of addressing cumulative impacts was being increasingly recognised, particularly during Round 2 (RUK 2011) with issues around 'lack of experience base and guidance across all industries' in assessing cumulative impacts. Key challenges predicted to arise in Round 3 where identified by RUK (ibid) as:

- adaptation to a new consenting system and regulatory regime (PA 2008) in English and Welsh waters;
- the difficulties of data collection in large areas far offshore;
- uncertainties in the assessment of environmental impacts;
- challenges in the assessment of cumulative impacts;
- obtaining a consent that is fit for purpose; and
- achieving effective monitoring.

During the peak of activity in Round 1 and 2 in the early/mid 2000s, the importance of collaborative working between regulators, stakeholders and developers had begun to emerge (RUK, 2011). A number of groups had come into existence to support this e.g. FLOWW (Fishing Liaison with Offshore Wind and Wet Renewables group) which was

established in 2002 and developed a set of common standards which define how wind farm developers work with the fishing industry (FLOWW, 2014). The need for development of cumulative impact assessment methodologies and guidance where identified by a number of organisations as a high priority for Round 3 developments (MMO 2013). As undertaking assessment of cumulative impacts requires co-ordination between developers and other industries which 'can be challenging' (RUK, 2011), it was considered essential that the guidance should be 'definitive regulatory/industry endorsed guidance' to ensure that approaches for determining potential cumulative impacts were consistent (MMO, 2013).

Challenges to developing guidance – a brief exploration of practice theory

As opined by Nicolini (2012, p.227) 'practices are perpetuated and made durable by people who come to share similar skills, practical concerns and ways of making themselves accountable'. Morgan (2017) refers to the concept of 'best practice' as identifying a set of ideas on how to achieve an optimum outcome and therefore as essentially 'the production and transfer of knowledge'. More particularly, he refers to the transfer of a precisely and formally articulated type of knowledge termed 'explicit' knowledge (Zack,1999 cited in Morgan 2017) or 'propositional knowledge' (Eraut, 1994). This type of knowledge is that derived from reading a manual or guidance e.g. on how to drive a car or ride a bicycle. However, just reading the manual or guidance is not sufficient and to be able to actually drive a car or ride a bicycle, the explicit/propositional knowledge has to evolve into practical knowledge or 'know-how' (Eraut, 1994) i.e. knowledge which underpins practice and cannot be separated from it. Essentially, just producing guidance will not shape practice unless the practitioner actually uses it to develop their level of knowledge and know-how on the methods it seeks to guide (Eraut,

1994, Durning et al, 2010).

Practice, in a generic sense, is not uniform; it can vary from mechanical, operational forms of practice to complex and diffuse processes (such as activities in land use plan and policy making) (Morgan, 2017). Eraut (1994), based on observations of the practice of professionals involved in practice with complex and diffuse processes (medicine, teaching, engineers and architects) identified a third category of knowledge held by such practitioners which he termed 'process knowledge'. This he defined as: 'knowing how to conduct the various processes that contribute to professional action' (p.107). Process knowledge includes knowing how to access and make good use of sources of explicit/propositional knowledge. Therefore, it can be concluded that, in using guidance for a complex assessment such as assessing cumulative impacts, where the spatial-temporal impacts may vary for different receptors, the practitioner needs to develop both the practical knowledge on the methods for assessment and also needs to understand the underlying processes and be able to apply them to different contexts.

In issuing new guidance it has to be recognised that for the level of knowledge to progress from propositional to practical and then for the level of expertise or competence in that practice to move from novice through to expert, the sense and meaning of practice is one that has to be supported and developed (Eraut, 1994, Durning et al 2010, Nicolini 2012). The methods for achieving increasing knowledge to inform their practice will change as their level of expertise changes (Table 2).

Table 2. Methods of knowledge development (based on Figure 2 in Durning et al 2010)

Level of expertise	**Methods of knowledge development utilised at this level of expertise**
Novice – becoming aware of guidance	• Apprentice/experiential and situated learning (e.g. 'on the job') • Formal networks and formal learning (e.g.made aware through stakeholder events or continuing professional development) • Relies on use of explicit/propositional knowledge (i.e. needs to use the manual/guidance)
Intermediate – beginning to use guidance	• Beginning to develop 'know-how so not purely reliant on explicit/propositional knowledge.

	• Benefit from examples of practice • Knowledge of underpinning processes may not be fully development
Expert	• Uses informal networks to refine and develop practical knowledge • Experiential learning still important through application to projects • Has tacit knowledge and good process knowledge

Another challenge to developing guidance is ensuring it does not become just another part of an 'overload' of information in terms of publication of multiple case studies, written advice or guidance documents. This can be a limitation to practice particularly if the reliability or legitimacy of the material is not known, or those using it have limited expertise or process knowledge (Durning et al 2010). Practitioners can therefore become 'stuck in their ways' and rely on established methodologies based on older guidance. The practice being addressed in guidance may also not be recognised by those it is intended to inform as they consider it not applicable and they 'do things differently here' (Nicolini. 2012 p226). Similarly, what may work well as effective practice in one situation, may not easily transfer to another due the context in which practice is occurring. Dixon et al (2007, p49) highlight this in relation to risk communication and public liaison and how a strategy for communicating with the public regarding the remediation of a contaminated site was effective in one local governmental authority area, but when the same strategy was adopted in a neighbouring authority area it proved to be very ineffective and lead to a break-down of trust. In seeking to develop guidance on the assessment of cumulative impacts for OWF, it was recognised (RUK 2011, MMO 2013) that, for the guidance to have legitimacy and durability, it should be derived from and be 'co-created' by the very diverse community (i.e. the statutory consultees, consultants, developers and regulators) within which the practice it is aiming to guide is located.

Developing guidance through stakeholder collaboration

The requirement to consider project level cumulative impacts has been included in the

EU Environmental Impact Assessment (EIA) Directive since it first appeared in 1985 (Broderick et al, 2018). The requirement has been narrowed down in the most recent revision to the Directive (Directive 2014/52/EU):

3. 'Annex IV – The environmental impact statement should include:
4. '5. A description of the likely significant effects of the project on the environment resulting from, inter alia:
5. (e) the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relation to areas of particular environmental importance likely to be affected or the use of natural resources'

The requirement to consider project level cumulative impacts are also included in Directive 92/43/EEC (the 'Habitats Directive') and Strategic Environmental Assessment Directive (2001/42/EC) (Broderick et al, op cit) both of which are also applicable to offshore windfarms (a strategic environmental assessment was carried out for Round 3).

Funding to support development of the guidance was provided by the Natural Environmental Research Council (NERC) through their Marine Renewable Energy Knowledge Exchange Programme (MREKEP). The project was led by one of the authors of this paper and co-ordinated through RUK. Whilst the NERC/RUK document (RUK, 2013) is termed 'Cumulative Impact Assessment Guidelines' they are in fact a series of eleven 'guiding principles'. Although they were developed for project level impact assessments in the offshore wind energy sector they were also intended to have wider relevance, including to the wider understanding of cumulative impact assessment in other sectors and future strategic environmental assessments (SEA).

The 'guiding principles' provide a framework that develops a consistency of approach in the cumulative impact assessment of OWF; not so much providing guidance as setting an expectation of standards. They were intended to set current good practice

standards for the scope, content, and methodology of cumulative impact assessment in order to facilitate greater transparency and consistency between assessments, and to go beyond simply legal compliance. In particular, the aim was to: ensure that all stakeholders have the same expectations of the assessment process; reduce uncertainty over the process; and promote streamlining of the consenting process. The following section of the paper sets out the process of stakeholder collaboration which led to their development

The 'guiding principles' were developed collaboratively with regulators and stakeholders in the OWF sector. Research to develop initial concepts and understanding commenced in 2012 and was steered by an advisory group comprising representatives from OWF developers, The Crown Estate (TCE), national government and a regulator (Natural England). Workshops were held in July and November 2012 and attended by over 30 attendees on each occasion comprising representatives from a wider group of stakeholders (statutory consultees, NGOs e.g. Royal Society or Protection of Birds (RSPB), regulators, academics and industry (both consultants and developers)).

The first workshop in July 2012 sought to explore understanding of 'what works' and 'what does not work' and how the latter could be addressed through the guiding principles. Delegates were sent short position papers in advance of the workshop so that discussions could focus on new issues and gaining agreement rather than presenting information. Discussion sessions within the workshop addressed:

- early stages of cumulative impact assessment: screening and scoping;
- later stages of cumulative impact assessment: industry led initiatives; assessment/mitigation; project versus plan level assessment;
- how would the principles be applied – structure and length; and

- what is a ‘meaningful’ assessment.

A draft document was produced which was then discussed at the second workshop in November 2012. This workshop adopted a two-stage iterative approach. In the first stage delegates identified where there was consensus, where there was in part disagreement and where there was dissatisfaction with the principles being proposed. The contentious principles were then discussed and revised. The process was then repeated in the second stage. In addition to the two workshops, opportunities were provided for written comments to be provided from those not able to attend and over 300 comments were received. Presentations were also made to a number of relevant industry and decision-making organisations including the Offshore Renewable Energy Licensing Group (ORELG) (which comprises government organisations, industry and non-governmental bodies), RUK’s Consents and Licensing Group and to the National Infrastructure Division of the Planning Inspectorate.

The resulting outcome was the ‘guiding principles’ document which was published in June 2013 (RUK 2013). It emphasises that the focus is on producing assessments ‘which strike the right balance between pragmatism and precaution’ and which allow for a meaningful assessment of the impacts to be undertaken whilst at the same time ‘allowing development to proceed in a timely fashion’. It also included a definition of cumulative impacts which have since been referred to as ‘the most comprehensive definition’ available (Natural England, 2014). There are 11 ‘guiding principles’ under four headings (Text box 1):

Text box 1 – Guiding Principles for CIA of OWF (source RUK/NERC 2013)

- ‘General Principles’:

(1) ‘cumulative impact assessment is a project level assessment, carried out as part of a response to the requirements of the European EIA, Habitats and Wild Birds Directives, designed to identify potentially significant impacts of developments and possible mitigation and monitoring measures’;

(2) ‘developers, regulators and stakeholders will collaborate on the cumulative impact assessment’;

(3) ‘clear and transparent requirements for the cumulative impact assessment are to be provided by regulators and their advisers’;

- ‘Scoping Principles:

(1) ‘cumulative impact assessment will include, early, iterative and proportionate scoping’;

(2) ‘boundaries for spatial and temporal interactions for cumulative impact assessment work should be set in consultation with regulators, advisers and other key stakeholders, in line with best available data’;

(3) ‘developers will utilize a realistic Project Design Envelope’;

(4) ‘developers will consider projects, plans and activities that have sufficient information available in order to undertake the assessment’;

- Data principles

(1) ‘the sharing and common analysis of compatible date will enhance the cumulative impact assessment process’;

- Assessment principles:

(1) ‘cumulative impact assessments should be proportionate to the environmental risk of the projects and focused on key impacts and sensitive receptors’;

(2) ‘uncertainty should be addressed and where practicable quantified’;

(3) ‘mitigation and monitoring plans should be informed by the results of the cumulative impacts assessment’.

A rationale for inclusion and guidance on implementation is provided for each principle in the published guidance document.

Evaluating its use in practice

In order to evaluate how the guidance has been used to help shape practice, a review of documentation submitted with applications for consent for all OWF around the coast of England and Wales submitted to the Planning Inspectorate for consent between 2013 and 2018 was undertaken. It was decided not to look at Scottish applications as they follow the two-tier process with different applications for offshore elements and onshore elements so potentially two environmental statements are produced.

All documentation associated with the consenting process for projects which come under the remit of the Planning Inspectorate (PINS) Nationally Significant Infrastructure division are available from the inspectorate portal (located at https://infrastructure.planninginspectorate.gov.uk/). A search of the Register of Applications identified 10 OWF as submitted for examination between 2013 and 2018. These are listed in Table 4.

Table 4. OWF applications registered with PINS between 2013 and 2018

Application Name and generating capacity of consented development	**Location**	**Developer**	**Date Of application submission**	**Status**
Hornsea Project Three Offshore Wind Farm (2400MW)	East of East Riding of Yorkshire coast, east coast of England	Orsted Power (UK) Limited	14/5/18	Examination in progress
East Anglia THREE Offshore Wind Farm (1200MW)	Approximately 70km east of Lowestoft, off east coast of England	East Anglia THREE Limited	18/11/2015	DCO granted on 07/08/2017
Hornsea Offshore Wind Farm (Zone 4) - Project Two (1800MW)	89km east of East Riding of Yorkshire coast, east coast of England	SMart Wind Limited	30/01/2015	DCO granted on 16/08/2016
Navitus Bay Wind Park	South West of Isle of Wight, off south coast of England	Navitus Bay Development Limited	10/04/2014	DCO refused on 11/09/2015
Dogger Bank Teesside A&B (2400MW)	North Sea between 125 kilometres (km) and 290km off the UK North East coast	Forewind Ltd	28/03/2014	DCO granted on 05/08/2015

Dogger Bank Creyke Beck (2400MW)	Yorkshire and Humber, off east coast of England	Forewind Ltd	29/08/2013	DCO granted on 17/02/2015
Hornsea Offshore Wind Farm (Zone 4) - Project One (1200MW)	East of East Riding of Yorkshire coast, east coast of England	SMart Wind Ltd	30/07/2013	DCO granted on 10/12/2014
Walney Extension Offshore Wind Farm (750MW)	Irish Sea off Walney Island, west coast of England	DONG Energy Walney Extension (UK) Ltd	28/06/2013	DCO granted on 07/11/2014
Atlantic Array Wind Farm	Bristol Channel, south west coast of England	Channel Energy Limited	14/06/2013	Withdrawn. This case has been archived and all records removed from the PINS site.
Burbo Bank Extension offshore wind farm (2500MW)	Liverpool Bay NW of Wirral Coast, west of England	DONG Energy Burbo Extension (UK) Ltd.	22/03/2013	DCO granted on 26/09/2014
Rampion Offshore Wind Farm (700MW)	Approximately 13 - 23km off the Sussex coast, off south east coast of England	E.ON Climate and Renewables	01/03/2013	DCO granted on 16/07/2014

As the information for the Atlantic Array Wind Farm was not available from the PINS portal, this development is not included in the study.

To evaluate how or whether guidance had been used the following methodology was adopted:

(1) review content list for main section of environmental statement (the document which sets out the outcome of the EIA process) to determine where cumulative impacts have been considered and addressed (e.g. in topic specific chapters or a separate chapter on cumulative impacts);

(2) review introductory chapter setting out the approach to the EIA process to determine if any guidance on methodology is referred to;

(3) review reference list for relevant chapters to identify what, if any, guidance is referred to; and

(4) review methodology for addressing cumulative impacts set out in environmental statement and assess to what extent it follows the methodology

in the ‘Guiding Principles’. It is known from previous research into the quality of practice (Durning and Broderick 2015) that the methodology used is not always transparent and therefore an assumption may need to be made on to what extent any guidance which is referenced has actually been used to shape and inform practice.

Findings

The findings are summarised in Table 5. Seven of the 10 ES reviewed do reference the Guiding Principles and the two that did not were submitted in early 2013 before the Principles were published. A number referred to other guidance such as the very early but still oft cited EC generic guidance on cumulative impacts assessment (Hyder, 1999) and topic specific guidance e.g. King et al (2009) relating to birds and Scottish Natural Heritage (SNH 2005) (even though the developments were not in Scotland). It was interesting to note that a number referred to the use of PINS Advice Note 9 (relating to determining the ‘design envelope’) which contains elements of cumulative impact methodology; only the most recent OWF application referred to PINS Advice Note 17 which specifically addresses cumulative impacts assessment (PINS 2015). Whilst PINS Advice Note 17 does not explicitly state the RUK guidance should be used, it does refer to the need for applicants to follow ‘industry guidance’. It also states the need for applicants to follow guidance from statutory consultees (e.g. MMO 2014, Natural England 2014) and the guidance from these statutory consultees does also draw also on the RUK Guidance (e.g. Figure 2 in MMO 2014 which is reproduced from the RUK guidance and shows the relationship between addressing CIA in SEA, EIA and HRA).

Table 5 – findings of evaluation on use of guidance

Offshore Wind Farm	**Application Date to PINS** **And ES date**	**Evaluation of where RUK 2013 guidance is referred to in the ES**	**Other guidance addressing CIA referred to in ES**
Hornsea 3	14 May 2018 ES dated May 2018	Volume 1 Chapter 5 (EIA methodology) at paragraph 5.2.1.1 states that the assessment methodology drew on RUK 2013 guidance. Paragraph 5.4.2.4 states 'Hornsea Three is being developed within a period of rapid growth in the offshore wind sector…as such the approach to CEA [cumulative effects assessment] has, over recent years, become an issue of increasing importance for offshore wind developers ' and that therefore 'the approach to CEA undertaken for Hornsea Three takes into account the principles outlined in the RenewableUK guidelines and PINS Advice Note, together with comments made in response to the Hornsea Three scoping report'. Paragraph 5.4.3.13 also repeats that the RUK2013 guidance has informed the methodology, in this case in relation to the need to incorporate an 'appropriate level of pragmatism' in the assessment of cumulative impacts.	PINS (2015)
East Anglia 3	15 December 2015 ES dated November 2015	RUK 203 guidance is cited in the assessment methodology section in Chapter 6 (EIA methodology) at paragraph 62 which states: 'The CIA for each receptor topic are based on generic advice such as... Cumulative Impact Assessment Guidelines Guiding Principles For Cumulative Impacts Assessment In Offshore Wind Farms (RenewableUK 2013)'.	BSI (2015); MMO (2014); PINS (2012)
Hornsea 2	22 February 2015	RUK 2013 guidance is cited in EIA methodology chapter (Chapter 5). At paragraph 5.4.3 it states:	King et al., 2009);

	ES dated 30 January 2015	"CIA has, over recent years, become an issue of increasing importance for offshore wind developers. In response RenewableUK and the Natural Environment Research Council (NERC) have released Cumulative Impact Assessment Guidelines (RenewableUK, 2013). The guidelines seek to inform and facilitate agreement on a range of concepts arising in planning applications such as those for offshore wind. The approach to CIA presented for Project Two takes into account the principles outlined in this document, together with comments made in response to the Project Two Scoping Report … the Project Two Phase 1 Consultation Document … and the Project Two Draft Environmental Statement.' This is further emphasised at paragraph 5.4.40 which states: 'This approach [utilising a Tier 1 and Tier 2 approach (see Figure 1)] is consistent with the RenewableUK Cumulative Impact Assessment Guidelines, specifically Guiding Principle 4 and Guiding Principle 7 (RenewableUK, 2013)".	King et al (2009); Mclean et al (2009)
Navitus Bay	8 May 2014 ES dated 8 April 2014	The RUK guidance is referenced in Chapter 5 (EIA methodology) at paragraph 5.10.9 as being part of a 'significant number non-statutory guidance' which is available to inform practice and at paragraph 5.10.10 it states the 'CIA methodology adopted for the project reflects the advice provided in the guidance described above'.	Hyder (1999); Fuller and Sadler (1999); King et al (2009); Marsden et al (2010);
Dogger Bank Teesside A&B	23 April 2014 ES dated March 2014	Chapter 33 of the ES is a summary of the Cumulative Impact Assessment undertaken for the development. Although the RUK guidance is not referenced in section 2.3 which addresses which guidance is available (Hyder, 1999 and PINS 2012 are referenced) it does appear in Table 3.1 – summary of consultation in response to a comment on the cumulative impact of the development on commercial fisheries: 'The Forewind CIA strategy is detailed in Appendix 4A Forewind Cumulative Impact Assessment Strategy - Offshore. The strategy follows the Guiding Principles for Cumulative Effects Assessment that were produced by RenewableUK and endorsed by the Offshore	Hyder (1999); PINS (2012)

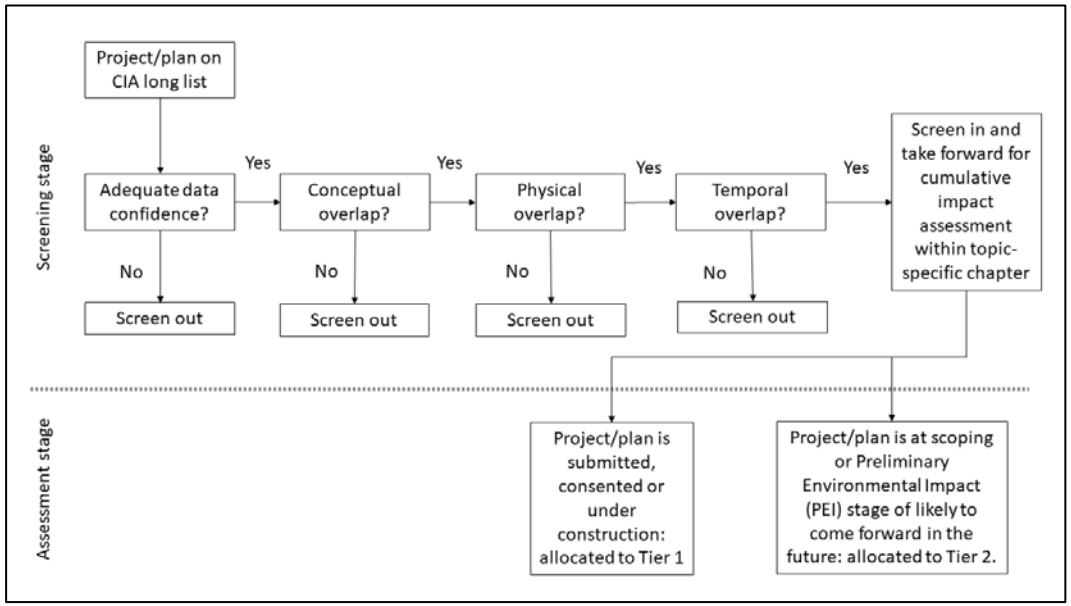
		Renewable Energy Licensing Group (ORELG)'.	
Dogger Bank Creekye Beck	25 September 2013 ES 25 August 2013	The developers included an appendix to the ES which sets out their approach to CIA (The Cumulative Impact Assessment Strategy – Offshore (Chapter 4, Appendix A, PINS application reference 6.4.1)). At paragraph 1.1.2 of this document they state: 'Forewind is aware of and is party to the ongoing development of Guiding Principles for Cumulative Effects Assessment, by RenewableUK. It is hoped that this emerging guidance can be utilised for assessment of future Forewind projects, but it is recognised that this guidance is not available for Forewind's early projects. In the absence of agreed guidance, Forewind has developed a strategy for undertaking CIA for its own projects. The principles of this strategy were discussed and developed along with the developers of the Hornsea and East Anglia Round 3 Zones.'	Hyder (1999); SNH (2005)
Hornsea 1	22 August 2013 ES dated 30 July 2013	Volume 4 Annex 4.5.1: Cumulative, Transboundary and Inter-relationships Document (dated July 2013) states at paragraph 2.1.10: 'Project One is being developed within a period of rapid growth in the offshore wind sector. This includes development of other Round 3 projects, Round 1 and Round 2 projects, together with Round 1 and 2 extension projects in UK waters. The ongoing consultation and engagement between the offshore renewables industry, The Crown Estate (TCE) and Regulators, has highlighted the requirement for guidance including best practice notes. For example, RenewableUK and Natural Environment Research Council (NERC) have commissioned a Cumulative Impact Assessment Guiding Principles Study (RenewableUK 2013). This paper seeks to inform and facilitate agreement on a range of complex concepts. The approach to cumulative assessment for Project One takes into account the Cumulative Impact Assessment Guidelines'.	BSI (2015); PINS (2012)

Walney Extension	22 July 2013 ES dated 28 June 2013	Chapter 33 (Cumulative Effects) in Volume 1 of the ES, summarises the process undertaken to assess the cumulative impacts of the development. At paragraph 33.5.3 it states: 'In addition to existing (operational) developments, relevant projects, plans and licensed activities have been identified on the principle of their being reasonably foreseeable future projects ("RFFP") and for which sufficient information is available to inform CEA. RFFP as defined by guiding principle 7 of the Renewable UK and WSP guidance are projects which have been consented, for which a consent application has been made or which are currently in the statutory planning process, i.e. in the public domain having been screened or scoped. This does not include all those developments listed in [PINS] Advice Note 9 … because there is insufficient information in respect of projects which have not yet reached the statutory planning process upon which to conduct a meaningful assessment'. Volume 2 of the ES in Annex A.2 (cumulative effects: discussion document) dated April 2013 in section 2.1 (methodology) states: 'There is no defined statutory approach or consensus on how a CEA should be undertaken for an offshore wind farm. DONG Energy's approach to undertaking CEA for the Project draws upon the Renewable UK and WSP Guidance on CEA currently under development which proposes 11 'Guiding Principles' (GPs) for CEA. These are presented in Table 2.1, along with a description of how they have been addressed in this discussion document, and references to the relevant section of the document where they can be found'.	PINS (2012)
Burbo Bank Extension	April 2013 ES is dated March 2013	Not referred to: ES predates publication of guidance	Hyder (1999)

Rampian offshore wind farm	1 March 2013	Not referred to: ES predates publication of guidance	Hyder (1999)

Whilst quite often the methodologies used are described in narrative and not always very specific, some, such as Walney Extension and others, do provide graphical evidence of their methodology. Figure 1 is an example of this.

Figure 1 – example of methodology to screen projects for inclusion in CIA (source Figure 5.2 in SMartwind 2015)



Conclusion

The OWF industry in the UK has grown dramatically over the last 18 years from initial beginning in 2000 of two turbines each of 2MW to over 1400 operating turbines and a capacity of 5.1GW by end of 2016. The consenting process at first struggled to keep pace with developments with a resulting knowledge gap in aspects of practice and decision making. As the industry began to mature the need for collaboration and joint working emerged as did the need to ensure that guidance to aid project decision making was developed. The OWF is a complex industry with range of stakeholders involved and it also functions in a very dynamic natural environment where there are few certainties on how the environment will behave. The credibility and quality assurance of best practice is important (Durning, 2010, Morgan 2012) and dependent on the status of the organisation or person producing it. Its origin of being co-created with involvement of the relevant parties and endorsement by key organisations has given it the legitimacy that it can be used.

Issues and concerns regarding the production of best practice are summarised by Morgan (2017) as: context (and de-contextualisation); transferability; power and governmentality (where best practice represents a 'political rationalisation of the problems and solutions'). However, where guidance is developed by those who undertake practices these issues can be over-come and lead to, as Nicolini observed, being 'perpetuated and made durable by people who come to share similar skills, practical concerns and ways of making themselves accountable' (Nicolini, 2012, p 227). Evaluation of the use of the RUK guidance has shown that it is being used and is aiding in the development of transparency in the methodology for assessing cumulative impacts.

As TCE announced in November 2017 that they are beginning a process to consider a Round 4 of seabed rights available to OWF developers (TCE 2017b) it is hoped the RUK guidance will continue to be influential is shaping the process for cumulative impact assessment. As opined by Willsteed et al (2018) industry led guidelines project 'greater clarity about expectations and how to improve consistency and seek to enable meaningful CIAs'.

However, ease of access to guidance is important and current practices are to expect all information to be readily available via the internet; this has potential ramifications as guidance can disappear when organisations update their sources. The RUK guidance is no longer available on the RUK publications website, however, it is still available to open access via the funders (NERC) website. This leads to another interesting aspect regarding the need to ensure that there is open access to guidance; developing guidance and then hiding it behind a firewall limiting access only to paid members, or charging for its use (as does happen) is not going to lead to changing practice. Without documents being put into digital repositories there is a risk of having to keep 'reinventing the wheel' in terms of practice and guidance and for industries as complex as OWF embedding practice which is agreed by stakeholders as valid and can be relied upon by decision makers as leading to effective practice, is important. The need for an online central repository for data, evidence, guidance and good practice on impact assessment for offshore wind in the UK was one of the key findings from a recent industry-led pilot study on the feasibility of developing an 'Industry Evidence Base' to lead to more proportionate and effective EIA in the offshore wind sector (Howard, 2018).

One aspect it has not been possible to address in this study is whether the practice shaped by the guidelines has led to a more effective assessment process. The 'lead-in' time for developments can be long and at the time of writing (early 2018) only one of the

developments (Burbo Bank Extension) was fully operational. Three (Rampion, Walney Extension and Hornsea Project One) were under construction whilst the others were in early pre construction or had not yet commenced activities (and one still waiting a decision on consent). An important area for future research will be to undertake *ex post* follow up to determine through analysis of monitoring data and stakeholder discussions whether the guidelines have been influential in improving the effectiveness of the CIAs.

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