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Workshop to Identify Alternative Energy Environmental Information Needs

Workshop Summary

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List of Abbreviations and Acronyms

ADCP	acoustic doppler current profiler
BACI	before after control impact
CMACS	Centre for Marine and Coastal Studies, Ltd.
CODAR	Coastal Ocean Dynamics Applications Radar
COWRIE	Collaborative Offshore Wind Research into the Environment
EIA	Environmental Impact Assessment
EIS	Environmental Impact Study
EMF	electromagnetic fields
EPRI	Electric Power Research Institute
ESP	Environmental Studies Program
FERC	Federal Energy Regulatory Commission
FLOWW	Fisheries Liaison for Offshore Wind and Wet
GIS	geographic information systems
ILP	Integrated Licensing Process
MMS	Minerals Management Service
MW	megawatts
NGO	non-governmental organization
NIMBY	not in my back yard
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
NOREL	Nautical Offshore Renewable Energy Liaison Group
NREL	National Renewable Energy Laboratory
NWCC	National Wind Coordinating Committee
OCS	Outer Continental Shelf
OMB	Office of Management and Budget
OREEF	Offshore Renewable Energy and Environment Forum
R&D	research and development
RAG	Research Advisory Group
SEA	Strategic Environmental Assessment
UK	United Kingdom
U.S.	United States
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

1.0 Introduction

1.1 Purpose and Intent of the Workshop

With the passage of the Energy Policy Act of 2005, the Minerals Management Service (MMS) assumed regulatory responsibilities on the Outer Continental Shelf (OCS) for activities that produce or support the production, transportation, or transmission of energy from sources other than oil and gas (i.e., alternative energy). Potential impacts on the human and marine environments must be evaluated in order for MMS to make environmentally sound decisions when authorizing alternative energy activities on the OCS. MMS funded a synthesis and analysis report that reviewed existing data on environmental effects of alternative energy uses and identified information needs, entitled *Worldwide Synthesis and Analysis of Existing Information Regarding Environmental Effects of Alternative Energy Uses on the Outer Continental Shelf* (Michel et al., 2007). This report provided the basis for a workshop, attended by experts in the field, to identify data needs and to outline potential studies for the MMS Environmental Studies Program and its partners.

The workshop was held on 26-28 June 2007 in Herndon, Virginia. Over 200 invitation letters were sent out to a broad mix of representatives of Federal and State agencies, industry, academia, non-governmental organizations (NGOs), and national and international experts. Participants registered on a workshop website, which was updated frequently with the list of current registrants. In all, 144 people attended the workshop.

This workshop was an important step for the MMS in communicating and developing a collaborative relationship with other Federal agencies, affected State and local groups, and industry. Members of groups with knowledge about existing offshore alternative energy development (i.e., academia or representatives from countries or states where development is already occurring) were invited to share their expertise.

The intent of the workshop was to:

- Gather and initiate a dialog among representatives from within the MMS, other Federal agencies, States where development is most likely to occur, the alternative energy industry, academics, and foreign experts in the field.

- Evaluate the body of information currently available.

- Identify data and knowledge needs in the information available about the human and marine environments with respect to top alternative energy issues.

- Develop a list of potential environmental studies to fill those identified gaps.

- Discuss development of partnerships for information sharing and financial collaboration.

1.2 Workshop Format

The format for the workshop was as follows (see Appendix A for the workshop agenda). The workshop began with ten technical presentations by national and international experts covering the state of wind and wave technologies, future trends, environmental concerns, and lessons learned. The presentations provided a strong technical background for later discussions.

During sign-in, each participant registered for one of four breakout groups: 1) Aquatic Resources; 2) Flying Animals; 3) Physical Oceanography and Air Quality; and 4) Social Sciences and Economics. In each breakout group, a MMS scientist was the technical lead and provided a summary of the information needs for each resource area based on the Synthesis Report. A facilitator guided each group's discussion and asked for a volunteer to report out on behalf of the group in a plenary session at the end of the second day. There were two sessions for each breakout group: first, the groups were asked to discuss and develop a list of critical information needs that were scientifically feasible; after a break, each group was asked to provide supporting detailed information for the most important priorities.

The facilitators briefly reviewed rules and goals of the sessions. During the first session of the breakouts, there was open discussion on the key information needs. The aim was to generate potential project ideas and identify information gaps, not to evaluate them at this point. As the groups reached consensus on what were the priority research needs, the needs were recorded on large-scale posters that were printed with the following subheadings:

- Data Needs
- Suggested Methods
- Collaborators
- Other Limitations
- Special Considerations

Members in each breakout group were given sticky notes to write down specific suggestions and comments under the subheadings for each priority information need. After this exercise, the facilitators led a discussion of each priority information need, based on the posted comments, to further refine and define the topics. At the end of the second breakout session, the MMS scientist, facilitator, and group spokesperson compiled the results of the group into a presentation to be made during the afternoon plenary session. On the morning of the third day, there was a final Plenary Session where the group discussed mutual interest in, and opportunities for, collaboration and partnership on studies.

The results of the workshop are provided in the following sections. Section 2 contains short summaries of each technical presentation. Section 3 contains the results of the Aquatic Resources Breakout Session. Section 4 contains the results of the Flying Animals Breakout Session. Section 5 contains the results of the Physical Oceanography and Air Quality Breakout Session. Section 6 contains the results of the Social Sciences and Economics Breakout Session. Section 7 contains a summary of the discussions during the final Plenary Session. The workshop agenda is in Appendix A. The list of participants who attended the workshop is in Appendix B. The technical presentations are in Appendix C. Biographies for the invited speakers are in Appendix D.

2.0 Technical Presentations

There were eight technical presentations on the first day and two on the morning of the second day (see Agenda in Appendix A). The slides for each powerpoint presentation are included in Appendix C. Following is a summary of each technical presentation.

Current State and Future Trends in Alternative Energy – The Contractors Point of View
Kurt Thomsen, *Advanced Offshore Solutions*

The current state of offshore wind technology includes turbines that are 3 megawatts (MW) that are installed in water depths up to 27 meters. The limiting factors are the costs of foundation installation and maintenance in deeper water and further offshore, cabling costs, and transfer power losses with distance offshore. Because of the push to place wind parks further offshore, turbines must become larger to be more cost-effective; the 5 MW turbine will become the standard. Currently, contractors cannot cope with larger turbines and foundations. Thus, there needs to be growth and development in supporting technologies for construction, installation, and maintenance for the larger turbines to be placed further offshore.

Offshore Wind Power in Denmark
Steffen Nielsen, *Danish Energy Authority*

Denmark currently has 3,100 MW of wind power, providing 20% of the national electricity demand, of which 423 MW is from offshore. Because of plans for up to 4,600 MW from offshore development, the government has set up a "one-stop shop" that coordinates among agencies for consent and approvals. Danish policymakers are also working to reduce financial risks through various programs. One of the biggest challenges is grid integration. The results of monitoring studies at the two large offshore wind parks (Horns Rev and Nysted) were reviewed. These studies have supported refinement of strategic mapping to support selection of 23 potential sites to meet the planned expansion offshore. The studies also indicated the need for better public consultation, to get more local community involvement.

Wind Energy Status and Future
Robert Thresher, *National Wind Technology Center, National Renewal Energy Laboratory*

The United States currently has 11,600 MW of wind power, all from land-based development. To generate 20% of the electricity demand in the United States, 300 gigawatts would be needed. To support this growth, wind energy costs must be competitive by: increasing turbine size; making significant R&D advances in reliability of components, low wind speed technology, and foundation types; and manufacturing improvements. Further research is also needed to monitor, model, and assess the potential for avian impacts and develop methods and technologies to reduce risks. Wave and ocean current/tidal energy technologies are still in the developmental stages. Modest investments in environmental research and development are needed to reduce potential impacts and thus promote the installation of alternative energy projects offshore.

Offshore Wind in the United Kingdom
Michael Hay, *British Wind Energy Association*

The United Kingdom (UK) target is 10% electricity from renewable energy sources by 2010 and 20% by 2020. There are plans for 28 sites totaling up to 9,000 MW from offshore wind because of limited space on land and the ability to locate close to demand centers. To accomplish this, the government uses Strategic Environmental Assessments to support scoping studies, developed a simpler consenting process (through the Marine Bill), and is addressing grid issues. There are multiple groups in place to support the development of offshore renewable energy projects including the Collaborative Offshore Wind Research Into the Environment (COWRIE), the Research Advisory Group (RAG), the Offshore Renewable Energy and Environment Forum (OREEF), the Nautical Offshore Renewable Energy Liaison Group (NOREL), and the Fisheries Liaison for Offshore Wind and Wet (FLOWW).

Licensing Offshore Renewable Energy in the UK
Rachel Mills, *Marine and Fisheries Agency, Department of the Environment, Food, and Rural Affairs*

The license application process in the UK is well established, although there have been many lessons learned. There should be a project management approach to the license application process, with specific targets and a dedicated case worker to provide consistency. Transparency in the process and decisions is essential. Consistency is also needed in license conditions, and monitoring of compliance should be conducted. UK regulators have learned that it is important to make sure that the license conditions clearly specify requirements and are time limited. Otherwise, there can be conflicting views on how the license conditions are interpreted. Another lesson was the need for more flexible and proportionate enforcement; that is, there should be options such as suspension of a license because of violations of the conditions, rather than the only option being revoking of the license.

Impact Assessment and Monitoring of Offshore Wind Farms: UK Perspective
Chris Jenner, *RPS Group Plc*

The Environmental Impact Assessment (EIA) process for Round 2 in the UK was reviewed as applied to two case studies: The Thames Estuary projects and the Lynn & Inner Dowsing projects. The challenges are to collect baseline data appropriate for impact assessment that focuses on key concerns and specification of conditions to mitigate identified potential impacts. Implementation of consent conditions and validation of the effectiveness of mitigation measures are critical to both existing and future projects.

Wave Energy Development in the United States: Present Status and Future Trends
George Hagerman, *Virginia Tech, Advanced Research Institute*

Wave energy resources in the United States vary by location and season but are available on all coasts including Alaska and Hawaii. Extracting 15% of total wave energy flux and converting to electricity at 80% efficiency would yield 252 terawatt-hours per year, which is comparable to the annual energy output of all existing conventional hydro-electric projects in the United States.

The technologies for wave energy conversion are diverse, including terminators, attenuators, and point absorbers. There are eleven wave energy projects in the Federal Energy Regulatory Commission (FERC) regulatory process, all on the west coast, and one Navy funded demonstration project in State waters in Hawaii. The learning curve and evolution of designs from initial concept to mature designs that reduce energy costs allows new technologies to be competitive with the market value of the energy.

Environmental Concerns Associated with Wave Energy Conversion Technology in the United States
Greg McMurray, *Oregon Department of Land Conservation and Development*

Environmental concerns associated with wave energy conversion technologies include wave energy reduction, with estimates of 3-15% reduction, although there are many uncertainties. Shadow effect is minimized if the project is placed more than 3.2 kilometers (2 miles) offshore, although there could be impacts to sediment transport if projects are located within nearshore littoral cells. Hard structures can act as fish attraction devices, potentially creating a collision risk for larger marine mammals and birds. Electromagnetic field risks to listed salmonids are of special concern on the west coast. Chemical toxicity concerns include spills, biofouling coatings, sacrificial anodes, and chemicals in the transmission system. Acoustics impacts may affect individual animals as well as populations if there are ecological barrier effects of the arrays. Space-use conflicts need to be addressed. Cumulative effects are difficult to predict. Major knowledge gaps include array effects, hard substrate effects in a soft-bottom habitat, barrier effects, collision risk for large vertebrates, system survivability, and ecological costs of avoidance. Some of these risks can be evaluated with current information; however, monitoring will be essential to determine actual risks and effectiveness of mitigation measures.

Progress of MMS Regulation Development, Document Production, Scheduling, Government Framework
Maureen Bornholdt, *Minerals Management Service*

The Energy Policy Act of 2005 amended the OCS Lands Act to permit MMS to authorize alternative energy project activities on the OCS. MMS is establishing an alternative energy program and is in the process of developing comprehensive program regulations. MMS is also processing two individual offshore wind project proposals off the coasts of New York and Massachusetts. The program regulations and development will address interagency coordination, lease issuance, lease administration, project plan reviews, conduct of approved plan activities, and decommissioning. During the lease administration period, the payments, rental details, operating fees, and bonding issues are determined. In addition, a project plan review period (modeled after the UK and Denmark processes) includes a site assessment phase and a construction and operation phase (including geological surveys and operating procedure review). MMS is preparing a Programmatic Environmental Impact Statement, with the final document expected to be released late summer 2007. The Final Rule is expected to be published in 2008.

Highlights of Marine-based Studies to Support Wave, Current, or Tidal Energy Development

Stephen Bowler and Nicholas Jayjack, *Federal Energy Regulatory Commission (FERC)*

As of 31 May 2007, the FERC Hydropower Program had 38 permits for alternative energy projects in the licensing process, including eight for ocean current technology, four for wave technology, and twenty-six for tidal technology. FERC uses an Integrated Licensing Process (ILP). The Makah Bay wave energy project was reviewed as an example of the implementation of the Alternative Licensing Process and timeline. License conditions include eelgrass and benthic life surveys along the cable route, buoy noise assessment, buoy antifouling paint effectiveness assessment, monitoring of marine mammals to determine entanglement potential, cultural resource impact monitoring during construction, and recreational use monitoring to determine if the buoy array acted as a tourist attraction.

3.0 Aquatic Resources Breakout Group

The Aquatic Resources breakout group covered the following resources: benthic resources, fishery resources, marine mammals, and sea turtles. There were 25 members in the group with broad representation from Federal and State agencies, academia, industry, non-governmental organizations, and the international community. The first session started with the following summary of the information needs identified in the Synthesis Report:

Benthic Resources

- Better benthic habitat mapping of proposed sites for alternative energy facilities.
- Consensus on evaluating the positive or negative effects of the introduction of hard substrates in soft sediments: sustainability, energy flows, species interactions, and an understanding of scale.
- Well-designed monitoring protocols that will provide good baseline data and generate meaningful results at the appropriate level of confidence.
- A definitive study to answer whether electromagnetic fields (EMF) from cables from offshore alternative energy facilities directly affect benthic communities.
- Studies on fate and effects of antifouling coatings released from wave and current energy devices, particularly as new products are developed.
- More sophisticated methods for assessing cumulative impacts.

Fishery Resources

- Fishery habitat maps for regional, site-specific, and cumulative impact assessment.
- Comprehensive approach to address limited baseline data, spatially and temporally.
- Integration of benthic community studies with fish and bird studies for predator-prey interactions.
- Dose and responses for the types of sounds from construction and operation for representative fish species.
- A definitive study to answer whether EMF from cables directly affect sensitive fish species (attraction, avoidance, prey detection).
- Consequences of the introduction of artificial hard substrates on fishery sustainability, energy flow, and the fisheries communities.
- For ocean current devices, studies on the impacts of turbine speed, water flow, and water pressures on fishes.
- Models and methods to evaluate management of alternative energy parks as fishery resource enhancement areas.

Marine Mammals

- Baseline studies are needed for key species in each region. Studies need the following:
  - Exploration and development of platforms and methodologies for improved monitoring and assessment of marine species;
  - Dynamic models that link environmental conditions at the time of each sighting; and

  - Appropriate sampling resolution and study duration to provide sufficient baseline data for impact detection.
- Impacts of pile-driving and operational sounds on marine mammals for different settings and species hearing capabilities, to define the zones of influence, determine the effects, and develop appropriate mitigation measures.
- Experimental studies on the response of marine mammals to increased vessel traffic (sound, disturbance, harassment).
- Studies to assess attraction, collision risks, and impacts on movement through ocean current facilities.

Sea Turtles

- Baseline studies in high-priority areas for species density, importance, specific uses, and routes in and around the area.
- Impacts of pile-driving and operational sounds and vessel traffic noise on sea turtles for different settings and different species hearing capabilities, to define the zones of influence, determine the effects, and develop appropriate mitigation measures.
- Studies to determine if sea turtles are attracted to offshore energy installations, by lights and increased prey, then evaluate the consequences.

Discussions opened with consideration of benthic mapping needs. Although more information is desirable, some data are available for many areas. It was noted that the baseline studies funded by MMS at OCS sand and gravel sites would be applicable. Benthic habitat mapping was considered to be an area where MMS could work with other agencies to fill an important information need. There are several benthic habitat initiatives that would be good collaborative efforts. However, consistency in protocols, classification systems, and products is essential to produce edge-matched maps. Benthic habitat maps would be an important data layer when planning for further studies of the use of these habitats by key aquatic resources.

There was strong support among group members for regional studies that would provide baseline data for impact assessment; however, as important, was the need to ensure siting of initial alternative energy development in areas to avoid significant potential impacts and conflicts. This approach was used in the UK during Round 2 where a Strategic Environmental Assessment (SEA) was used to identify offshore areas for alternative energy development. MMS indicated that identification of priority areas for regional studies would be driven by the level of industry interest.

The group identified the need to understand how alternative energy facilities might affect vertical diurnal movements and on/offshore migrations. Most of the assessments have discussed alongshore migration patterns; however, there are major offshore-estuarine migrations that should be considered, including anadromous fishes (and protected species, in particular).

The group identified the importance of long-term monitoring studies to understand natural variations in distribution, abundance, and the influence of other factors (particularly climate change) for key species of concern. It was noted that many studies of offshore wind parks in Europe and the UK showed no significant differences at the wind parks compared to reference

sites because of large temporal and spatial variations in abundance. Group members suggested guidance is needed on which species and habitats should be included in baseline studies and monitoring. Information on threatened and endangered species is needed for consultations with other Federal agencies. It was suggested that other species can be monitored as surrogate indicators for broader groups with similar life history and behavior.

The issues of multiple uses of offshore alternative energy sites and the potential for exclusion of fishing were considered to be very important. There are many complex biological and socio-economic issues with both de facto exclusion areas and specifically designated exclusion areas. Development is not likely to occur in highly productive fisheries areas (to avoid impacts and conflicts), thus any designation of a wind park as a marine protected area would do little to reduce direct fishing pressure.

Based on the discussion and earlier voting, the group developed eight main categories of information needs organized around types of potential disturbances or impacts that could affect all aquatic species, as follows:

- EMF – Attraction and avoidance
- Noise – Human and animal
- Migratory Issues – Local, long distance, vertical, and on/offshore
- Endangered Species
- Collision/Entanglement/Entrainment – Fishes, marine mammals, and sea turtles
- Habitat Changes – New substrate, biofouling community, range extension for invasive species, sediment alteration, scouring, and change in current flow and wave regime
- Attraction/Avoidance – Lighting, structure, and prey concentration
- Contaminants – Oil spills from increased vessel traffic and antifouling coatings

Each of these categories was recorded onto a large poster with columns for the five areas of information being sought by MMS (data needs, suggested methods, collaborators, other limitations, special considerations). The group posted written comments on sticky notes in these columns for each category. Tables 1-8 are summaries of the comments by the group for each category.

Table 1 is a summary of the comments provided on the topic of EMF attraction and avoidance. Information is needed to adequately assess the effects of EMF on sensitive fishes and benthic organisms, particularly protected and rare species. There was concern that the transmission cables from offshore facilities to shore would cause attraction or avoidance and result in habitat fragmentation effects. For species with small or highly localized populations, this could lead to a population-level effect.

Table 2 is a summary of the comments provided on the topic of noise impacts. More information is needed on sound frequencies, levels, and propagation in settings where alternative energy facilities will be sited in the U.S. There was concern that existing data were only for single units rather than fully operational arrays where sounds are generated from both operations and maintenance activities. The best data will come from well-designed monitoring programs at actual operating sites in the U.S.

TABLE 1. Summary of comments on information needs for EMF – attraction and avoidance effects on aquatic resources.

EMF - Attraction/Avoidance				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Development of a model calibrated with field and laboratory measurements of EMF levels produced for variations in cable size, capacity, sediment type, burial depth, etc.		European Agencies; Cardiff University - effectiveness of acoustic avoidance and engineering solutions		Consider both standard industry practices with respect to electric cables and anticipated next generation technology
Lab studies on fishes and detection/response to EMF for selected key species and life stages (e.g., salmon smolt), including surrogates for sensitive species		UK Collaborative Offshore Wind Research into the Environment (COWRIE) EMF studies; University of Cranfield; Centre for Marine and Coastal Studies, Ltd. (CMACS)		
Study of areas with existing subsea cables and reference sites to assess impacts from measured EMF and evaluate potential for fragmentation of populations (cables could be linear blockages to movements)	Telemetry studies and lab evaluation coupled with population studies; Include visual behavior of species response to a submarine cable both buried and anchored on surface	NOAA National Marine Fisheries Service (NMFS)		Limitations of field studies, so may need controlled experiments; It is important to consider alternating current vs. direct current differences
Compilation of existing studies/data review		Operators		Do not reinvent the wheel; look at all the research currently being conducted in Europe that was mentioned at this workshop

TABLE 2. Summary of comments on information needs for noise – human and animal effects on aquatic resources.

Noise (Human, Animal)				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Monitoring data on sound frequencies and levels for entire arrays, not just individual structures, for construction, operation, and maintenance in US settings	Towed and static deployed hydrophones and devices currently deployed; Monitoring via pop-up buoys; Other long-term monitoring	COWRIE has measured noise at offshore wind projects in UK; should build on their experience; Noise measurements at EMEC and (future) Wavehub in UK	Both passive and active echo effects in arrays; May need to consider distance from shore and types of noise	Sound propagation can vary by location; also location conditions can vary seasonally (temperature, salinity, wave climate), so may be complex
Species-specific audiograms and temporary and permanent threshold shifts for marine mammals and sea turtles, especially threatened and endangered species	Video/direct observation in combination with hydrophones to document mammal response to various noise levels to a particular technology	NMFS; U.S. Navy; Should build on the extensive research into the effects of acoustics on marine mammals and fishes		These are permanent stationary structures (unlike moving noise sources), thus there are potential impacts to local communities
Studies on masking of noise for fishes, marine mammals, sea turtles - hearing and communication		Jeremy Nedwell – Subacoustech Ltd.; Jonathan Gordon - Sea Mammal Research Unit, University of St Andrews, UK; Dr. Barry Shepard - RPS Group		Transmission of above-surface noise into the aquatic environment via mooring lines, cables, towers, etc.
Lab studies on fish perception of sound from construction and operation activities to establish dose/response for different endpoints		NMFS		Comparison and noise density of existing man-made noise levels and frequencies
Field data on the impacts of turbine vibration on seabed to flatfish and benthic species	Video/direct observation with hydrophones to document fish response			
Effectiveness of scheduling, bubble curtains, other mitigation measures to reduce pile driving noise		COWRIE - Current research on effectiveness of Acoustic Deterrent Devices and engineering solutions for quieter piling		
Long-term effects and cumulative effects of other activities in area				

TABLE 3. Summary of comments on information needs for migratory issues (local, long distance, vertical) on aquatic resources.

Migratory Issues (local, long distance, vertical)				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Better understanding of the inshore/offshore and north/south migration and movement patterns (by life stage) for pelagic fishes (e.g., King/Spanish Mackerel) and benthic fishes (e.g., Gag grouper)	Fishery-dependent data may be of some value; however, fishery independent monitoring programs are much better (e.g., south Atlantic region, southeast area Monitoring and Assessment Program and Mid-Atlantic Regional Marine Research Program)	NMFS; Fishery Management Councils		Life stage shifts in habitat use; Fish distribution and behavior at different water depths since underwater turbines can possibly operate at various depths
More detailed data on marine mammals migration routes		NMFS		Mammal distribution and behavior at different water depths since underwater turbines can possibly operate at various depths
Role of introduced hard substrates in enhancing movement of species, including invasive species				Studies completed in other countries
Better understanding of how installations might affect vertical migrators				At current depths, vertical migration is not a prominent feature of system; there are some day/night migrators
Migration can be energetically expensive; can minor alternations lead to fitness consequences?				

TABLE 4. Summary of comments on information needs for aquatic threatened and endangered species.

Threatened and Endangered Species				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Baseline data on spatial and temporal distribution and habitat use in priority development areas for salmon, sturgeon, sea turtles, marine mammals	Current methods (aerial, vessel visual surveys) and improved techniques; acoustic tagging of fishes and sea turtles, passive acoustic hydrophones and T-PODS for mammals; Need improved methods to include environmental conditions and dynamic models on abundance and distribution data	NOAA Office of Response and Restoration – Environmental Sensitivity Index digital data have compiled existing datasets; NMFS; National Marine Sanctuaries Program; Fishery Management Councils; USFWS		Consider areas targeted for reintroductions of extirpated species (e.g., sea otters along the Oregon coast)
Characterizations of sites/areas that provide habitat to specific species	Research methods used by USFWS and NMFS endangered species programs	Same as above		Are there any benefits to these species due to exclusion zone protection?
Species-specific data on sensitivity to the various stressors (noise, contaminants, EMF)		European agencies		
Extent of exposure to potential impacts - collision/entanglement, contaminants, noise, habitat alteration, etc. from single projects and cumulatively (energy and other activities in an area)		European agencies	Cumulative impacts will be difficult to evaluate until actual monitoring data on impacts are available	Particularly concerned about wild salmon vulnerability to EMF and predation in wave arrays; It will be difficult to understand how impacts from noise, contaminants, etc. have consequences on the survival or reproduction of individuals and then on populations
Evaluate the potential to design installations so the site could be beneficial to some species (i.e., refuge)				

TABLE 5. Summary of comments on information needs for collision, entanglement, and entrainment for aquatic resources.

Collision/Entanglement/Entrainment (fishes, marine mammals, sea turtles)				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Approach to quantify and evaluate increased risk of collision from construction and service vessel traffic, considering local and regional scales, for marine mammals and sea turtles	Historic data of collisions and entanglements in area; Modeling risk of collision/entanglement for single project and for several projects in a region	NMFS; USFWS		Primarily a rare, threatened, and endangered species concern
Effective measures to reduce risks of service vessel collision: avoidance protocols and techniques		NMFS; USFWS		Continuous vs. periodic monitoring; Can periodic monitoring be conducted to effectively predict collisions at all times?
Information on which to estimate probabilities for entrapment/entanglement between structures (mostly wave and current technologies), particularly for listed species	High resolution sonar and camera systems mounted on devices; currently being tested/proposed for open hydro and lunar energy in the UK; Environmental audits of remote facilities	UK researchers/developers that are testing devices (e.g., Lunar Energy, Ocean Power Delivery, Open Hydro)		Primarily a rare, threatened, and endangered species concern
Designs to reduce potential entrapment/entanglement		Engineering and design experience from hydro power plants should be researched		Consider designs to reduce attraction to reduce risk
Analysis of the species, life stage, and significance of entrainment in wave/ocean current systems		Research and assessments in support of liquefied natural gas facilities		

TABLE 6. Summary of comments on information needs for habitat changes for aquatic resources.

Habitat Changes (new substrate, biofouling community, sediment alteration, scouring, change in current flow and wave regime)				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Better habitat maps on which to evaluate potential impacts	Examine MMS Marine Minerals Program sand and gravel studies for baseline and potential for habitat change	Consider adopting NOAA Coastal Services Center marine habitat classification scheme for habitat mapping		
How to evaluate consequence of introduction of hard substrate in soft sediments (artificial reef effect) – changes in benthic community, predatory effects, fish community, spread of invasive species, etc.	Review studies of existing installations, e.g., recently published report by University of Plymouth Marine Laboratory (UK) that reviewed all UK projects		Assessing cumulative impacts will require detailed information of degree of habitat change per project	Increase in local habitat heterogeneity typically leads to increased trophic complexity and higher energy flows; Benefits from cessation of bottom trawling; Climate change may also be a factor in shifts in species distributions
How to evaluate consequence of a change in habitat from pelagic to fixed reef community on structures in the photic zone	Consider National Science Foundation, Long Term Ecological Research project for wind farm as fixed reef community	National Science Foundation		Need to consider secondary and tertiary food web consequences
What are the changes in food availability (low trophic level) at offshore wind parks	Ecological sampling, observations			
Potential impact to eggs and larvae using the Gulf Stream	NOAA/commercial wave/current/sound transport models			
Improved and standardized approaches and protocols for monitoring benthic community and effects	Before After Control Impact (BACI) approach for species abundance changes; Review studies/results from monitoring of oil and gas platforms			

TABLE 7. Summary of comments on information needs for attraction and avoidance impacts for aquatic resources.

Attraction/Avoidance (lighting, structure, prey concentration)				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
How to reduce attraction due to lighting	Research alternative designs for navigation lighting (color, masking, etc.)	Commercial light designers		Lighting can attract prey that will attract species of concern, with increased risk of entanglement/entrainment
What is the potential for areas with large arrays to serve as local refuges for certain species	Direct observation; Hydroacoustics	NMFS; USFWS; Fishery Management Councils		Numerous data are available for single structures, artificial reefs, however scale of arrays could be the important issue
Do structures attract/concentrate prey and predators to small area; also attraction of recreational fisherman to reef	New methodologies for impact assessment to fisheries on ecosystem basis			

TABLE 8. Summary of comments on information needs for impacts of contaminants on aquatic resources.

Contaminants				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
What are types, release rates, transport, fate, and toxicity of antifouling compounds	Dispersion models; Site-specific biofouling studies	USEPA; Geoff Suain, FIT - release rates/toxicity	Antifouling prescreened and approved (limited concern)	Are animals that feed off filter feeders at higher risk of exposure to contaminants?
Research on fluids used in offshore turbines should consider state-of-art, environmentally advanced/benign materials		Turbine manufactures for contents of products		
Improved oil spill prevention from service vessels	Specific spill prevention/ control requirements	NOAA; U.S. Coast Guard		Difficulty of response in open water conditions
Release of contaminants or contaminated sediment from transmission line burial				

There are insufficient data on the audiograms for key species of marine mammals, in particular, so it is difficult to assess responses, both lethal and behavioral, for the different types of sounds generated from offshore energy installations. Impacts to benthic resources, including flatfishes, from noise and vibration were also discussed. There are concerns that the sounds from alternative energy installations could mask the sounds used by animals for communication, prey identification, and other behaviors. It was acknowledged that pile-driving sounds would be of particular concern, thus more information is needed on appropriate mitigation measures to reduce impacts during the construction phase.

Table 3 is a summary of the comments provided on the topic of migratory issues for aquatic resources. There was concern that offshore installations could become barriers to both along shore and on/offshore migration patterns for marine mammals, sea turtles, and fishes. Barriers to estuarine migration were a newly identified concern. Vertical migration patterns by plankton were also of concern. The introduction of hard substrates in otherwise soft-substrate habitats could provide stepping stones for range expansion of invasive species as well as species of concern. It was acknowledged that studies would also have to consider other factors affecting range expansions, such as climate change.

Table 4 is a summary of the comments provided on special concerns for threatened and endangered species. Most of the concerns are also addressed in the other topics, but the group felt that it was important to specifically call out concerns for these protected species. MMS will have to consult with NOAA and USFWS, so they will need species-specific information on abundance, use, and potential impacts, both direct and cumulative.

Table 5 is a summary of the comments provided on collision, entanglement, and entrainment concerns. Collisions from increased vessel traffic (construction and maintenance) may be of concern in marine mammal and sea turtle concentration areas for all types of technologies. Methods are needed for evaluating the increased collision risks. Entanglement and entrainment were more of a concern for wave and ocean current technologies, where the devices are anchored or tethered to the bottom and have open and/or moving parts. Developers need to be informed of the importance of designing devices and projects that minimize these risks, particularly when threatened or endangered species may be affected.

Table 6 is a summary of the comments provided on habitat change concerns. It was acknowledged that offshore alternative energy installations are likely to change the habitat, which will lead to changes in communities, species interactions, energy flow, etc. Guidance is needed on how to determine the significance of these changes (e.g., major, minor, insignificant). Cumulative impacts could be significant as projects expand or new projects are built adjacent to existing facilities.

Table 7 is a summary of the comments provided on attraction and avoidance concerns resulting from lighting, structure, and prey concentration. Navigation lighting should be designed to minimize the risk of attraction of prey, which could attract predators of concern, such as marine mammals, sea turtles, and pelagic fishes. Introduction of large arrays of hard structures may attract certain species and serve as a local refuge. Again, the scale of large arrays, compared to a single oil and gas platform, requires more study.

Table 8 is a summary of the comments provided on contaminant concerns. The group was concerned with the increased risk of oil spills from the increased service vessel traffic at the offshore installations, where containment and recovery is very difficult. Oils used in the devices should be selected so they have the least environmental risk, even though the volume of oil in individual devices is relatively small. Wave and ocean current developers will need to use safe technologies to address marine fouling that do not release toxicants into the water. Once these antifouling technologies are identified, studies will be needed to determine their concentrations and fate in water, sediments, and food pathways.

Active collaboration among government agencies, industry, and academic researchers is essential. Collaboration should start with the design of devices to minimize environmental impacts. There should be more collaboration among agencies on regional baseline studies. Industry will have to be involved in site-specific monitoring. However, because the initial post-construction monitoring programs will generate key data on actual impacts that will inform future projects, they will need to be well designed and have strong collaboration among stakeholders to give credibility to the results.

During the plenary session, the Aquatic Resources group reported on their discussions. The key discussion topics were identified as:

- Invasive species
- Estuarine migrations
- Marine Protected Areas (exclusion zones)
- Footprint of structures relative to the environment
- Collaboration with industry and agencies doing similar research in the European Union
- Competition for use on OCS – similarities of impacts from different activities

When asked what the "show stoppers" were, the key issues were identified as potential impacts to threatened and endangered species, especially in migration areas, and changes to fish habitat. For the species of concern, it will be necessary to compile and evaluate the existing information on distribution and abundance and identify information needs, then conduct the field studies to fill those needs and support the assessment of potential impacts and monitoring. Furthermore, research is needed to develop platforms and methodologies for improved monitoring and assessment of marine species in offshore areas.

4.0 Flying Animals Breakout Group

The Flying Animals breakout group covered the following resources: birds, bats, and flying insects. There were 22 members in the group with representation from Federal agencies, academia, industry, non-governmental organizations, and international experts. The first session started with the following summary of the information needs identified in the Synthesis Report:

- Baseline data on distribution and abundance by species group for on-water and in-air movements and behavior during migration, wintering, foraging, and staging to assess the risk to bird populations. Specific studies for key species include:
  - Define flyways: distance from shore, density within migratory corridors, and timing of spring and fall migration.
  - Determine flight height including understanding inter- and intraspecies variability
  - Understand diurnal and nocturnal movements
  - Understand foraging and wintering use of offshore habitats
  - Define potential use of offshore areas by threatened and endangered species
  - Identify temporal patterns
  - Improve baseline data on distribution and abundance of all species groups in offshore habitats
  - Analyze the effects of weather on migratory and other movements
- Monitoring protocols for using acoustic, radar, and thermal imaging for attraction and avoidance behavior studies.
- Better tools for evaluating mortality at offshore wind parks: acoustic, accelerometer, and thermal target detection systems.
- Improved predictive models related to collision and displacement (with new data).
- Understanding the extent and context to which bats fly offshore: migration patterns, corridors, weather impacts, flight altitude and characteristics, group size, feeding behavior, and temporal variation.

These needs were based on a literature review of past studies on onshore wind farms, European offshore wind parks, and modeling results. The major focus was wind turbines, which is the only technology that has been thoroughly investigated. The group then discussed the needs for further research for flying animals, with a clear emphasis on offshore wind parks.

There was strong support for regional studies to be completed and used as the basis for siting of projects and the design of project-specific studies. The priority areas for regional studies were identified as the mid-Atlantic, southern New England, and the Gulf of Maine, based on where projects are likely to be built in the near future and bird/bat resource concerns. There was much discussion on study design and products. Baseline studies should not be based on migration patterns, because setting a fixed migration period or pathway can leave out important species and temporal considerations. Studies should not identify flyways, since the flyway can dramatically change based on species, weather, and inter-annual climatic changes. Instead, studies should map abundances by species for different periods and be integrated with weather conditions. Flight height is an important parameter, as is nocturnal movement. Thus, new methods and research technologies, such as thermal and acoustic detection systems, will have to be developed and tested on fixed platforms.

Because avoidance and attraction behavior of birds and bats are key concerns, monitoring studies at specific projects in the U.S. are needed to quantify these impacts and identify appropriate mitigation measures. It was acknowledged that the results of the European monitoring studies may not be applicable to the U.S. because of differences in species, behavior, site conditions, etc. However, development of tools to evaluate collision and mortality rates should be done in collaboration with researchers in Europe and the UK who have been working to develop such systems. MMS will need actual data to improve and validate predictive models for assessment of collision and displacement at future projects. Baseline assessment methods that need further development include acoustic, radar, and thermal detection systems.

To reduce risks to flying animals, more information is needed on the types and effectiveness of different mitigation measures. Studies were recommended at existing sites to evaluate different lighting techniques. It was noted that the Communication Tower Working Group (chaired by USFWS) has conducted research on lighting techniques for onshore towers and turbines; studies should be conducted first on land where it is easier to test and evaluate different approaches. Initial studies should include redundancy of methods to evaluate effectiveness of each method. For example, studies should use acoustic, accelerometer, and thermal imaging methods, simultaneously. Initial studies should be at inland wind projects. Once the effectiveness of methods tested inland has been evaluated, the effective components can be moved to offshore sites for further testing.

There is very little information on which to make even initial assessments of the potential impacts to bats. It is not known if they fly offshore, how far, or how high. There was discussion as to whether bats would be attracted to offshore towers. Survey methods for birds should be evaluated as to whether they can be used to detect bats as well.

There is a need for a risk assessment framework to evaluate the significance of results, particularly acceptable risk, since some impact is possible.

Based on the discussion, the group developed seven main categories of information needs for assessment of potential impacts to flying animals, as follows:

- Regional summaries for known abundance data for priority offshore areas – Identify priority 3-D spatial/temporal distributions for both birds/bats
- Regional baseline studies in priority areas to fill data gaps for both birds/bats
- Synthesis of old/new flying animal data into geospatial abundance layers (by species/group to inform siting)
- Site-specific study protocols/guidelines for:
  - Collision/mortality detection
  - Attraction/avoidance behavior/change
- Improved predictive models that are based on new data and results
- Mitigation measures effectiveness evaluation at specific future installations (e.g., testing of different lighting configurations)
- Risk assessment framework to address key issues

Each of these categories was recorded onto a large poster with columns for the five areas of information being sought by MMS (data needs, suggested methods, collaborators, other limitations, special considerations). The group posted written comments on sticky notes in these columns for each category. Tables 9-16 are summaries of the comments by the group for each category.

Tables 9-11 show summaries of the comments provided on the topics dealing with creating good baseline data layers on the distribution, abundance, seasonality, and habitat use for birds and bats in priority offshore areas, where alternative energy development is most likely to occur. The first step (Table 9) is to compile and evaluate the existing data, much of which is quite old and patchy. Key data gaps should be identified, and recommendations made for new studies to fill these gaps. Data for shoal areas were mentioned as an important gap in existing NOAA data collected from ships that avoided these shallow areas. The USFWS has been working on data compilation, quality review, and digitization, thus they would be a good collaborator. Nisbet and Veit (in press) have prepared a summary of the status of all seabirds on the U.S. east coast.

New regional studies would then be conducted (Table 10). There are many requirements for new study methods and technologies because of the need for survey data at night, for flight height, during adverse weather conditions, by species, etc. New technologies need to be developed, tested, and validated.

With the new data and geospatial data analyses, improved geographic information systems (GIS) data should be generated (Table 11) for key species and species groups. These regional datasets are needed to support better siting analyses. They would also help identify the types of site-specific studies needed for individual projects.

Tables 12 and 13 are summaries of the comments provided on the need for site-specific study protocols and guidelines for a) collision and mortality detection, and b) attraction, avoidance, and behavior change. The group agreed that accurate assessment of avian mortality was critical for public confidence in the benefits of offshore wind energy. There are many difficulties in this work because there are no proven technologies to detect collisions and quantify mortality. Once effective methods being tested on land-based towers and turbines are developed, offshore platforms would be good test sites for further refinement for marine applications. The methods used need to provide definitive data on the actual mortality rates of offshore wind parks. There was discussion on the potential use of beached bird carcass surveys as one method to detect large-scale mortalities at offshore sites.

Study methods and technologies are needed for studies to determine attraction, avoidance, and other changes in behavior of birds in the vicinity of offshore wind parks. The studies in Europe and the UK are of limited value because the conditions and species in the U.S. are very different. There are very little data on attraction, which could increase risks of collision mortality for species normally not at risk.

TABLE 9. Summary of comments on information needs for regional summaries of bird/bat abundance data for priority offshore areas.

Regional Summaries for Known Bird/Bat Abundance Data for Priority Offshore Areas				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Summaries of species-specific (seabirds; shore birds; neotropic passerines; raptors; other water-related birds) data (temporal and spatial abundance) based on geographic area (use or reason for presence, such as breeding, staging, over-wintering, migration corridor)	Compile and evaluate all historic and current survey data for all OCS areas (not just prime wind areas); Identify data gaps for priority areas	Data for mid and north Atlantic being compiled by USFWS; Mass Audubon's Nantucket Sound studies on terns, wintering sea ducks, etc.; Nisbet and Veit, 2007: Summary of status of all seabirds on U.S. east coast; Manomet Bird Observatory data from ~1975-1985 mostly Georges Bank and Gulf of Maine; National Audubon Society, Regional Ornithological Society; The Nature Conservancy Marine Planning Group	Existing data are old and very patchy (for the most part)	Distinguish between peer-reviewed studies and gray literature; For each study provide summary of how data were collected and discuss level of uncertainty and accuracy; Create searchable database by location or species; Look beyond ship-based data, e.g., historical NEXRAD data should be considered for high altitude birds
New methodologies for new surveys	Review existing methods and prepare matrix of methods and metrics	USFWS; University researchers		Before and after strong meteorological (or other) environmental events; Include all birds that pass through, not just seabirds
Compilation of what is known about offshore abundance, distribution, behavior of bats		Bat conservation NGOs; University researchers		

TABLE 10. Summary of comments on information needs for regional baseline studies in priority areas to fill data gaps for birds/bats.

Regional Baseline Studies in Priority Areas to Fill Data Gaps for Birds and Bats				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Improved baseline data on distribution and abundance of all species groups in offshore habitats; Include surveys of shoal areas, which have significant data gaps and are priority development areas; Shoreline bird inventory during staging periods	Test long-range detectors for imaging from shore, e.g., radar (NEXRAD) & IR laser; At-sea radar; Include flight altitude, nocturnal movements, and weather variation; Boats (chartered and ships of opportunity from NOAA) and planes should be used	USFWS; U.S. Geological Survey (USGS); NOAA; University researchers; National Audubon Society	Annual variations may make mapping of large spatial distribution not predictable; Annual variation must be considered in designing before and after studies, so important to understand the statistical power of the data, including altitude measurements	Baseline studies should be multi-year to consider temporal variations; Integrate with climatology; Trajectory of migration important (leap frog vs. more direct long distance); These data need to document "background" changes against which to gage changes thought to be due to wind farms
Understand habitat use; Need assessments of food resources and bird resources and species variability through annual cycles	Develop sampling protocols with USFWS and NGOs	USFWS; NOAA; University researchers		It is now possible to get data on food distribution (ADCP); Correlate sea surface temperature with distribution abundance for patchy species
Baseline data on beached bird rates	Existing protocols carcass census	NGOs		Scavenging behaviors should be considered
Extent and context of offshore distribution of bats	Methods development needed	USFWS; University researchers		

TABLE 11. Summary of comments on information needs for synthesis of old and new flying animal data into GIS.

Synthesis of Old/New Flying Animal Data into GIS Abundance Layers (by species/group to inform siting)				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Spatial and temporal data on species distribution, abundance, and habitat use	Use CAMRIS (Computer Aided Mapping and Resource Inventory System)	USFWS; National Renewable Energy Laboratory (NREL) avian database is a good example of synthesis of peer-reviewed studies	Data record too short to determine shifts in population distribution, abundance, prey availability; Limited weather data for past studies; Inconsistencies in data on sex, age, activity, etc.	Provide a data layer that illustrates percent uncertainty depending on study design; Access to large datasets may be difficult

TABLE 12. Summary of comments on information needs for site-specific study protocols and guidelines: Collision/mortality detection.

Site-Specific Study Protocols and Guidelines: Collision/Mortality Detection				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Accurate assessment of avian mortality which is critical for public confidence in offshore wind energy	Build platform for collection of data on attraction and collisions - semi-permanently established at wind park site; Need radar/observation platforms for sites (movable)	California Energy Commission; NREL: USFWS; NOAA – National Weather Service, National Ocean Service, NMFS; National Audubon Society; Communication Tower Working Group	No proven technologies, so will take time to develop	Will need to partner with industry to allow blades/towers to be modified; Use models to figure out what are the most important data to collect (sensitivity analysis)
Methods to detect collisions remotely	Initial studies should include redundancy of methods to evaluate effectiveness of each (acoustic, accelerometer, and thermal imaging); Ensure that any studies using these technologies are coordinated with similar effectiveness studies being undertaken for land-based wind development	Communication Tower Working Group; European researchers; NREL experience in developing protocols for land-based wind	Difficult to validate percent detection of different methods at sea where collection of carcasses is not possible because of rapid predation, sinking, other losses of fallen birds	Learn from European studies; Develop guidelines on when each method should be used and what the results will show; Need to develop a method for adverse weather studies
Determine scavenging rates based on known (observed) consumption and rate (over time); this will allow more accurate estimates of mortality when assessing mortality events	Identify scavenge rates during seasonal changes, for species-specific rates, considering sea state, time of day; regional variation; Observe bird events (movement and strike mortality) and document weather before/after the event	Industry; Universities; USFWS		
Evaluate use of beached bird surveys for monitoring mortality rates	Validate use of carcass drift with telemetry to evaluate potential large kill with weather events	USFWS; NGOs		Protocols should be developed with USFWS and NGO

TABLE 13. Summary of comments on information needs for site-specific study protocols and guidelines: Attraction/Avoidance.

Site-Specific Study Protocols and Guidelines: Attraction/Avoidance Behavior/Change				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Monitoring protocols for using acoustic, radar, and thermal imaging for attraction and avoidance behavior studies; Need to identify appropriate species to study (of concern, surrogate)	Build on experience in Europe and UK; Need to test both visual and remote methods; NEXRAD may be relatively inexpensive tool to measure "biomass aloft" over long term pre-construction periods	USFWS; NMFS; Universities	Flocks may not be co-incident with the presence of migrating prey at a specific location	Collect data on collisions during fog, rain, and night; Integrate with studies on prey availability and change; A lot of avoidance data - need to focus on attraction; First projects in each region serve as prominent platforms for monitoring equipment
Guidelines for assessment of impacts, for specific project and cumulative	Review results of UK Cumulative Impacts Workshop (May 07)		Make sure that long-term effects are considered, and that there is not bias against certain species	Can a standard protocol and data requirements be developed for carrying out a cumulative impact assessment?

TABLE 14. Summary of comments on information needs for improved predictive models.

Improved Predictive Models – Based on New Data and Results				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Improved predictive models related to collision and displacement; Habitat suitability models for offshore habitats, including water depth, seafloor substrate, prey distribution/seasonality, etc.	Time varying probabilities based on statistical distribution, weighted averages, rotor swept areas, etc.; Consider cumulative impacts from all stressors	National Wind Coordinating Committee (NWCC); Universities; USFWS	Probability will differ by species, so will need species-specific study data; Land-based efforts have been unsuccessful in developing a predictive model (see California Energy Commission study)	Other effects – Weather, prey changes, abundance variations, etc. How effective are the existing predictive models? Are there data to evaluate this? Can specific models be used for specific situations? Include measures of uncertainty for baseline and mortality data in models
Guidelines for how to evaluate consequences of collision and displacement		USFWS		What are the likely impacts of displacement (food availability/energy expenditure)? Are there models to predict this?

TABLE 15. Summary of comments on information needs for mitigation measures evaluation.

Mitigation Measures Evaluation at Specific Future Installations				
Data Needs	**Suggested Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Develop a list of potential mitigation measures acceptable to both industry and regulators	Review mitigation methods employed elsewhere for effectiveness, including both on land and offshore; UK monitoring data will start to show whether the mitigation measures in licenses have been/are being effective; Findings of independent peer-review monitoring panel	Industry; NGOs; USFWS; Electric Power Research Institute (EPRI) – Presently they are developing information on avian vision; Communication Tower Working Group	Compare mitigation strategies to other energy/OCS projects (e.g., sand and gravel) for fairness issues	A structure for integrating mitigation measures and changing restrictions (shut down times, etc.) must be built into the regulations and permitting process; Monitor effectiveness of mitigation and revise accordingly (e.g., follow adaptive management principles)
Develop rulemaking with conservation measures that will mitigate known (predicted, verified) impacts to wildlife resources	Habitat loss/displacement compensation buyouts, based on magnitude of loss	NOAA; The Nature Conservancy		Use royalties for habitat/compensation banking/restrictions
Avian light attraction data: aviation and navigation obstruction lighting	Controlled experiments with aviation and navigation obstruction lighting offshore			Review existing studies for power and wind projects on land – lighting; MMS may have access to offshore installations where lighting research could occur

TABLE 16. Summary of comments on information needs for a risk assessment framework to address key issues.

Risk Assessment Framework to Address Key Issues				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
A risk assessment framework to evaluate the significance of results, particularly define acceptable risk	Use existing frameworks for other energy projects; Measure potential bird mortality against other known adverse environmental impacts from climate change, fishing practices, etc.; Standardize output probabilistically rather than deterministically	Develop joint guidance document for OCS risk assessments with collaboration among external consultants, USFWS, and MMS	Need to involve experts and broad range of stakeholders in development of risk framework – Review lessons learned from NREL and land-based experiences in developing risk framework	Annual (or seasonal) iterative input of population statistics from decade-fixed points; Should be for specific key species; Focus on the decisions to be made for alternative energy on the OCS; Standardize treatment of uncertainty for output, recognize uncertainty in analytical techniques deployed, how data were collected, and how data were analyzed
Develop risk assessment with possibilities of exposure and consequence and level of uncertainties	Explore use of expert elicitation as a technique to reduce site-specific uncertainties in avian studies and the companion risk assessment	National Academies; Risk experts involved with "structured decision making"		Would help determine what will happen at a specific site
Comparative data – other stressors to birds in same region				What is an acceptable level of impact on a population? (As industry expands, have to expect at least some impact)

Table 14 is a summary of the comments provided on the need for improved predictive models once actual data on abundances, behavior, collision, and mortality risks are available. There may be a need for specific models for specific conditions. These models will be used to assess impacts at future sites. They should include measures of uncertainty. With improved models, guidelines will be needed for how to evaluate the output, in terms of significance of predicted impacts. Eventually, it will be important to consider cumulative impacts from all stressors.

Table 15 is a summary of the comments provided on the need for evaluating and testing effective mitigation measures. The group discussed two types of mitigation measures: 1) measures to be implemented as part of the design or operation of a facility (e.g., shut down of turbines during periods of peak bird migration); and 2) compensatory measures to offset predicted impacts to resources (e.g., creation of additional nesting habitat for the number of endangered roseate terns estimated to be killed by turbines).

Table 16 is a summary of the comments provided on the need for a risk assessment framework to address the key issues associated with impacts to flying animals.

The results of the Flying Animals breakout group were presented at the Plenary Session. Each of the priority information needs was discussed, and the results of voting on these topics were presented. The need for regional baseline studies in priority areas to fill data gaps in the knowledge of the density and habitat use of offshore areas for birds and bats was ranked as being of highest priority. The need for site-specific study protocols and guidelines for detection of collision and mortality was ranked second, and detection of attraction and avoidance behavior was ranked third. The need for testing and evaluation of mitigation measures at specific future installations (e.g., testing of different lighting configurations) was also of priority. During the discussion, it was reiterated that more consultation with other agencies and experts was needed; thus, the group recommended that the first steps needed were a data summary and data gap analysis.

5.0 Physical Oceanography and Air Quality Breakout Group

The Physical Oceanography and Air Quality breakout group covered the following resources and processes: waves, currents, sediment transport, and air quality. There were 18 members in the group with representation from Federal agencies, academia, and industry. There was little discussion on air quality, probably due to the fact that few of the participants at the session were meteorologists. The first session started with the following summary of the information needs identified in the Synthesis Report:

- A method or approach for establishing acceptable limits to the impacted environment caused by modified physical processes.
- Additional monitoring of waves and currents at existing facilities: offshore of the development, within the development, and in the lee.
- Shoreline morphology monitoring.
- An accurate way of representing alternative energy structures in numerical models for farfield modeling.
- Data sharing infrastructure should be established, and any data sharing requirements should be specified.
- Determining the extreme farfield impacts of extracting a significant amount of energy from an ocean current.
- Assessment of the ability of these structures to impact the stability of the complete ridge or shoal upon which they are founded.

The initial discussion was on the need for an assessment that would lead to generation of maps identifying where the wind, wave, and ocean current resources were suitable to support alternative energy extraction, and how these areas spatially relate to electrical demand and grid capacity. Existing maps of energy potential are based on limited data. It was agreed that national-scale mapping of renewable resources potential was a key information need, to attract developers, to prioritize areas for future assessment, and to support environmental assessments.

Sediment transport issues included potential changes within the development site (nearfield) and along adjacent shorelines (farfield). It will be important to know the natural rates of change so that impacts from the development can be detected and quantified. Sediment dynamics need to be studied over the long term (decadal scale) to form adequate baseline data. Because many of the early development sites may be located on sand shoals, where the water depths are shallow, the sediment transport processes and rates need to be better understood. The MMS Marine Minerals Program is conducting studies of ridge and swale features that are important borrow sites for shoreline restoration projects along the east and Gulf of Mexico coasts. These studies will contribute to the understanding of the sediment dynamics of these features.

The issue of potential impacts to sediment transport focused on the lack of criteria to determine what is an acceptable level of change. Models can be used to predict shoreline changes, for example; however, without knowledge of the natural variation at a given site, it is difficult to assess the significance of the effects of the offshore structure. Within a project site, changes to sediment transport patterns may be important in terms of local scour around foundations; however, changes in grain size can have biological implications in terms of benthic communities,

habitat use, and trophic transfer. Similarly, participants felt a need to make sure that impacts to the physical processes are connected to further impacts to biological and conflicting-use resources.

Two types of air-related impacts were discussed. Increased vessel traffic during construction, maintenance, and decommissioning could be a local source of air pollution. However, the benefits of alternative energy (reduced combustion of fossil fuels for power generation) would greatly offset these impacts. There was some concern and uncertainty about the effects of wind parks on air velocity and turbulence, thus affecting local climate and air quality onshore, in the lee of wind parks. It was decided to limit the discussion on air quality as the participants felt that impacts on air quality due to alternative energy development on the OCS would be significantly less than impacts to other physical processes.

There were similar farfield concerns expressed with ocean current energy, particularly on the Gulf Stream, where farfield impacts could include nutrient mixing and potentially modified micro-climates. Farfield concerns with respect to wave energy extraction included shoreline and bank morphology.

Analyses of potential long-term consequences are complicated by predictions that wind, wave, and current fields may be significantly modified by climate change, and some participants suggested including future climate change scenarios in long-term analyses.

Many of the participants expressed concern about the cumulative impacts of multiple projects in areas with the highest energy potential. Examples include ocean current extraction in the Gulf Stream, wave extraction in high-energy wave climates on the west coast, and on wind energy extraction in the high-energy wind regions of the Northeast.

Based on the discussions, the group identified the following main themes for information needs:

- Need for geospatial tools – Resource mapping (wind, ocean current, waves), biological resource mapping, onshore energy demand and grid connection
- Baseline of existing conditions – Nearfield
- Baseline of existing conditions – Farfield
- What are impacts from structures – Nearfield, including stability of shoals and ridges
- What are impacts from structures – Farfield, including impacts of loss of energy from a system
- What to do with quantitative impacts results – Need some guidelines on what levels of change are acceptable

Each of these categories was recorded onto a large poster with columns for the five areas of information being sought by MMS (data needs, suggested methods, collaborators, other limitations, special considerations). The group posted written comments on sticky notes in these columns for each category. Tables 17-22 are summaries of the comments by the group for each category.

TABLE 17. Summary of comments on information needs for geospatial data tools to support energy resource mapping and physical processes impact assessments.

Geospatial Data Tools				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Alternative energy resource maps for offshore areas – Combined modeling and observational data for wind, wave, and ocean current	Coupled modeling and observation studies: 1. Collection of existing data; 2. Preliminary modeling to define spatial scales, regions of uncertainty, and identify data gaps; 3. Field data collection; 4. New data used to refine models	NOAA; U.S. Army Corps of Engineers (USACE) for nearshore waves; Navy; States; Contractors, private industry; Academia; Private sector should be encouraged (incentives) to share data	Density of measurements; Encompassing all relevant processes (modeling); Resolving spatial scale and resolution issues of the baseline data	Shared funding by many agencies necessary because of great cost
Maps of demand in relation to resource and grid capacity		Utilities; Department of Energy		Expected growth in electricity demand; Regularly updated "living database"
Geospatial tool with all natural biological resources, utilities, energy demands, physical processes, etc. for siting analysis and impact assessment	Interdisciplinary studies to look for models	Academia (all areas dealing with science issues in comprehensive fashion)		
Approaches to determine biological consequences of physical changes, e.g., how much destratification or frontal creation or decrease is acceptable				
Integration with regional and other related interest groups together with their data and monitoring networks.	Examples: -CODAR deployments near Cape Hatteras and New Jersey -Regional wave models -NDBC buoy data -prior science studies, e.g. SEEP, OMR, PRIMER			

TABLE 18. Summary of comments on information needs for developing a baseline of existing conditions in the nearfield.

Baseline of Existing Conditions (waves, currents, wind, sediment transport) – Nearfield				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Better understanding of morphology and sediment transport patterns and rates on shoals, to be able to predict/detect changes post construction	Field data collection and numerical modeling	USGS; NOAA; USACE; Consultants; Developers		Consider ongoing studies of shoals - sediment transport processes and rates - by MMS Marine Minerals Program
Long-term metocean data (wind, waves and currents) farther offshore; Baseline monitoring – stratification and frontal structures	In-situ monitoring, CTD/ADCP; Remote sensing; Numerical modeling; Hindcasting	Regional Associations/IOOS; NOAA	Little historical data, so long-term datasets are not possible yet – will need to use hindcasting and forecasting methods	Integration of site monitoring into regional Ocean Observing Systems - ability to use modeling capabilities and tap into physical and biological monitoring of arrays in place

TABLE 19. Summary of comments on information needs for developing a baseline of existing conditions in the farfield.

Baseline of Existing Conditions – Farfield				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Data and approaches to predict impacts to shoreline sediment transport mechanisms and other forces driving geomorphic change	Field sampling using LIDAR; In-situ testing; Numerical modeling; Hindcasting; Current change	States; USGS; USACE; NOAA Coastal Services Ctr; Universities	Need to identify where to focus initial efforts to collect data – where are the likely sites	Temporal issues (decadal vs. short term)
Historical sediment transport patterns for analysis of changes after offshore development	Analysis of historical aerial photography/hydrographic charts; Shoreline change monitoring programs	NOAA (buoy and bathymetric data); MMS (sediment studies)		Historical shoreline change rates can be determined from aerial photography; NOAA charts may provide data for offshore changes
Wind, waves and currents further offshore of present datasets	In-situ testing (buoys or masts); Numerical modeling; Hindcasting	NOAA; Regional Ocean Monitoring Networks		
Understanding deepwater sediment transport processes; Littoral cell definition	HF Radar; Sediment transport models	USGS; USACE; Universities		

TABLE 20. Summary of comments on information needs for assessing the nearfield impacts of structures.

Impacts of Structures – Nearfield				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Data and models to predict and mitigate local and global scour near foundations in conditions similar to the U.S. OCS.	Pre- and postconstruction multibeam side scan sonar mapping and bathymetry; Numerical models	Developers with government oversight; Researchers at existing projects in Europe and UK	No actual monitoring data for U.S. settings for model validation and refinement	Processes are sub-meter in scale
Data and improved models to predict changes in currents, waves, and sediment transport within the project footprint; Effects of spacing and water depth so can minimize impacts through project siting/design	Field studies at existing sites with in situ instrumentation for currents, wave, wind using HF radar, ADCPs, etc.; Protocols for postconstruction monitoring of projects in the U.S.; New model development	Developers with government oversight; Researchers at existing projects in Europe and UK	No actual monitoring data available for U.S. settings for model validation and refinement; Scaling – prototype testing over time	New approaches to physically represent the turbine bases in models – spacing is too small for grid size; Long-term data for impacts to waves, wind, and currents are sparse; Need real field data to improve and validate models; May need to consider changes in fishing practices (exclusion of trawl fisheries) that could affect sediment dynamics
Methods to assess potential for stratification and alteration to mixing of nutrients in the euphotic zone	Field CTD; Buoys; 3D Hydrodynamic modeling; MODIS Ocean color	National Space Administration Agency; Academics; Private		

TABLE 21. Summary of comments on information needs for assessing the farfield impacts of structures.

Impacts of Structures – Farfield				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Models to predict shoreline changes	Sediment transport models driven by site-specific data on wave climate, bathymetry, etc.	Developers with government oversight	Depositional environment shoreline type	Defining significant change compared to natural variation, coastal development, climate change, sea-level rise, etc.
Data to assess impacts to wave/current fields, sediment transport in lee of facilities	Monitoring of existing site; Model refinement	Developers with government oversight	May need nearby undeveloped site for reference	Models need improvements to generate the wind field in lee more accurately
Does energy extraction alter stability of the Gulf Stream?			Climate change impacts on Gulf Stream	Meandering of Gulf Stream brings nutrients onto shelf – changes could have large, cumulative impacts

TABLE 22. Summary of comments on information needs for how to apply quantitative impacts data on physical processes.

How to apply quantitative impacts data?				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Wave height reduction from development on the OCS, what is an acceptable impact?	Shoreline deposition changes; Public meetings	USGS; State agencies; Local interest groups	Shoreline type and use would influence acceptable tolerances	It will be important to include extreme weather events in the analysis
Current, waves, sediment concentrations, tides	Statistical analysis; Database development	Academia	Data format and consistency - data sharing	Seasonal variations require long-term data collection
Social data on acceptable impacts	Create new government-managed group	USEPA; Academia; Industry; Public		Determining regulatory compliance
National database	Interactive GIS database – internet enabled mapping system (resource limiting conditions)	NOAA- NODC		Temporal issues – long term vs. medium term vs. short term
Better understanding of cumulative impacts of multiple installations; how to define the acceptable density		NOAA; Developers; Industry; Universities		

Table 17 is a summary of the comments provided on the needs for geospatial data tools to support energy resource mapping and physical processes impact assessments. The group wanted more detailed analysis and maps of the energy potential in the OCS to support policy development, attract developers, assess impacts to physical processes, and identify linkages and interactions with biological resources. They hoped these maps or spatial databases would include metocean data/climates, seafloor properties, space-use conflict areas, electrical demand and grid capacity, as well as sensitive biological areas. This effort would require compilation and synthesis of existing data and collection of new data to fill data gaps, which they thought would be significant. They felt the priority should be first collecting the existing datasets and establishing links with regional monitoring networks and other agencies collecting data (e.g., NOAA).

Table 18 is a summary of the comments provided on the needs for developing a baseline of existing conditions in the nearfield around potential development sites in the OCS. Emphasis was on shoals and ridges where wind energy developments are most likely to be located in the near term because of their shallow depths. Research being funded by the MMS Marine Minerals Program on sediment transport and impacts of dredging at offshore sand borrow sites should be directly applicable.

Table 19 is a summary of the comments provided on the needs for developing a baseline of existing conditions in the farfield of potential development sites in the OCS. Emphasis was on baseline (historical) data and understanding of nearshore sediment transport processes on which to evaluate potential changes postconstruction of offshore projects. Where historical metocean data are unavailable, hindcast data were seen as a passable (although less-preferred) substitute. Historical data on shoreline change are available or may be determined using aerial photography, but not on shoreline sediment transport patterns and rates within the entire littoral zone, or historical data on their driving forces (wind, waves, currents offshore out in the OCS); this will need to be connected using numerical models. In the lee of likely development locations in the OCS, more detailed monitoring of shoreline change and sediment transport was also thought prudent.

Table 20 is a summary of the comments provided on the needs for assessing the nearfield impacts of structures. The group discussed three types of impacts: 1) local scour around foundations; 2) broader changes in waves and currents influencing sediment transport processes and thus sediment characteristics in the footprint of the development site; and 3) broader changes in water currents and circulation that could affect water quality inside the development site. The results of monitoring studies at existing wind parks in Europe are of only limited value because conditions at U.S. sites are very different. Model refinement is needed to address issues of the fine scale needed for analysis, for the actual size and spacing of structures as well as the physical processes to be modeled.

Table 21 is a summary of the comments provided on the needs for assessing the farfield impacts of structures. Three areas of concern were discussed: 1) shoreline changes from offshore wind and wave energy developments; 2) changes in wave and current field and thus sedimentation patterns in the lee of developments (between the project site and the shoreline); and 3) impacts of

current energy extraction on the Gulf Stream. Existing models need refinement and validation based on site-specific monitoring studies.

Table 22 is a summary of the comments provided on how to apply quantitative impacts data on physical processes to support impact assessments. Modelers can generate data quantifying changes in terms of a percent reduction in wave height, or a distance over which currents are reduced. However, there is no guidance on what degree of change should be considered acceptable, for both direct and cumulative impacts. In the desktop studies conducted in Europe, the impacts to physical processes were always considered insignificant.

The group also discussed the importance of information sharing during all phases of a project and encouraged MMS to develop an information-sharing program.

Overall, the physical oceanography and air quality group concluded that, at the present time, efforts should be focused on the marine-based impacts. They believed that concerns with the air quality impacts were either less significant, or less likely to occur. The most significant need identified by the group was the need for bringing data into one place–preferably a spatially referenced database/mapping tool. The group did not limit what should be included, but specifically identified winds, waves, currents, seabed characteristics and stratigraphy, energy resource potential, electricity demand and grid capacity, space-use conflicts (navigation, fishing grounds, etc.), biological indicators, and sensitive areas, as well as numerical modeling results. It is believed that this system would provide an efficient means for determining where to focus the efforts of further data collection and modeling. It would also provide a framework for project developers and MMS to collaborate on effective siting; all participants agreed proper siting was the primary and most effective impact mitigation approach. The group encouraged the collaboration among regional monitoring networks and other agencies (NOAA, USGS, etc.) to populate the database and identified expanding regional networks and other existing programs as perhaps the most efficient means of filling physical data gaps and establishing baseline monitoring.

Nearfield impacts of the developments focused on the better understanding of the physical processes going on within the footprint of developments, and some felt it would require the development of new approaches to accurately represent the structures in a numerical model. Farfield impact discussions were dominated by impacts to shorelines; however, the farfield impacts of a modified Gulf Stream were identified. The group generally felt that any farfield impact assessments were limited by the fact that at present, wind, wave, current, and nutrient datasets do not extend far enough offshore to be useful to all alternative energy applications on the OCS. A discussion surrounding all of the impacts included concerns with the cumulative impacts of numerous installations, and how MMS will determine the acceptable limits of the cumulative impacts. Linkages between modified physical processes and biological impacts were not discussed in detail; however, it was felt that a good initial approach at establishing those linkages was to include biological indicators in the spatial database.

6.0 Social Sciences and Economics

The Social Sciences and Economics breakout group covered a broad range of topics related to feasibility of projects, policy, regulations, permitting, and socioeconomic impacts. There were 21 members in the group with representation from Federal agencies, academia, industry, and the international community. The first session started with the following summary of the information needs identified in the Synthesis Report and by MMS staff:

- Conduct of studies on policy, socioeconomic impact
- Detailed guidelines for visual impact assessments
- Determination of thresholds of visual impact
- Impacts to onshore land use
- Impacts to onshore infrastructure
- Economic impacts – job creation or income generated
- Impacts to indigenous tribes and subsistence fishing
- Effects on recreation and tourism
- Impacts to navigation and transportation – impacts to space
- Communications – impacts to radar

Breakout group members focused much of the initial discussion on economic issues of project development. MMS stated that it is not the government's role to determine if a proposed project is economically viable; that is a business decision. However, impacts in different areas are within the government's scope. Group members suggested that array size can affect both economic and environmental impacts. The number of arrays will affect cumulative impacts. Economic viability will affect scenarios selected for assessing impacts. And, economic viability will affect the developer's willingness to take on monitoring and mitigation requirements. It was also pointed out that the size and location of the lease area may determine what a developer realistically can and can not propose.

The economic viability discussion led the group to the subject of cost/benefit analysis. Group members suggested that cost/benefit analyses of alternative energy projects should be holistic and broad, address issues such as differences between renewable sources and fossil fuels which are finite, and consider the subsidies provided to conventional fuels, regional differences in energy demand versus sources, environmental and human health effects associated with air pollutants, climate change, and experimental technologies, and how some issues such as visual impacts may vary by geographic area. It was acknowledged that costs and benefits should be determined regionally, not nationally, because of significant regional differences, even though renewable energy is in the national interest. National policies are important; in the UK, there is a strategic national policy that drives renewable energy project development. The group concluded that guidelines on cost/benefit analysis are needed.

A subset of the cost/benefit analysis discussion focused on the appropriate methodology for assessing traditional socioeconomic impacts such as those on tourism, property values, or fisheries as an input to the cost side of the cost benefit equation. Surveys and case studies are two different approaches to those types of assessments that have their specific advantages and disadvantages. Neither approach is standardized. Surveys are sometimes used to assess local

acceptance of alternative development options, but for the local people, the results are often viewed as unreliable. There are a variety of concerns with surveys ranging from lack of trust in the survey sponsor to the mechanics of the survey itself – either the form or content of the questions or the sampling method.

The issue of experimental vs. commercial projects was raised a number of times in the discussion of economic viability and cost/benefit analysis. It was suggested that experimental projects should be treated differently than commercial projects, in terms of the leasing process, including any cost/benefit analysis, and permitting requirements, since they can not be expected to be economically viable. Deployment of meteorological masts should fall under the leasing process of experimental projects. The question was raised as to whether the environmental assessment for leases for experimental projects, i.e., those testing technology, would/should be different than the assessment for commercial projects.

As was the case for all the breakout groups, there were repeated requests for maps showing areas of alternative energy resources overlain on maps showing energy needs, infrastructure, environmental and use conflicts, and other concerns. This kind of information is essential for initial project scoping, siting, and economic analyses of costs and benefits. Industry is very interested in MMS providing geographical data and tools for initial project evaluation. Maps at the regional level were specifically requested in order to make sure that geographic and economic nuances are captured. Group members suggested a number of collaborate efforts that they felt would enhance any mapping effort and improve the quality of information available at the regional level. These included working with the shipping industry, commercial fisheries groups, fishery management councils, research tied to the mapping effort, and existing resources from Federal, State, and local sources.

Throughout the discussion, the group grappled with understanding the differences between the established MMS oil and gas program and the still under development alternative energy program.

The group's discussion fell into the following major categories of issues and concerns:

- Alternative energy adaptive management (as applied to monitoring and mitigation requirements)
- Commercial vs. experimental technologies
- Cost/benefit methodology
- Space-use issues and conflicts
- Understanding stakeholders
- Mapping
- Regional and national issues—meta-level
- Regulatory coordination/collaboration

Each of these categories was recorded onto a large poster with columns for the five areas of information being sought by MMS (data needs, suggested methods, collaborators, other limitations, special considerations). The group posted written comments on sticky notes in these

columns for each category. Tables 23-29 are summaries of the comments by the group for each category.

Table 23 is a summary of the comments provided on the use of adaptive management principles as applied to monitoring and mitigation requirements. Because these are new and evolving technologies, there are many requirements for monitoring to determine the magnitude of potential impacts. These requirements should be appropriate to the scale of the project. The study results should be used to shrink or change future requirements to reflect the current understanding or knowledge base. Studies should not automatically be required for every new site. MMS should periodically review the results of past studies and revise monitoring requirements.

Table 24 is a summary of the comments provided on how the different phases of project development should be treated. The group thought that the experimental phase of a project, usually installation of instrumentation to collect site conditions data on wind, waves, currents, etc., should have minimal requirements for permitting and leasing. Because of the need for demonstration projects in U.S. settings, such projects should be supported, with different requirements. MMS should also support information sharing for all projects.

Table 25 is a summary of the comments provided on the needs for improved methodologies for cost/benefit analyses of alternative energy projects. This topic had the most number of "sticky note" comments for this breakout group. There was a clear need for more "hard" data on which to make these kinds of analyses. Also, there were many comments on quantifying the true costs of conventional energy production, considering the future costs of climate change and the broad consequences to humans and natural resources. Such holistic analyses will require both social and economic research to collect the necessary data and develop the appropriate methods of analysis.

Table 26 is a summary of the comments provided on space-use conflicts and mapping; these two categories were combined because there was overlap in the data, methods, etc. Mapping tools and the necessary data are needed for developers to identify and avoid space-use conflicts very early in the scoping process. During one of the presentations on the SEA process in the UK, it was clearly shown that simple overlays of uses are of limited value; nearly all areas show potential conflicts. Thus, more sophisticated methods are needed that allow ranking of factors and weighing of variables. With updated and higher-resolution maps of energy resources, developers will be able to identify potential sites within their areas of interest and get initial information on resource and conflict issues. Because there will always be some conflicts, developers in this emerging industry want guidance documents to help them collaborate with stakeholders so they can resolve conflicts early in the process. The guidance document should include information on possible mitigation measures to reduce or avoid conflicts. Developers need to benefit from the experience of others in this regard.

Table 27 is a summary of the comments provided on understanding stakeholders. Again, the group discussed the need for tools and documents to guide developers towards successful communication with stakeholders. Developers also voiced the need to better understand the MMS process for leasing and permitting. The group also identified the need for MMS to develop

TABLE 23. Summary of comments on information needs for how to apply adaptive management principles to monitoring and mitigation requirements for alternative energy installations.

Alternative Energy Adaptive Management (Monitoring and Mitigation)				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Guidance on how adaptive management principles should be applied to monitoring and mitigation requirements for alternative energy installations over time	Activating requirements in consent documents	NOAA; USFWS: Industry		Need to identify scale of project that would make certain monitoring worthwhile, required, and/or reasonable; Monitoring requirements for future projects should shrink or change to reflect the current understanding or knowledge base
Information needed to determine the minimum scale for assessing technology and impacts	Periodic review of current understanding of impacts	Natural resource agencies; NGOs		How do you balance encouraging investments in new technologies with the risk that future knowledge may find the impacts of these technologies unacceptable?

TABLE 24. Summary of comments on information needs for treatment of commercial versus experimental technologies.

Treatment of Commercial versus Experimental Technologies				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Definitions of technical (e.g., met towers), demonstration, and commercial projects, with demonstration bridging the gap	Definitions would include size, duration, experience level in the region, technology variations, and data to be acquired	Federal agencies; States; Industry; Utilities; Universities	Are criteria needed to assess the appropriate maximum scale of commercial projects?	Small-scale projects less than a specified amount of power generated are needed for operation, integration, and maintenance experience
Leasing and permitting requirements for different phases of projects, as listed above	Identify duration requirements; Fast track a ruling to allow data collection for R&D on the OCS (e.g., installation of met towers)	Federal agencies; States; Industry; Utilities; Universities	In the U.S., demonstration projects are needed because there are concerns not addressed in Europe/UK projects, including hurricanes and lightning strike survivability; Regional variability in conditions, experience and knowledge of technology	Allow greater uncertainty/probability distributions for data requirements for experimental technologies used in demonstration projects; Less information would be needed for small-scale, time-limited R&D projects; Europe started with small projects that provided data and helped with public acceptance
Database summaries of experimental technology information, including current projects, study goals, further links		Industry		Should be a minimum requirement that data reports be posted to this new database by the project in order to get an experimental status (or noncompetitive status); Data sharing moves industry towards greater certainty and more narrow distributions as technology is demonstrated and moves to commercial status
R&D funding		MMS; DOE		Federal funding moves projects along faster

TABLE 25. Summary of comments on information needs for developing cost/benefit methodologies for alternative energy projects.

Cost/Benefit Methodologies				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Better data on which to quantify benefits, such as health benefits from lower pollutant emissions, reduced greenhouse gases and climate change effects on environment and humans, greater energy independence, and job gains	Surveys and interviews; Contingent valuation analysis; Choice of appropriate discount rate; Determine levelized costs and benefits; Sensitivity analysis; Consider data from European experience; Data for on-land installations	Local business groups; Local and regional stakeholders/interest groups; USEPA; U.S. Department of Energy	Holistic approach is hard to agree on but needed; Monetary impact is very hard to quantify; Hard to understand full cost of non-renewable generation alternatives considered in NEPA	Guidelines are needed on: how to value public policy requirements in the analysis; How to quantify societal benefits of renewable energy; Each region will need different data and approaches; Need data on real costs of conventional power production
Better data on which to quantify costs, such as installation and operating costs, grid integration, negative environmental effects, negative effects on property values, aesthetics, fisheries, tourism, job losses		Local business groups; Local and regional stakeholders/interest groups; USEPA; U.S. Department of Energy Industry; Utilities	No hard data from prior experience; Much is based on speculation and personal drivers; Every project will have consultants that will work for and against the project	Each region will need different data and approaches; Is there a conservation benefit to exclusion zones/artificial reef effects that should be valuated vs. lost fishing access costs?
Financial analyses of alternative and conventional energy – magnitude of subsidies; financial viability; potential for lease payments; determination of "optimal" subsidy lease payments				Create an MMS royalty structure that helps support a renewable energy industry on the OCS
Standards of methodology should be consistent across all similar industry sectors; Consistency of language usage across agencies	Survey European experience; Workshops with key stakeholders; Interviews with social scientists and decision makers; Mapping of process to identify areas needing standardization; BACI and dynamic methods where BACI does not work		It is time consuming to make generic guidelines	Identify where standardization of methodology is needed and where regional variability does not warrant it; Recognize that methodologies will need to be adapted to suit different technologies at different stages of maturity

TABLE 25. Cont.

Cost/Benefit Methodologies				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Overarching examination of methods for understanding potential benefits and detrimental effects of emplacing offshore alternative energy facilities and development of standards of validity and reliability in their application	Literature review to identify relevant research methods and guidelines for application of social and economic research and analysis in natural resource use settings; Interview core experts and others who use information to identify desirable standards of reliability, validity, and precision; Existing information and regulatory regimes should be assessed for other similar industries (e.g., electrical power generation) creating a database of requirements to use as a reference; Convene inter-agency panels to clarify discrepancies and codify language	Fishery Management Councils; NMFS; Bureau of Land Management; National Park Service; State agencies with social science capacity; Key stakeholders; Developers	Involve state agencies to identify areas that could not be standardized and why; Vast number of stakeholders	Goal is to generate guidelines for the application of social and economic research methods in assessing potential benefits and challenges of alternative energy options on the OCS; Involve social science research specialists in project

TABLE 26. Summary of comments on information needs for space-use conflicts and mapping.

Space-Use Conflicts and Mapping				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Geospatial tools to identify potential space-use conflicts	GIS overlays are simple but likely to identify potential conflicts everywhere, thus more sophisticated methods are needed that include ranks and weighs that can be varied depending on local conditions	Shipping interests; Utilities; Military; State and Federal resource agencies; Fishery management councils; Local agencies; Trade associations; Commercial fishing groups		Tools should be available to developers who can do their own analyses; Need to establish guidelines for buffers around certain types of conflicts (e.g., pipelines, shipping routes); Initial tool is needed soon, can refine over time
Data needed for geospatial tool analysis, including shipping routes, aeronautical routes, military use areas, oil and gas infrastructure, fisheries areas, recreational use areas, tourism, view sheds; subsistence, cultural resources, critical habitats, marine protected areas	Identify needed data layers, compile existing data, evaluate and identify data gaps, conduct surveys to collect key missing data; Consider economic importance to the region; Poll developers to get feedback on project (type, scale, location) to prioritize areas to be mapped	Shipping interests; Utilities; Military; State and federal resource agencies; Fishery management councils; Local agencies; Trade associations; Commercial fishing groups	Some data are confidential (post 9/11); Variations in data scale and detail may not support project-level analysis; Will need the cooperation of agencies who have the data	Should MMS compile all existing data for use by developers or link to datasets maintained by other agencies? OMB authorization for surveys; Statistical grids used by fishery agencies too large resolution, needs to be refined through work with fisheries and other users
Guidelines for collaboration with stakeholders and identification of possible mitigation measures	Expand visual analysis to include/quantify affected population; Include "hard" costs like tourism impacts	Shipping interests; Utilities; Military; State and federal resource agencies; Fishery management councils; Local agencies; Trade associations; Commercial fishing groups		Generic mitigation strategies may not be applicable nationwide, however examples might speed resolution; Education of locals: trips to offshore wind farms, meetings with all stakeholders including fishing, tourist groups, NIMBY groups
Energy resource maps, objective is to make detailed maps of developed areas to be targeted (UK model)	Compile data on wind, wave, and currents energy potential			If the NREL maps are used for offshore "prospecting," need more data on land effects on wind

TABLE 27. Summary of comments on information needs for understanding stakeholders.

Understanding Stakeholders				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Guidance document for developers on how to communicate with stakeholders to promote local acceptance of projects and alternatives	Interview agencies and developers to identify needs and issues; Survey coastal communities and other stakeholders to identify key issues that may pose problems; Develop tools for productive outreach and communications; Develop ethnographic studies to document attitudes pre- and postconstruction	Federal, state, local permit entities; Community associations; Public officials; Tribal governments; Fisheries interest groups	Variations in regions and states	Must be clear to developers in terms of process; The different stakeholders in each region need to be defined; Get a small group of stakeholders together representing each region and brainstorm about the issues for each stakeholder group; Identify valid indicators for use in long-term socioeconomic monitoring framework
Building better partnerships between developers and MMS	Interview developers about their ideas on an accommodative "competitive" process, and demonstration projects that can be used to measure environmental impacts (to refine later generations of rules)	Industry	The expectation of studying everything before implementing anything needs to be removed	Developers need a defined permitting process to foster this new industry
Outreach program to provide the public with objective information on issues associated with alternative energy on the OCS	Develop methods that educate the general public, e.g., publish articles in local and national media; Develop polling methods on NIMBY issues in different regions and nationally		Need to realize that you will never satisfy everybody	Extend understanding beyond perceptual/attitudinal dimensions of offshore renewables to social and sociopolitical (behavioral) response to programs/projects

TABLE 28. Summary of comments on information needs for regional and national issues.

Regional and National Issues				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Regional data on cost of power, utility reserves, energy needs, strength of transmission grid, variations in grid rules, competing priorities, etc.	Review of jurisdiction between Federal, State, and local agencies	Regional IS0s (independent system operations); Utilities		
Identify what issues are of national interest and which issues are of local interest; Identify most optimal way to address both	Surveys; Workshops with stakeholders; Review other agency experience and lessons learned, i.e., USEPA			

TABLE 29. Summary of comments on the need for regulatory collaboration.

Regulatory Collaboration				
Data Needs	**Methods**	**Collaborators**	**Other Limitations**	**Special Considerations**
Create "one stop" for permitting; Establish a timeline for entire permitting process to enable developers to estimate expenses	Establish regional work groups with Federal, State regulators and grid operators to address cross jurisdictional process, consistency in regulatory regime	Federal agencies; State agencies; Developers; Public		Permitting needs to be driven by one department on the Federal level; Need to develop process for coordination with the States
Identification of issues in fishing, environmental, navigation, aviation; Data for each of these issues for strategic development areas around the country	Working groups on each issue on a national level, including industry reps and relevant regulatory representatives; Coordination by one agency	Federal agencies; State agencies; Developers; Public	Will not be able to capture all issues of local or regional importance or variability	Define parallel groups at the regional level to ensure two way transfer of pertinent information; Ensure emerging information is available to all
Regulatory guidance for developers - process flow map of regulatory/permitting procedure; A framework for coordination and clarity in regulations and schedules	Meta-study that defines Federal, State and local regulators and jurisdiction for selected States	Federal agencies; State agencies; Developers; Public		May require regional analysis; Use of lean principals to optimize process while meeting requirements

a program of public outreach and education on the issues associated with alternative energy development on the OCS.

Table 28 is a summary of the comments provided on regional and national issues. Many of the comments overlapped significantly with previous issues. Table 29 includes comments on the need for regulatory collaboration. Representatives from this nascent industry voiced considerable frustration over the complexity, costs, and delays in permitting, leasing, and other regulatory compliance requirements. They encouraged MMS to provide for a "one-stop" process to assist developers. They requested guidance documents explaining the regulatory process and the issues that may arise during the process.

At the Plenary Session, the group presentation started with the fact that MMS's intent was not to determine economic viability of specific projects; however, there was significant discussion by the group of factors that would aid developers and others in understanding implications of critical parameters such as size of units, extent size of arrays, scope of lease areas, variation in environmental and socioeconomic factors across regions, etc.

The group identified a need to use lessons derived from renewable projects in Europe. They saw the need for and desirable content of comprehensive cost-benefit analyses that included consideration of the unique nature of renewables vis-à-vis traditional OCS resources.

The topics of most interest to the group were:

- Treatment of commercial vs. experimental technologies
- Space-use issues/conflicts
- Understanding stakeholders
- Standards of methodology
- Cost/benefit methodology

There were two key areas of concern. First, there was a clear need for development of tools for mapping energy resources and potential conflicts; stakeholder collaboration guidance; a guide for developers on permitting and leasing; and tools for improved communications between MMS and developers. Second, it was noted that the issues discussed by the group were not the traditional areas of study under the topics of social sciences and economics. Rather, there was extensive discussion on permitting and regulatory requirements. This was, in part, because the group thought that topics such as visual assessments had been adequately addressed in the synthesis report.

The group identified the following as examples of priority projects:

- Impacts of alternative energy projects on local tourism
- Space and use conflicts between commercial fishing and alternative energy projects
- Identification and perceptions of stakeholders
- Establishing/identifying state-of-the-art social science methodologies

7.0 Final Plenary Session

The session opened with a brief summary of the discussions over the first two days of the workshop. Then it was opened up to further open discussion, which is summarized below under the major information needs.

7.1 Geospatial Data and Tools

All four breakout groups identified the need for the compilation and evaluation of geospatial data and collection of new data to fill identified data gaps. Maps showing the locations of energy resources were of priority interest to every group: Utilities need them to assess the role that alternative energy may provide in future energy supplies; Developers need them to select the most feasible sites for further analysis; Regulators and resource managers need them to identify priority areas to start baseline data collection; and State and local agencies need them to inform the public on the issues. Higher-resolution, nationwide data are needed on energy resources, namely wind, waves, and currents. The existing maps need additional data and refinement of the analysis. Several groups are collecting data at specific sites. The U.S. Department of Energy will be an important collaborator.

Once the priority areas are identified for possible alternative energy development in the OCS, the Federal and State resource agencies will need to compile existing data on habitats of concern and the distribution, abundance, and use of these areas by species of concern to identify key data gaps and develop study plans to collect missing data to support regional assessments. Researchers noted that compilation of existing data requires extensive data validation and quality control before the data can be used in environmental assessments. Data compilations are also needed for other types of use conflicts, such as navigation, commercial and recreational fishing, tourism, cultural resources, etc.

There was discussion about what studies will be conducted by MMS and what studies industry will be asked to conduct. Though there are no hard rules, generally the MMS Environmental Studies Program will conduct or support studies that address generic issues (e.g., the effect of sound on marine mammals) or cover large, regional issues (e.g., regional circulation patterns). Industry would be expected to conduct studies at a specific site (e.g., benthic habitat mapping in the footprint of the installation).

There are many opportunities and a great need for collaboration and partnering to conduct the necessary mapping of natural resources. This mapping effort is needed to identify areas that should be avoided, support impact assessments of proposed projects, identify resources that may need more detailed study and/or mitigation to reduce impacts, and provide baseline for monitoring studies. This workshop was one step toward fostering partnerships among agencies to address the environmental issues associated with alternative energy development in the OCS. It will be important to continue collaboration.

7.2 Geospatial Analytical Tools

Each group also discussed the need for geospatial tools to support data analysis at different scales. Developers need to quickly identify areas to avoid, areas with potential conflicts or

issues, and areas with the least potential conflicts. They also need to identify the environmental and socio-economic resources that may need to be addressed during environmental assessments.

Specialized tools will be needed for data analysis and integration across disciplines. For example, weather is a very important factor influencing the distribution and abundance of birds offshore; thus, researchers need tools to help them acquire and analyze weather information in combination with bird survey data.

7.3 Evaluation of Mitigation Measures

The MMS Environmental Studies Program conducts studies on the effects of development activities in the OCS and supports research on strategies to avoid or reduce significant effects. This is one area where collaboration with other groups working on similar problems is essential, such as work being done by the Communication Tower Working Group on methods to detect and reduce bird strikes on wind turbines.

7.4 Development of Guidance Documents and Study Protocols for Impact Assessments

Standardization in field methods for data collection, classification, and assessment was another common theme among the breakout groups and in the plenary discussions. Some recommendations were specific to technical issues, such as methods for detection of collisions by birds with turbines, and new techniques to assess abundance of sea turtles in an area. Other recommendations focused on guidance documents for use by developers to communicate better with the public and to better understand permitting requirements.

7.5 Overarching Messages and Conclusion

During the plenary session discussions on the final day, the participants identified three areas needing MMS attention most immediately: 1) development of the Alternative Energy Program; 2) data collection and information management; and 3) collaboration and coordination. These areas represent the high-level results of the workshop and are areas where MMS efforts are already underway.

To support development of the Alternative Energy Program, participants indicated that a strategic assessment of regions where environmental information collection is needed would be valuable. The European experience and activities can serve as a guide for programmatic marine spatial planning. Stakeholders would benefit from guidance on the process and regulatory structure. Stakeholder involvement has been recognized as a key component of the Alternative Energy Program, and there are continuous efforts underway to ensure their participation.

Data collection and information management are of primary importance to the Environmental Studies Program (ESP). In this area, evaluation of the most important information needs is being undertaken currently and is supported by synthesis and consolidation of recent studies. Workshop participants frequently stated that the need for various map layers that contain current, high-quality data and that can be correctly aligned was essential.

Coordination and collaboration with stakeholders and potential partners are key to the success of alternative energy studies. Tapping into existing resources will minimize duplication of effort, ensure that all concerns are addressed, and result in better scientific products. Drawing upon expertise in the international community will be important to continue, and that dialog will enhance study designs.

Also during the final day's plenary session, workshop participants provided their perceptions of the greatest challenges to the ESP for information collection. These can be categorized into three areas: 1) programmatic issues; 2) collaboration and coordination; and 3) methods and data. This discussion highlighted some known concerns already being addressed.

Programmatic issues challenging the ESP include the availability of staff, funding, and time. It takes all three to build and complete a long-term strategy for alternative energy studies. The challenge lies in developing sufficient useful information quickly enough to proceed with sound decision-making in the near-term.

The need to continue collaboration and coordination efforts was reiterated by the group. Building new relationships and enhancing existing ones will be a critical component in filling alternative energy study needs. Partnerships need to be fostered at all levels, from local, through State and Federal, to international communities.

Participants recognized both the existence of necessary data and the need for additional data. Challenges to the ESP when handling existing data include gathering and synthesizing it; ensuring the scale and scope of the data are comparable; and standardizing methodology. As important as avoiding duplication of efforts already completed or underway is recognizing when enough information has been collected. Prioritizing needs and leveraging partners through collaboration and coordination will ensure the best uses of staff, funding, and time resources.

The basic tenet of the ESP mandate is to provide the scientific information necessary to assess the impacts of offshore activities on the human, marine, and coastal environments and support environmentally sound decision-making. The results of this workshop will feed into the studies development process that provides scientific information for the Alternative Energy Program. The ideas and information generated at the workshop will be used to develop a cohesive and comprehensive study plan that will provide critical information to support programmatic decisions. The ESP will continue to communicate with stakeholders and potential partners identified and further foster the efforts initiated at this workshop.

Appendix A

Workshop to Identify Alternative Environmental Information Needs

Workshop Agenda

Minerals Management Service Alternative Energy Workshop Agenda

Day One – Tuesday, 26 June 2007

08:30 Registration

WORKSHOP INTRODUCTION

09:00 Elizabeth Burkhard, Workshop Leader
Minerals Management Service, Herndon, Virginia
Welcome, Workshop Purpose, Background, and Overview of Agenda

CURRENT STATE, FUTURE TRENDS AND LESSONS LEARNED
Presentations will be delivered by experts covering the current state of wind and wave technologies, future trends, environmental concerns and lessons learned.

09:15 Kurt Thomsen
Advanced Offshore Solutions, Arhus, Denmark
Current state of and future trends in AE development in Denmark, factors influencing site selection, lessons learned

10:00 Steffen Nielsen
Danish Energy Authority, Copenhagen, Denmark
Environmental and social impacts of wind farm development in Denmark, lessons learned

10:45 BREAK

11:15 Robert Thresher
National Renewable Energy Laboratory, Golden, Colorado
Current state of and future trends in wind technology and associated environmental concerns in the US

12:00 LUNCH (on your own)

13:30 Michael Hay
British Wind Energy Association, London, England
Current state of and future trends in AE development in the UK, lessons learned

14:00 Rachael Mills
Department of the Environment, Food and Rural Affairs, London, England
AE development in the UK - government perspective, lessons learned

14:30 Chris Jenner
RPS Group Plc, Surrey, England
Environmental concerns associated with alternative energy development in the UK, lessons learned

15:00 BREAK

15:30 George Hagerman
Virginia Tech, Advanced Research Institute, Arlington, Virginia
Current state of and future trends in wave technology in the US

16:00 Greg McMurray
Oregon Department of Land Conservation and Development, Salem, Oregon
Environmental concerns associated with wave technology in the US

16:30 Elizabeth Burkhard
General Comments on the Day

16:40 Adjourn for the day

Day Two – Wednesday, 27 June 2007

08:30 Registration

09:00 Maureen Bornholdt

Minerals Management Service, Herndon, Virginia
Progress of MMS Regulation Development, Document Production, Scheduling, Governmental Framework

09:30 Stephen Bowler and Nicholas Jayjack
Federal Energy Regulatory Commission, Washington, D.C.
Highlights of Marine-based Studies to Support Wave, Current or Tidal Energy Development

09:55 Elizabeth Burkhard

General Comments and Charge to Breakout Groups

BREAKOUT SESSIONS

09:45 Concurrent Facilitated Breakout Groups

- Physical Oceanography and Air Quality
- Biological Oceanography
- Social Sciences and Economics

Each group will be given a 15 minute overview of the relevant information from the Literature Synthesis to provide the framework for the group discussions of information needs. Participants in each group will discuss and develop a list of critical information needs that are scientifically feasible. Break times will be determined within each group.

11:30 A member of each breakout group will take 10 minutes to present his/her discipline's list of information needs to the whole group in plenary session.

12:00 LUNCH (on your own)

PLENARY DISCUSSION SESSION

13:30 During this facilitated discussion session, participants will identify overlaps and cross-connections between ideas generated in the different breakout groups to streamline the lists. Each participant will identify the 3-5 most critical priorities in the streamlined lists in their opinions.

14:30 Public comment period
Those wishing to comment must sign up by 12:00 at the registration table. Comments will be heard in the registration order and will be time limited.

15:00 BREAK

BREAKOUT SESSIONS

15:30 Concurrent Facilitated Breakout Groups
Participants will return to the breakout groups to flesh out the top 3-5 information needs in the discipline with brief generalized descriptions and objectives. Completed descriptions of information needs will be turned in to the facilitators at the end of the day.

16:30 Adjourn for the day

Day Three – Thursday, 28 June 2007

08:30 Registration

PLENARY DISCUSSION SESSION

09:00 Facilitated Plenary Discussion Session
The group will discuss mutual interest in, and opportunities for, collaboration and partnership on studies.

10:30 BREAK

11:00 Public comment period
Those wishing to comment must sign up by 09:00 at the registration table. Comments will be heard in the registration order and will be time limited.

11:30 The workshop will conclude with a review of the discussions and closing remarks.

12:00 Adjourn the meeting

Appendix B

Workshop to Identify Alternative Environmental Information Needs

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Appendix C

Workshop to Identify Alternative Environmental Information Needs

Presentation Slides for Invited Speakers

MMS Alternative Energy workshop

Tuesday June 26th 2007

Kurt E. Thomsen
Advanced Offshore Solutions Aps

Current State and Future trends in AE

The contractors point of view.

Biography

- Kurt E. Thomsen
- Crane operator/assessor
- Construction architect
- Bs in Business Management
- Founded A2SEA in 2000 based on Patent aplication filed in Sept 1999. Now world leading installation contractor
- Owner AOS founded in 2006

Clients represented

- Cape Wind Associates
- Dong Energy
- DOTI GmbH
- E-on Energy Projects
- Essent Wind
- E2
- Nai Kun
- Renergys
- Multibrid

Siting of offshore projects

- Siting requirements
- Location
- Seabed
- Waterdepth
- Wave and wind climate
- Customers
- Nature

Location

- The site should be:
- Close to a loadcentre
- In as shallow water as possible
- In a sheltered area
- In an area where the wind is av. 9 m/s
- In a sensible location for the wildlife

Seabed

- Cost is related to seabed conditions
- Because:
- Foundations are expensive, up to 45% of total cost
- Installation of simple foundations are significantly cheaper than eg. Drilled foundation
- Therefore dense sand is preferred

Waterdepth

- Cost is related to waterdepth because:
- Forces and bending moments are guided by foundation length
- As cost of foundations is high, the shallowest positions is preferred
- As output of turbines is unrelated to waterdepth, economy of the windfarm drops dramatically when waterdepth is increased

Waterdepth and technology

- 2002: Waterdepth – 15 m
- 2007: Waterdepth – 27 m
- 2012: Waterdepth – 39 m?
- Probably not because:
- 2002: Turbines are 2 MW
- 2007: Turbines are 3 MW
- 2012: Turbines are 3.6 MW
- Output of the turbines are not enough to cover the added cost and cable loss
- The foundation and installation technology will be to expensive

Wave and wind climate

- The wind should blow on average 9 m/s
- The waves should not exceed 2 m Hs in more than 5% of the year
- The currents should not be too large as seabed moves
- Thus a sheltered area should be sought out
- Shallow water shoals are desirable

Customers

- The windfarm should be close to a loadcentre because
- The power should run as short a distance as possible due to transfer losses
- Windpower should be generated where it is needed, ie. Close to densly populated areas
- This make windfarms work costeffectively

Nature

- When all objectives are met the windfarm should also be placed sensibly
- We know that:
- Birds avoid windfarms offshore
- Fish are attracted to the foundations which create artificial reefs and nesting grounds
- Seals and mammals don´t really care
- The impact of an offshore windfarm is minimal to wildlife in general

Current state in offshore wind

- Turbines are still in the training years
- The size hasn´t significantly grown in the first 7 years
- The reliability of proven turbines is there
- Foundation cost hasn´t significantly dropped
- Cabling is still a very big challenge

Current state of technology

- Siting in shallow waters is crucial
- The second generation is not proven
- Installation contractors can not cope with larger turbines and foundations at the moment
- Foundation design is not geared for large waterdepths

What we know

- Turbines and foundations can be installed succesfully
- Windfarms can operate in coexistence with wildlife
- Cost can be comparable to ”normal” power
- The windfarms offshore work at a very high reliability in general

What windfarms do

- Windfarms generate jobs!
- They must be installed and decomissioned
- They must be maintained
- They must be repaired
- They must be surveyed
- It´s like your car and the local garage!!!

What they also do

- They generate clean power for your neighbourhood
- They offset CO2 emissions from day one
- They create opportunity for wildlife above and below sealevel
- As a consequence they generate opportunity for the users of the offshore environment

What they don´t do

- They do not form obstacles for the naval traffic above or below the surface
- They do not form obstacles for the aviation neither birds nor planes
- They do not form a threat to commercial fisheries or users of the sea

The future trends

- The turbines will become larger
- They will move further offshore
- They will generate more power
- They will become even more competitive towards ”normal” power production

Larger turbines

- Development is mostly prohibited by:
- Current state of supporting technologies

- Shortage in supply
- Shortage in contractor capacity
- Shortage in contractor capability

Further offshore?

- This is mainly prohibited by:
- Distance vs. Powerloss
- Foundation cost vs. Output
- Downtime and repair of turbines vs average weather conditions
- Cost of supporting plant and personnel
- Overall safety of supply, repair and maintenance

When will this happen

- An example: Airbus 380 vs. Boeing 747

- Question:
  Why was the jumbo jet the biggest for over 40 years?

- The answer:
  Lack of supporting technologies

My forecast

- The 5 MW turbine will mature over the next 5 – 8 years and become an industry runner
- This will facilitate development of windfarms which become more efficient than they already are, but not necessarily further offshore
- The offshore contractors will see a market for these turbines within the next three to five years
- So by 2015 we will no longer see the 3 MW turbines offshore

The permitting process

- The siting of an offshore windfarm should reflect what we want to achieve – clean efficient power
- The permitting process should adress the information which is needed, not what is nice to have. Ask for information which helps the process rather than delay it
- Be realistic in the scoping of EIA and other documents

Some input for the permitting process

- Horns Rev EIA approx. 1200 pages
- Borkum West EIA approx. 1000 pages
- Nordsee Ost EIA approx. 1500 pages
- London Array EIA approx. 2000 pages
- Cape Wind EIA approx. 4000 pages
- No correlation between the number of pages compared to the outcome of the investigation is detected in the projects built so far.

What is the next step

- To finish the regulatory framework, taking advantage of the lessons learned in Europe
- To finish the permitting process for the first offshore windfarm(s) in the USA
- To start building for a cleaner future – offshore.

Pictures courtesy A2SEA; Talisman; Vestas; MTHojgaard and Mammoet van Oord

Offshore Wind Power in Denmark

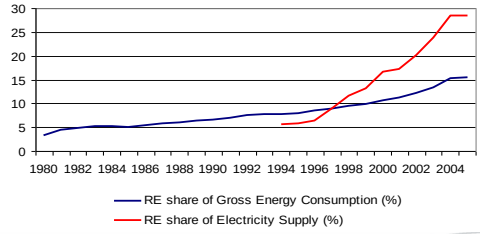
Steffen Nielsen
Head of Section
Danish Energy Authority
Ministry of Transport and Energy

Outline

- Perspectives on high share of RE and future grid integration challenges
- Political targets and current negotiations
- Regulation and tendering procedures
- Overview on the environmental programme
- Strategic assessment for future off-shore locations

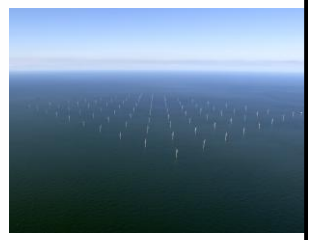
Renewable Energy in Denmark

- Highest contribution to electricity from new renewables in EU



Advantages of Wind Power

- Security of supply
- Energy import alleviation
- Export
- Employment
- Environment
  - i.e. climate change mitigation
  - thus also conservation of biodiversity



Danish Wind Power Industry

The Danish wind turbine industry employs about 21,000 persons, with a turnover for around 6 bill $/year

Most of the turbines are exported and today Danish wind turbine industry serves about 40% of the world market

Wind Power Production

Installed capacity app. 3.100 MW of which app. 420 MW is placed offshore

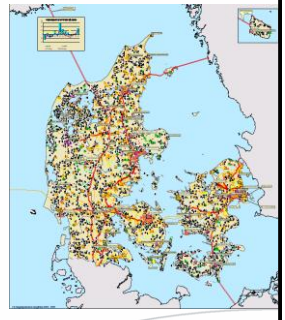
National average at normal wind conditions 20% of electricity demand

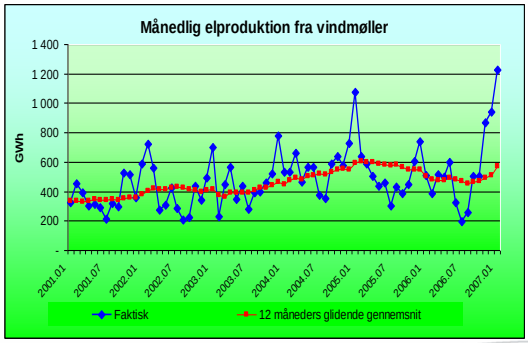
Western Denmark 2004 - 23%

National average 2006 - 17%

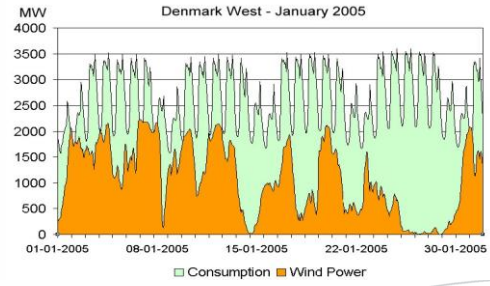
National average January 2007 - 36%

Western Denmark January 2007 - 41%





Challenge: To Feed the Grid with Wind Power
(Western Denmark as an example)



Large scale integration

- Denmark has good connection to base load
- Nord Pool – level playing field
- Short gate closure times to allow trades close to real time
- Guarantee the transmission and distribution of RE electricity
- Further integration is possible
- Storage, demand side management and market driven use of decentralised heat and power as future options

Danish Energy Policy

- Aim to have at least 30 % RE by 2025
- Reduce the use of fossil fuels by 15 % by 2025
- R&D support to energy to reach 133 million Euro/year by 2010
- To stabilise current energy demand without hampering economic growth
- Aim to have energy savings of 1.25 %/year
- New recommendations for wind power location:
  - Location for new onshore locations to comply to re-powering programme
  - Onshore and nearshore prototype tests sites
  - Future offshore locations and offshore test sites

Ongoing negotiations in Parliament
Government proposal of 21 June 2007

- Tender for additional 200 MW arriving at 1023 MW offshore by 2013
- General increase in premium to be added on top of market price
  - 3,5 US c/kWh first 5 years
  - Reduction by 0,9 US c every 5 years
  - 0,5 US c on top for balancing costs

Note
Ongoing negotiations are expected close by end June 2007

8 New Onshore test sites for testing of large wind turbines

1. **2 sites on West Lolland (Kappel I og Kappel II)**
2. **1 near Asnæs Power Station (Kalundborg)**
3. **1 near Esbjerg Havn**
4. **1 in Nissum Bredning (near 'Cheminova')**
5. **1 north of Limfjorden by 'Nordjyllandsværket'**
6. **1 east of Hirtshals Harbor**
7. **1 in the sea outside Frederikshavn Harbor.**

Will allow turbines up 200 meter's hight

16 years of experience offshore

- First Danish offshore wind farm 1991
- Strategic mapping 1995
- Capacity now 423 MW. (Total 3100 MW)
- Tenders for 2 x 200 MW wind farms to be established in 2009 and 2010 on track
- Strategic assessment for future location of 4600 MW offshore wind power – public consultation end 19 June 2007

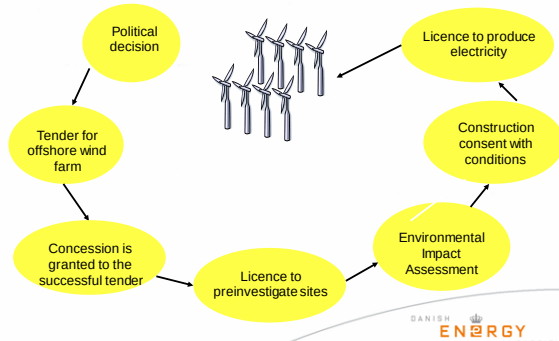
Aim to bring down financial risk

- Screening for site suitability (2003)
- Tender: Fixed price in 50.000 full load hours
- TSO to finance, construct and operate transformer station and sea cable
- TSO obliged to connect wind power and expand grid if necessary
- Security that grid connection is available in due time
- Financial compensation if the power produced is curtailed
- One stop shop communication

A one stop shop –
Streamlining consent procedures

- **The Danish State has all competence within the 12 NMZ and in the Danish EEZ**
- **Delegation to the DEA of juridical authority from the minister of Transport and Energy**
  - **Pre-investigation and exploitation of energy at sea**
  - **Construction of electricity production plants and grid-connections at sea**
- **Off-shore wind-power plants is thus consented and approved by the Danish Energy Authority in co-operation with other authorities – A one stop shop procedure**
- **Terms:**
  - **In pursuance of the electricity act**
  - **In pursuance of legislation from other authorities**
  - **On the cause of EIA suggestions and objections**

One stop shop consent procedure



Overview of the Danish Monitoring Program 1999 -2006

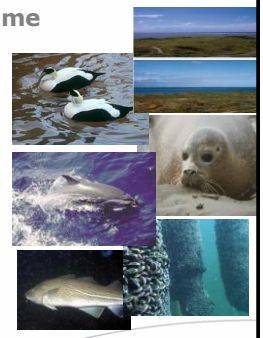
- Hydrography
- Coastal morphology
- Benthic fauna
- Artificial reef effect
- Fish
- Electromagnetic fields
- Temperature gradients around the cable
- Submarine noise emission
- Birds
- Seals
- Harbour porpoises
- Socio- and environmental economic effects

Administrative set up

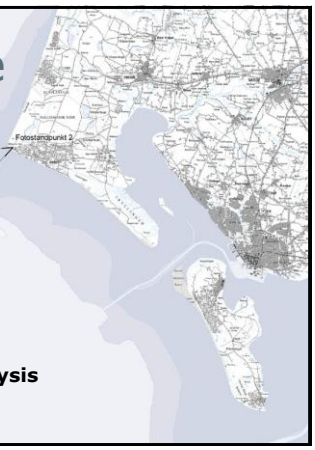
- The demonstration program was public funded
- Results are now available in a book – "Danish Offshore wind – Key Environmental Issues"
- Background reports available on www.ens.dk
- The Danish environmental group:
  - The Danish Energy Authority
  - The Danish Forrest and Nature Agency
  - DONG Energy
  - Vattenfall
- An independent international panel of experts evaluated the progress and outcome

Conclusions from the Environmental programme

- Public acceptance
- Migrating birds avoid collision
- Seals behaviour not affected
- Harbour porpoises return to the sites
- Significant artificial wreck effect observed



Acceptance



- **Qualitative Analysis**
  - **Interviews ect.**
- **Quantitative WTP analysis**
  - **Questionary survey at national and local level**

Horns Rev view from Blåvands Hug

Visualisation

Photography

Conclusions

Perception

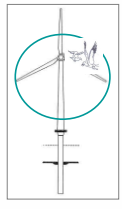
- Visibility - large wind turbines,
- Economic decline on local level - fishery and tourists
- Environmental issues - birds

Findings

- Lights on the nacelles
- No economic decline observed
- Clear indications of acceptance
- Need for high information level during the initial phase leading up to the EIA
- Low local attachment to the project

Birds - potential effects of the wind farm

- **Risk of collision**
  - Focus on long-lived species such as water birds
  - Internationally important migration corridor
- **Habitat loss**
  - Do loss or shift in foraging area have an effect?
  - Wind farm located near EU-habitat area



Birds – species of special interest

Horns Rev OWF

Diver

Common Scoter

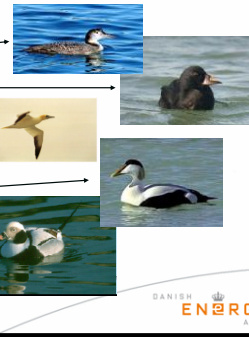
Gannet

Nysted OWF

Eider and Geese

Long-tailed duck

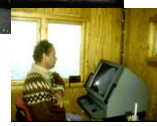
Cormorants



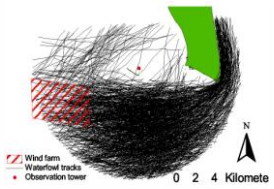
Birds - collision risk

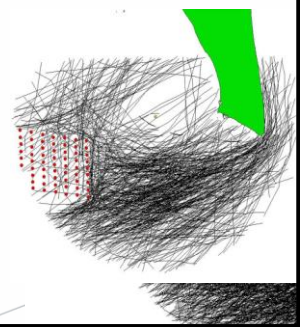
Assessing the collision risk:
Focus on waterfowl migration, and their avoidance response to offshore wind turbines

Birds – radar observations

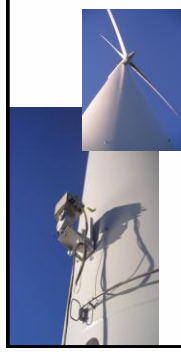


Birds – radar observations





Birds - infrared camera

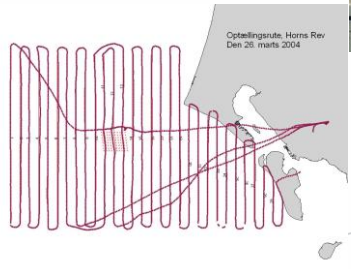


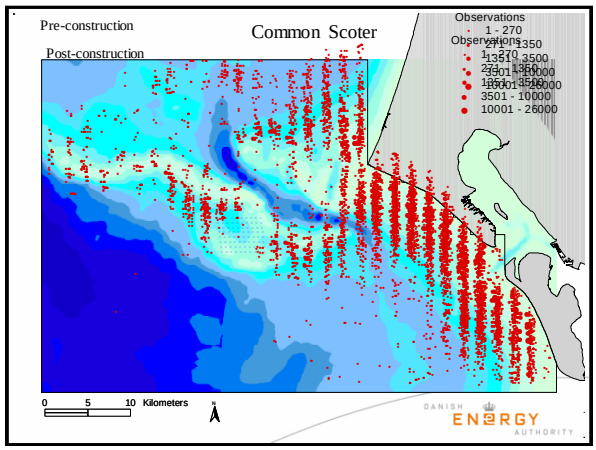
Birds – conclusions on collision risk

- In general only very few birds fly through or above the wind farms
- Change in waterfowl tracks at a distance of 3,000 m from the wind farm during daytime and 1,000 m during night time.
- During baseline studies approx. 35% of the flocks of waterfowl flew into the wind farm area compared to 9% in the operation phase.
- Less than 1 % of the birds fly close enough to the turbines to be at any risk of collision.

Birds – habitat loss, methods

Aerial surveys are carried out spring and autumn





Post monitoring programme issues

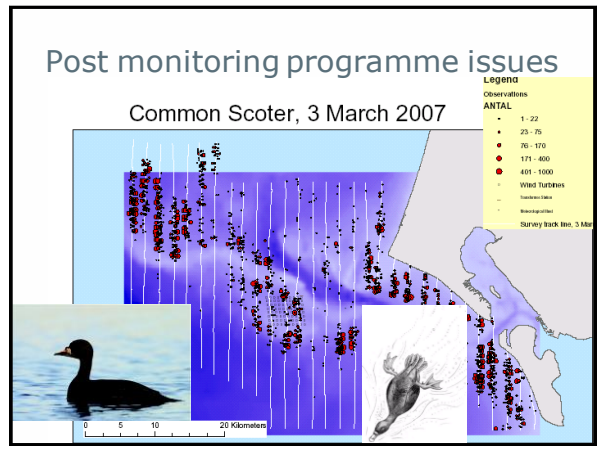


Foto: Nicky Plak (UNI-FLY)

DANISH ENERGY AUTHORITY

Benthic flora and fauna

Issues:

- Introduction of hard bottom structures i.e. foundations and scour protection
- Hydrographical effects around foundations

Foto: Maks Klaustrup

DANISH ENERGY AUTHORITY

Benthic flora and fauna

Results:

- Increase in biomass (50-150 times)
- Increase biodiversity (sanctuaries for rare species)
- Difference communities in the North and Baltic seas
- Sand bottom communities not affected

Fotos: Maks Klaustrup, Jens Christensen

DANISH ENERGY AUTHORITY

Fish

Issues:

- Artificial reef effect
- Sand eel
- Electromagnetic field around cable

DANISH ENERGY AUTHORITY

Fish

Results:

- Same amount of sand eel in- and outside wind farm
- Artificial reef effect – methodological challenge
- Electromagnetic field – methodological challenge


Fotos: Maks Klaustrup, Jens Christensen

Seals and Harbour porpoises

Issues:

- Effects by ramming
- Underwater noise and traffic
- Change in feeding possibilities

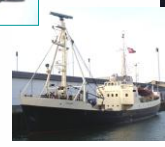
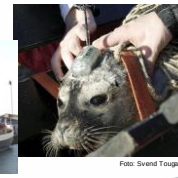





Foto: Svend Tougaard

Foto: Jonas Teilmann

Seals and Harbour porpoises

Results:

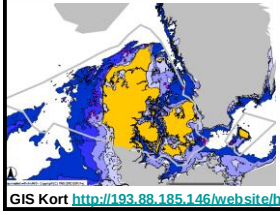
- Both: Effected by ramming
- Seals: No effects during construction and operation
- Harbour porpoises
  - HR: No effects during construction and operation
  - N: Slow recovery during operation – new results expected soon


Foto: Svend Tougaard

Foto: Jonas Teilmann

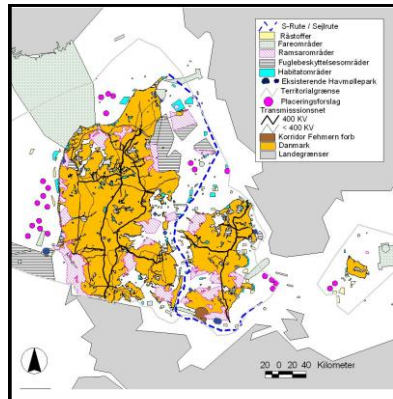
Preparing for the future 2025

- Update of the "The Offshore Wind turbine Action Plan for Danish Waters" from 1997 was published in April 2007 "Future offshore wind power - 2025"
- Strategic mapping assessing possibilities for the location of future offshore wind farms in Danish Waters:
  - Wind resources
  - Distance to shore
  - Water depths
  - Grid connection and reinforcement
  - Shipping
  - Nature and Environment
  - Other area interests

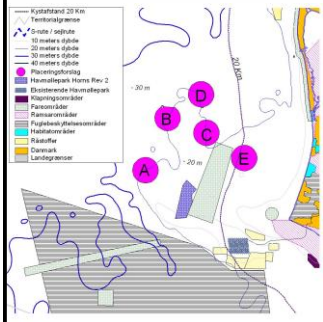
Main report and annexes to be found on www.ens.dk, was in public consultation until 19 June 2007. Consultation answers will be included in the decision-making process for the site selection.

GIS Kort http://193.88.185.146/website/havvind2/viewer.htm



- 23 sites of 200 MW identified
- 4600 MW
- Equivalent to 8 % of total demand or 50% of electricity demand
- Public consultation
- Tool for political decision-making

Horns Rev



- Wind resource:
  - 10.1-10.3 m/s at 100 m
- More than 4000 full load hours
- Water dept:
  - 10-25 m

In conclusion

- Ambitious target of 30 % RE
- Large scale grid integration challenge
- A doubling of offshore capacity on track for 2009-2010
- Tender procedure combined with TSO-grid financing and one stop shop brings down financial risks
- Future locations identified
- Environment no problem if sites are planned properly

Thank you for your attention

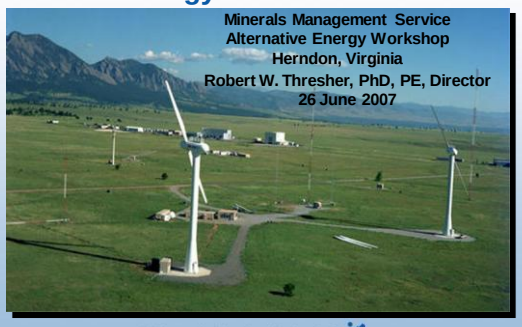
Steffen Nielsen

srn@ens.dk
www.ens.dk/wind

NREL National Renewable Energy Laboratory

Innovation for Our Energy Future

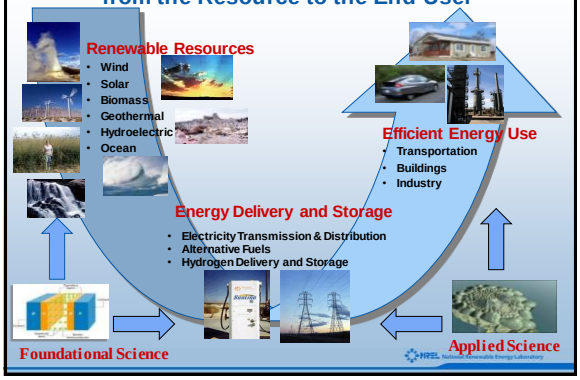
Wind Energy Status and Future



Minerals Management Service
Alternative Energy Workshop
Herndon, Virginia
Robert W. Thresher, PhD, PE, Director
26 June 2007

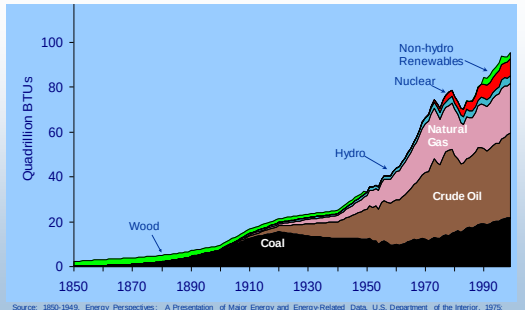
NREL is operated by Midwest Research Institute • Battelle

NREL Provides Science and Technology Solutions from the Resource to the End-User



The U.S. Energy Picture

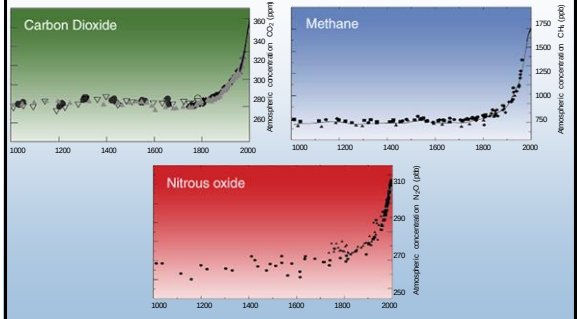
by source - 1850-1999



Source: 1850-1949, Energy Perspectives: A Presentation of Major Energy and Energy-Related Data, U.S. Department of the Interior, 1975; 1950-1996, Annual Energy Review 1996, Table 1.3. Note: Between 1950 and 1990, there was no reporting of non-utility use of renewables. 1997-1999, Annual Energy Review 1999, Table F1b.

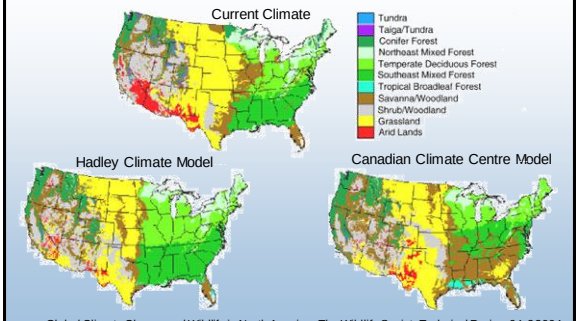
Changes in Atmospheric Concentration

CO_2, CH_4, and N_20 – A Thousand Year History



Source: IPCC Third Assessment Report (2001)

Simulations of vegetation response by 2070-2099 to different climate change models (U.S. Forest Service 2004)

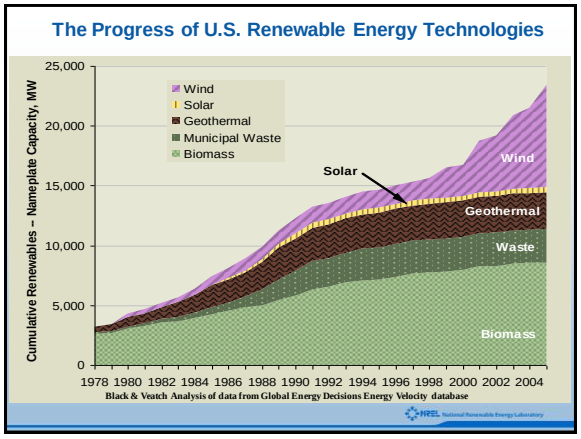


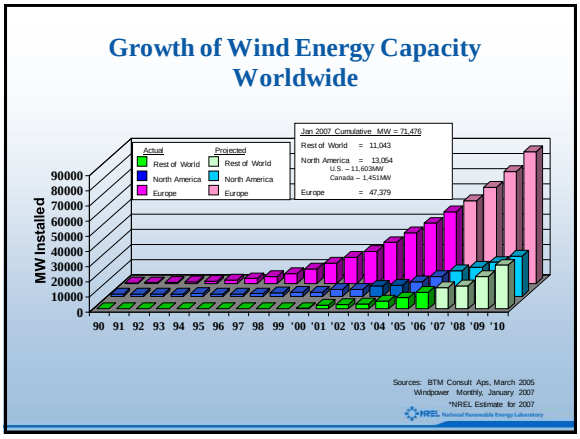
Global Climate Change and Wildlife in North America. The Wildlife Society Technical Review 04-22004.

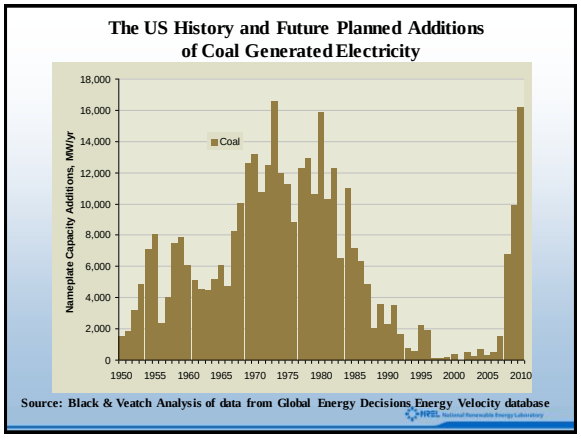
Possible Climate Change Impacts by 2100

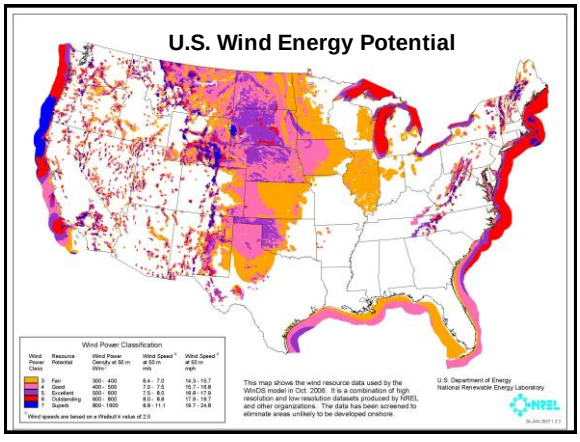
Possible changes in percentages of breeding Neotropical migrant species in the next 100 years (Price and Root 2001).	Possible change (%)	
	Gross	Net
California	-29	-6
Eastern Midwest	-57	-30
Great Lakes	-53	-29
Great Plains – Central	-44	-8
Great Plains – Northern	-44	-10
Great Plains – Southern	-32	-14
Mid-Atlantic	-45	-23
New England	-44	-15
Pacific Northwest	-32	-16
Rocky Mountains	-39	-10
Southeast	-37	-22
Southwest	-29	-4

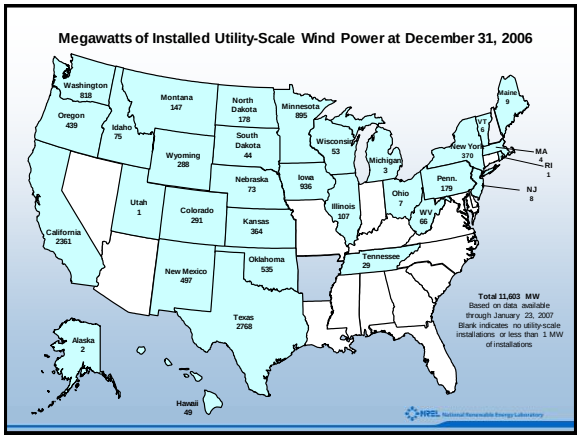
Global Climate Change and Wildlife in North America. The Wildlife Society Technical Review 04-22004.

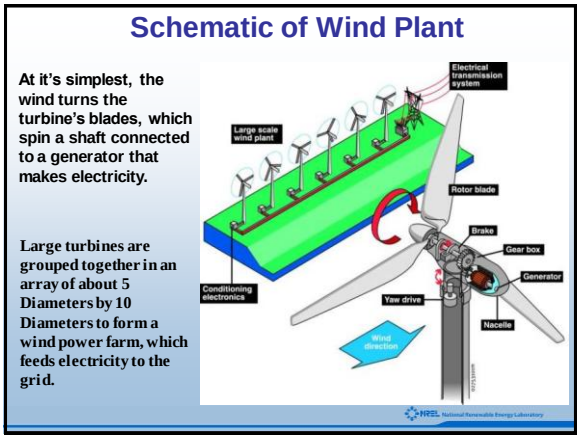

The Progress of U.S. Renewable Energy Technologies
Cumulative Renewables – Nameplate Capacity, MW
25,000
20,000
15,000
10,000
5,000
0
Wind
Solar
Geothermal
Municipal Waste
Biomass
Solar
Wind
Geothermal
Waste
Biomass
1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004
Black & Veatch Analysis of data from Global Energy Decisions Energy Velocity database


Growth of Wind Energy Capacity Worldwide
MW Installed
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
Actual
Rest of World
North America
Europe
Projected
Rest of World
North America
Europe
Jan 2007 Cumulative MW = 71,476
Rest of World = 11,043
North America = 13,054
U.S. – 11,603MW
Canada – 1,451MW
Europe = 47,379
90 91 92 93 94 95 96 97 98 99 '00 '01 '02 '03 '04 '05 '06 '07 '08 '09 '10
Sources: BTM Consult Aps, March 2005
Windpower Monthly, January 2007
*NREL Estimate for 2007


The US History and Future Planned Additions of Coal Generated Electricity
Nameplate Capacity Additions, MW/yr
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Coal
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010
Source: Black & Veatch Analysis of data from Global Energy Decisions Energy Velocity database


U.S. Wind Energy Potential
Wind Power Classification
This map shows the wind resource data used by the WinDS model in Oct. 2006. It is a combination of high-resolution and low-resolution datasets produced by NREL and other organizations. The data has been screened to eliminate areas unlikely to be developed onshore.
U.S. Department of Energy
National Renewable Energy Laboratory


Megawatts of Installed Utility-Scale Wind Power at December 31, 2006
Washington 818
Oregon 439
California 2361
Idaho 75
Montana 147
Wyoming 288
Utah 1
Colorado 291
New Mexico 497
Arizona
North Dakota 178
South Dakota 44
Nebraska 73
Kansas 364
Oklahoma 535
Texas 2768
Minnesota 895
Iowa 936
Missouri
Arkansas
Louisiana
Wisconsin 53
Illinois 107
Michigan 3
Ohio 7
Kentucky
Tennessee 29
Mississippi
Alabama
Georgia
Florida
South Carolina
North Carolina
Virginia
WV 66
Penn. 179
New York 370
VT 6
Maine 9
MA 4
RI 1
NJ 8
Delaware
Maryland
Alaska 2
Hawaii 49
Total 11,603 MW
Based on data available through January 23, 2007
Blank indicates no utility-scale installations or less than 1 MW of installations


Schematic of Wind Plant
At it's simplest, the wind turns the turbine's blades, which spin a shaft connected to a generator that makes electricity.
Large turbines are grouped together in an array of about 5 Diameters by 10 Diameters to form a wind power farm, which feeds electricity to the grid.
Electrical transmission system
Large scale wind plant
Rotor blade
Brake
Gear box
Generator
Conditioning electronics
Yaw drive
Nacelle
Wind direction

A New Vision
For Wind Energy in the U.S.


White House photo by Eric Draper

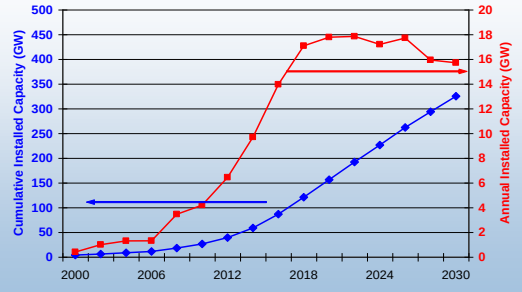
State of the Union Address

"…We will invest more in … **revolutionary** and solar **wind technologies**"

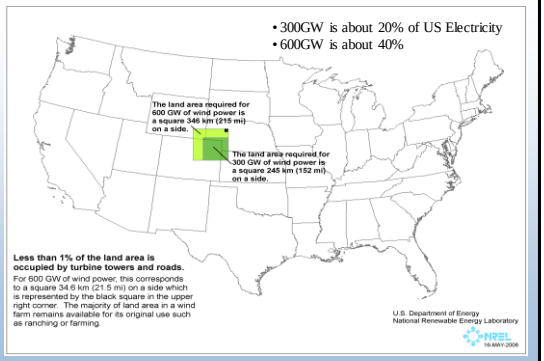
Advanced Energy Initiative

"Areas with good wind resources have the potential to **supply up to 20% of the electricity** consumption of the United States."

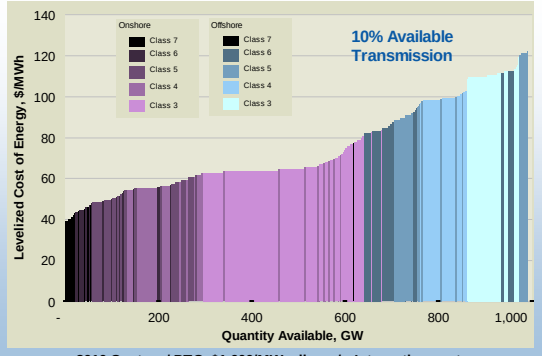
What does 20% wind electricity look like?



Land Requirements for 20% of the Nations Electricity



Wind Electricity Supply Curve for the U.S.



2010 Costs w/ PTC, $1,600/MW-mile, w/o Integration costs

Consideration for Siting a Wind Farm

- Income = Energy Output ~ (Wind Speed)^3
- Transmission Access
- Power Purchase Agreement with Utility
- Land with landowner willing to lease
- Permits: Minimal Wildlife & NIMBY
- Turbines at a Competitive Price
- Financing

A Utility Scale 1.5 MW Wind Turbine

Cost of Energy Trend

1981: 40 cents/kWh

Decreasing Cost Due to:
- Increased Turbine Size
- R&D Advances
- Manufacturing improvements

NSP 107 MW Lake Benton, MN wind farm

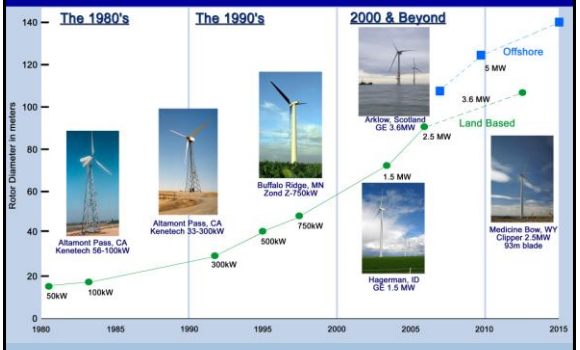
2006: 5-8 cents/kWh with no PTC for a 13mph wind speed at 10m (18mph at 100m hub)

Recent cost increases are due to:
- Price increases in steel & copper
- Turbines sold out for 2 years

Note: These energy costs are average for the US and costs in many locations with lower winds at hub height, higher insurance, permitting, and land cost, such as in California can increase energy cost by up to 20%.

Goal : To make wind competitive with no subsidies

Evolution of U.S. Commercial Wind Technology



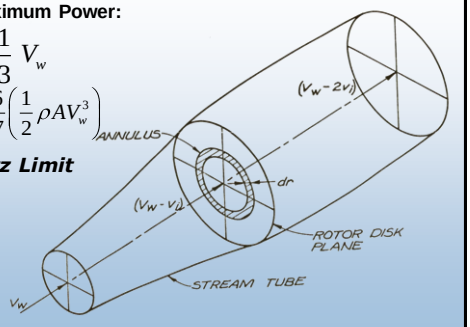
Stream Tube for Momentum Balance

For Maximum Power:

$$V_i = \frac{1}{3} V_w$$

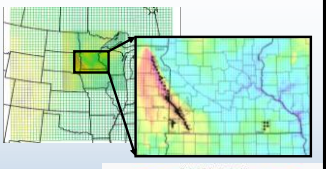
$$P = \frac{16}{27}\left(\frac{1}{2}\rho A V_w^3\right)_{ANNULUS}$$

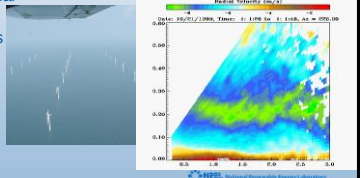
The Betz Limit



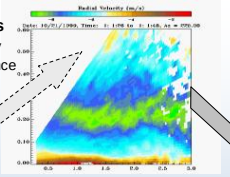
Wind R&D: Atmospheric Physics Modeling

- **Grid integration**
  - Short term forecasting
  - Wind farm power delivery
- **Resource assessment**
  - Long term hindcasting
  - Resolution enhancement
- **Site specific design**
  - Inflow turbulence & shear
  - Local topography
  - Wind farm array effects
- **Modeling impact**
  - Design & analysis
  - Ops & maintenance
  - Direct financial impact

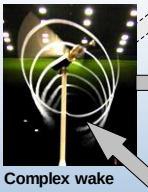


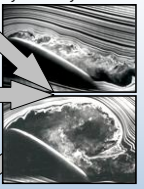


Powerful winds
U_∞, direction vary
Coherent turbulence
Turbine wakes



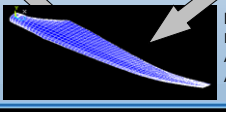
Energetic flowfield
Globally separated
Steep gradients
Dynamically active





R&D: Aeroelasticity
Nonlinear & coupled
Multiple physics
Scale range

Complex wake
Trailed vortices
Shed vortices
Persistent



Responsive structure
Light and flexible
Advanced materials
Aeroelastic load control

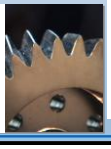
Status of Low Wind Speed Technology Projects

Completed Partnership with Clipper - Development of 2.5 MW Liberty Turbine

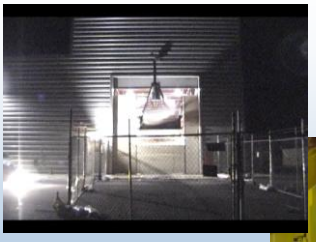
Completed Partnership with NPS in Development of Advanced 500kW Modular Power Converter
- And -
Closing Out NPS LWST Turbine System Development Project

Closing Out Partnership with Zond/Enron/GE in Development of 1.5 MW Turbine

Continuing Partnership with Genesis Partners LP to Develop New Convoloid Gearing Technology for Wind Turbines



LWST Blade Testing



A new 45-meter wind turbine blade was shipped to the NWTC for testing in July 2004.

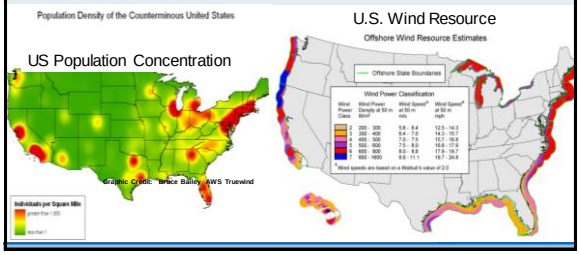
Clipper LWST Prototype
2.5 MW with 93 m Rotor

Offshore Wind Research: Why?

Land-based sites are not close to coastal load centers

Load centers are close to offshore wind sites

28 Coastal States Use 78% of Electricity



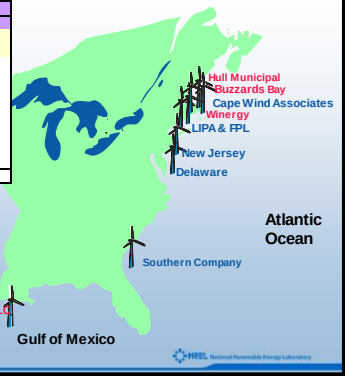
Horns Rev Wind Farm Installation

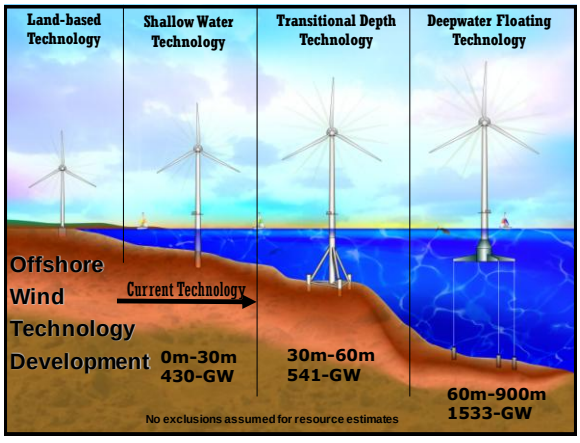
Country: Denmark
Location: West Coast
Total Capacity: 160 MW
Number of Turbines: 80
Distance to Shore: 14-20 km
Depth: 6-12 m
Capital Costs: 270 million Euro
Manufacturer: Vestas
Total Capacity: 2 MW
Turbine-type: V80 - 80m diameter
Hub-height: 70-m
Mean Windspeed: 9.7 m/s
Annual Energy output: 600 GWh

Proposed U.S. Offshore Projects

US Offshore Projects		
Project	State	MW
Capewind	MA	420
LIPA	NY	150
Winergy (plum Island)	NY	10
Southern Company	GA	10
W.E.S.T.	TX	150
Superior Renewable	TX	500
Buzzards Bay	MA	300
New Jersey	NJ	300
Hull Municipal	MA	15
Delaware	DE	600
Total		2455

No Offshore wind projects Installed in U.S. yet!





Offshore Wind Energy Cost Trends

Land-based Wind
1981 : 40 cents/kWh
2007 : 5–8.5 cents/kWh

Offshore
2007: 12 - 9 cents/kWh
25% – 35% cost reductions are needed

Upward Cost Pressures
- Turbine Supply Shortages
- Commodity price increases
- Regulatory Uncertainty
- Risk Uncertainty (weather, public acceptance, reliability, insurance)

Downward Cost Drivers

Learning Curve
- Mass production
- Infrastructure development
- Experience lowers uncertainty

Technology Improvements
- Multi-megawatt turbines
- High reliability components
- Optimized systems

Foundation Types

Proven Shallow Water Designs | Transitional

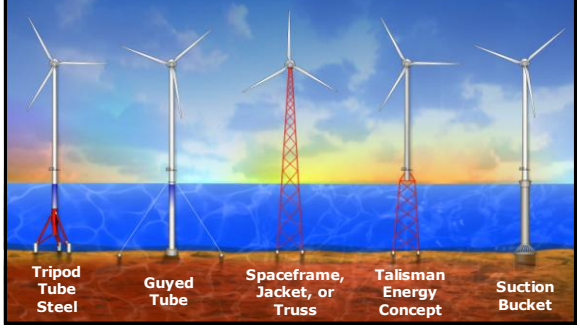
Monopile Foundation	Gravity Foundation	Tripod/Truss Foundation
➢Most Common Type ➢Minimal Footprint ➢Depth Limit 25-m ➢Low stiffness	➢Larger Footprint ➢Depth Limit 20m ➢Stiffer but heavy	➢No wind experience ➢Oil and gas to 450-m ➢Larger footprint

Graphics source: http://www.offshorewindenergy.org/

Transitional Depth Foundations

30-m to 60-m Depths

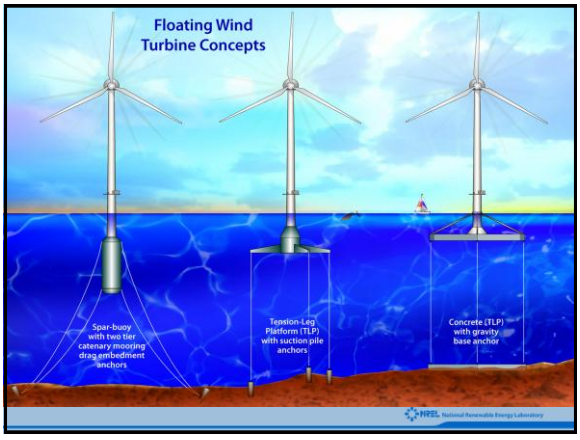
541 GW potential

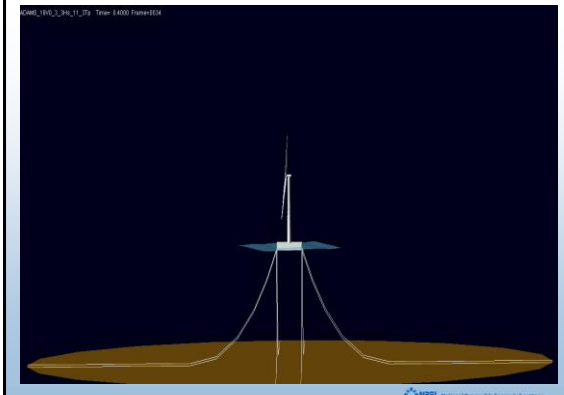


Substructure Load-out

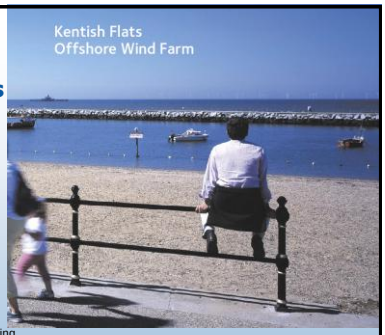
Photo Credit: Talisman Energy

Floating Wind Turbine Concepts





Visual Impacts are Central To Public Acceptance



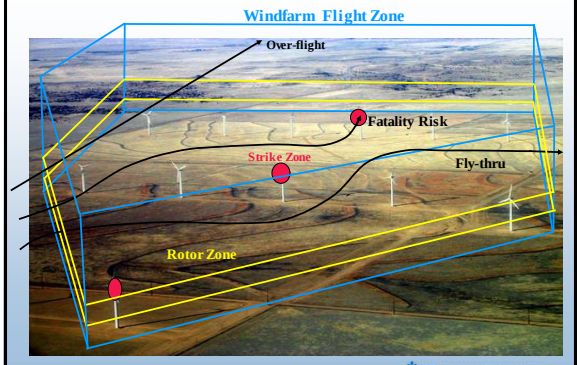
Country: United Kingdom
Location: Thames Estuary
Total Capacity: 90 MW
Number of Turbines: 30
Distance to Shore: 8.5 km
Depth: 5 m
Capital Costs: 105 MPound Sterling
Manufacturer: Vestas
Total Capacity: 3 MW
Turbine-type: V90
Mean Windspeed: 8.7 m/s
Annual Energy output: 280 GW-hours
Windfarm Developer: Elsam

National Avian – Wind Power Planning Meeting I
July 1994

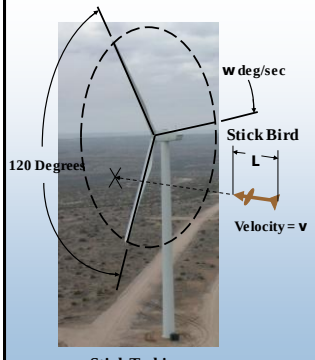
Meeting Outcome: Five Major Research Areas

- Assess mortality attributable to wind turbines at existing sites (including control data from "no turbine" sites)
- Predict mortality at planned wind power sites, based in part on previous bullet
- Predict population consequences
- Identify ways to reduce bird kills at wind plants
- Set values for off-site mitigation

Visualization of Avian Interaction Zones



A Simple Stick Collision Model



Bird passage time through the rotor:

$t_p = L/V$ = Length speed ratio (sec)

Blocked Sector of Turbine Rotor:

$B = t_p w$ (deg)

Probability of collision:

P_c = Blocked Area/Disk Area

$P_c = 3B/(360\text{deg})$

$P_c = 3(L/V)\{w(\text{deg/sec})/360\text{deg}\}$

To account for avoidance:

$P_c = 3\,A\,(L/V)\{w(\text{deg/sec})/360\text{deg}\}$

where A = { <1 for avoidance; 1 for no behavior; >1 for attraction }

Avian Strike Probability Versus Turbine Size

Altamont Scale

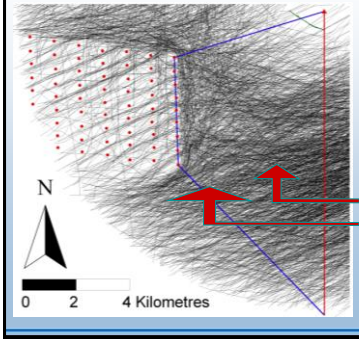
15 Meter Diameter and 100 kW

Next Generation Scale

93 Meter Diameter and 2.5MW

Avoidance Behavior is Significant

Radar Tracks of Migrating Birds through Nysted Offshore Windfarm for Operation in 2003



Response distance:
day = c. 3000m
night = c. 1000m

Candidate Avian Risk Metrics

Hypothesis: "Mortality risk increases with flight time in the rotor zone (yellow zone), if the turbine is operating"

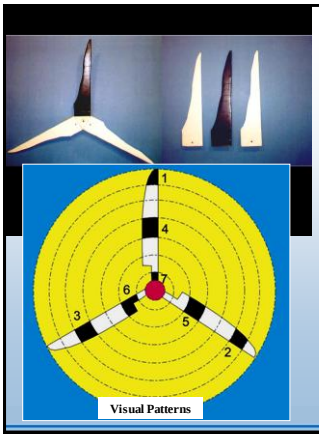
- **A Candidate Post-construction Fatality Metric:**

  Species Risk = Fatalities/(Swept Area x Turbine Operation Hours)

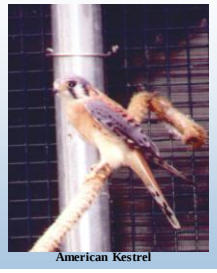
- **A Candidate Preconstruction Relative Risk Metric:**

  Species Relative Risk = (Flight Hours in Rotor Zone with Wind in Operating Range)/(Plant Swept Area x Hours with Wind in Operating Range)

Avian Risk Reduction: Visual Enhancement to Increase Avoidance

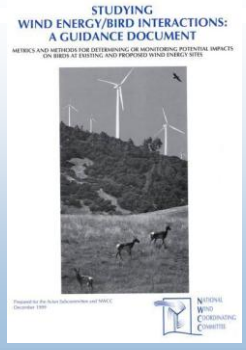


Visual Patterns


American Kestrel

Source: *The Role of Visual Deterrents in Reducing Avian Collisions*; William Hodos, University of Maryland

NWCC Avian Guidance Document



Assessing the suitability of a proposed wind farm site with regard to avian concerns is an important component of overall site evaluation. This NWCC document provides guidelines for conducting avian assessments.

Published December 1999.

Infrared Image of a Bat Flying Through a Wind Turbine Rotor

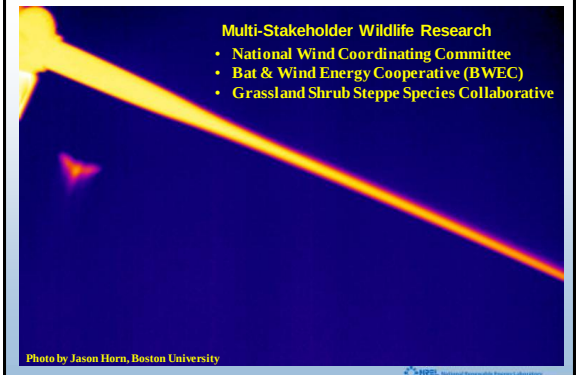
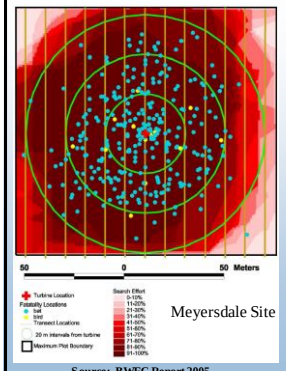


Photo by Jason Horn, Boston University

BWEC Study Results



Meyersdale Site

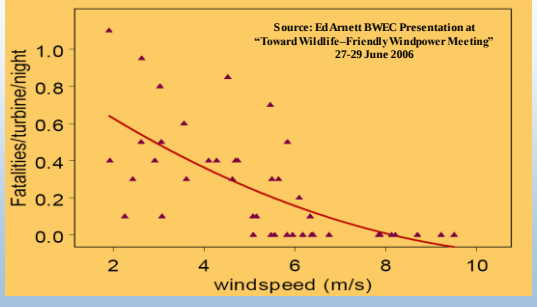
Source: BWEC Report 2005

Meyersdale Wind farm:
- NEG – Micon 1.5 MW Turbine
- 72 meter rotor Diameter
- 17 revs/min = 102 deg/sec
- Constant rotor rpm
- Green dots are bat carcasses
- Yellow dots are birds
- Bird and bat fatalities for all 20 turbines are overlaid

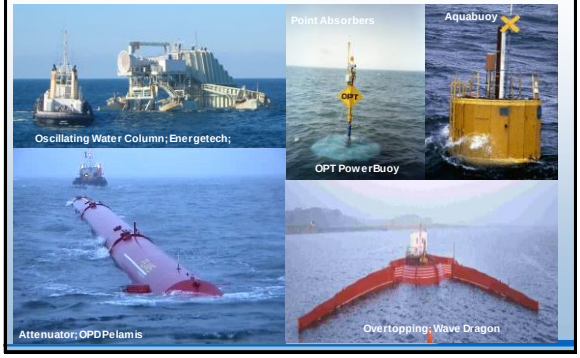
Observations:
- Bird and bat fatalities appear to be fairly uniformly distributed out to 40m
- Beyond a radius of about 40m fatalities drop off rapidly indicating carcasses are not thrown far outside of the blades span
- The higher velocity tip regions of the blade do not seem to be more dangerous than the root near the tower
- Bats are much more vulnerable than birds

BWEC Study Results

Fatalities decrease with increasing wind speed



Wave Technology Examples



Ocean Tidal & Current Technology


Verdant; Horizontal Axis; East River, NY


Gorlov Helical Vertical Axis; Merrimack River,


Hydro; Open Center Turbine; Gulf Stream

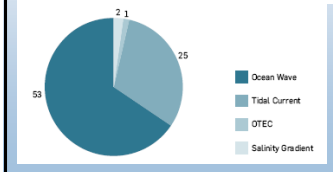

Lunar Energy, Rotech Tidal Turbine

Underwater Electric Kite; Merrimack River,


MCT SeaFlow Experimental Test

Ocean Renewable Device Types

Ocean energy type	Technology types	Estimated global resource
Ocean wave	Attenuator, Collector, Overtopping, OWC, OWSC, Point absorber, Submerged pressure differential, Terminator, Rotor	8 000-80 000 TWh/year
Tidal current	Horizontal/Vertical-axis turbine, Oscillating hydrofoil, Venturi	800+ TWh/year
Salinity gradient	Semi-permeable osmotic membrane	2 000 TWh/year
OTEC	Thermo-dynamic ranking cycle	10 000 TWh/year



Ocean Energy Project Types (%)

- 81 wave, tidal, OTEC, and salinity devices in development worldwide
- 2x industry growth from 2003 to 2006
- Only 14 full scale devices deployed at sea.
- Only 3 in the USA

Concluding Remark

World-wide electrical energy consumption is projected to grow by about 75% over the next 20 years. All energy technologies have some environmental impacts. Wind and ocean energy are developing rapidly, and a modest investment in environmental R&D now could make the impacts negligible. This would give us a carbon free electricity generating choice that could meet at least 20% of the world's energy needs.





NREL Avian Studies Available at:

http://www.nrel.gov/wind/avian_lit.html

- Permitting of Wind Energy Facilities: A Handbook
- A Pilot Golden Eagle Population Study in the Altamont Pass Wind Resource Area, California
- A Population Study of Golden Eagles in the Altamont Pass Wind Resource Area, Second-Year Progress Report
- Ponnequin Wind Energy Project – Reference Site Avian Study
- A Population Study of Golden Eagles in the Altamont Pass Wind Resource Area: Population Trend Analysis 1994-1997
- Predicting the Response of Bird Populations to Wind Energy-Related Deaths
- The Response of Red-Tailed Hawks and Golden Eagles to Topographical Features, Weather, and Abundance of a Dominant Prey Species at the Altamont Pass Wind Resource Area, California, April 1999-December 2000
- Searcher Bias and Scavenging Rates in Bird/Wind Energy Studies
- Status of Avian Research at the National Renewable Energy Laboratory (2001)
- Status of the US Dept. of Energy/NREL Avian Research Program (1999)
- Studying Wind Energy/Bird Interactions: A Guidance Document

Offshore Wind
European Environmental References

- European Union, COD, Principal Findings 2003-2005, prepared by SenterNovem, Netherlands, www.offshorewindenergy.org
- Offshore Wind: Implementing a New Powerhouse for Europe, Greenpeace International, March 2005 http://www.greenpeace.org/international/press/reports/offshore-wind-implementing-a
- Danish (Horns Rev and Nysted) Ecological Studies http://www.hornsrev.dk/Engelk/default_ie.htm and http://uk.nystedhavmoellepark.dk/frames.asp?Page_ID=44&Page_Ref=44&Templates_ID=1
- U.K.'s Strategic Environmental Assessment http://www.og.dti.gov.uk/offshore-wind-sea/process/envreport.htm

Offshore Wind in the UK

Michael Hay
Head of Offshore Renewables, BWEA

MMS Workshop, Dulles
26th June 2007

BWEA

BWEA

- UK's leading renewable energy trade association
- Represent wind, wave and tidal stream energy
- 330 Company members
- Help guide Government towards generic industry requirements
- Liaise with other offshore stakeholders
- Raise Profile and increase confidence

BWEA

Targets and Aspirations

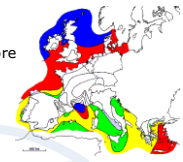
- UK: 10% electricity from renewables by 2010
- UK: 20% electricity from renewables by 2020
- EU: 20% Primary Energy from renewables by 2020
- EU: Around 35% electricity from renewables by 2020

BWEA

The UK is an Energetic Island……

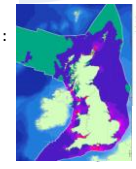
Onshore Wind:

Offshore Wind:

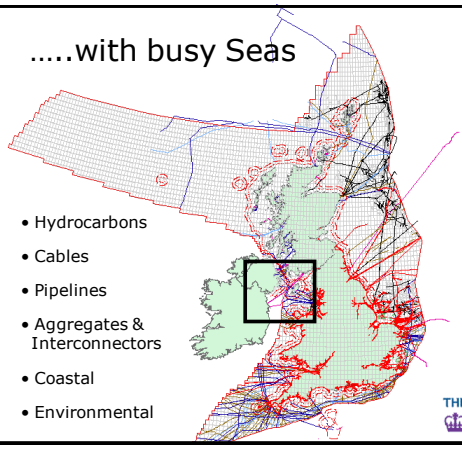


Wave:

Tidal Stream:



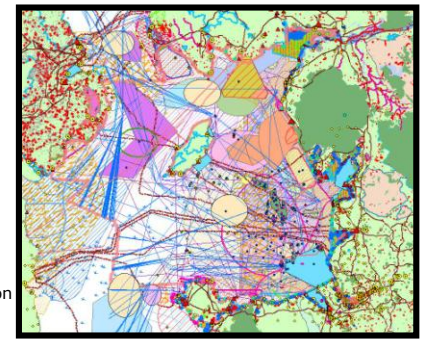
…..with busy Seas



- Hydrocarbons
- Cables
- Pipelines
- Aggregates & Interconnectors
- Coastal
- Environmental

THE CROWN ESTATE

- Landuse
- Tourism
- Oil &Gas
- Mariculture
- Coastal Defence
- Ports & Navigation
- Military Activities
- Culture
- Conservation
- Dredging & Disposal
- Submarine Cables



- Fishing
- Renewable Energy
- Marine Recreation
- Mineral Extraction

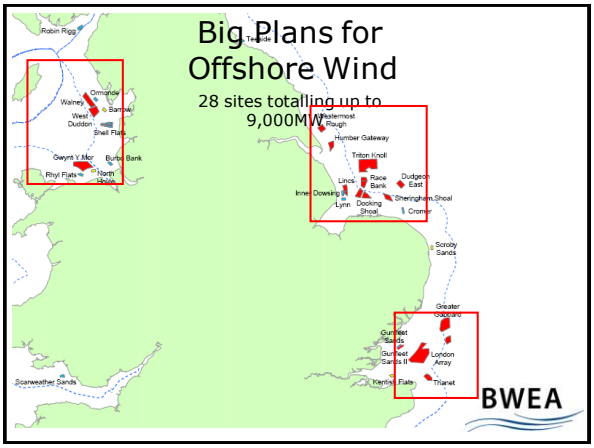
Why Go Offshore?!

- Limited space on land
- Possibility of being close to centres of demand
- Better wind resource, higher quality wind
- Bigger projects possible with larger turbines
- Suitable seabed conditions are required
- Foundations are key
- Diversification of offshore industries away from more traditional areas

BWEA

Big Plans for Offshore Wind

28 sites totalling up to 9,000MW



BWEA

The Development Process

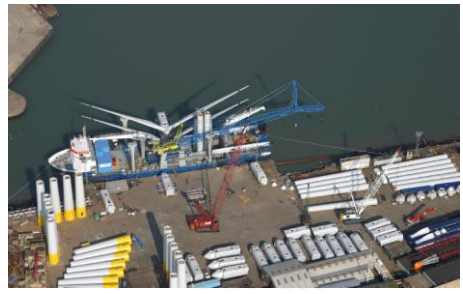
BWEA

The National Support Structure

- COWRIE
  Collaborative Offshore Wind Research Into the Environment
- RAG
  Research Advisory Group
- OREEF
  Offshore Renewable Energy and Environment Forum
- NOREL
  Nautical Offshore Renewable Energy Liaison Group
- FLOWW
  Fisheries Liaison for Offshore Wind and Wet

BWEA

BWEA



BWEA

BWEA

BWEA

BWEA

What's Next?

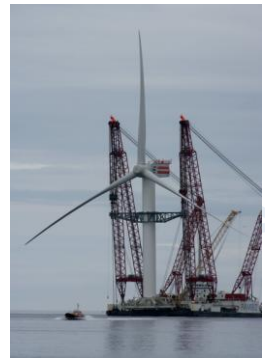
- Government beginning SEA scoping work now for future site awards in 2009/10
- Greater management of data and simpler consenting process through the Marine Bill
- Greater confidence with offshore stakeholders through early engagement and learning by building
- Super grid: Building infrastructure strategically across the North Sea?
- Bigger wind projects with larger turbines in deeper water?

BWEA

BWEA

BWEA

BWEA



BWEA

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BWEA

www.bwea.com

Michael Hay,
Head of Offshore Renewables
michael@bwea.com

BWEA

Licensing Offshore Renewable Energy in the UK

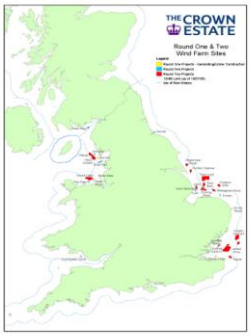
Rachael Mills
Minerals Management Service
Workshop, 26th June, 2007

marine and fisheries agency

Licensing Offshore Renewable Energy in the UK

- Intro – location of offshore wind development
- Licensing responsibilities
- The legislation
- The licence application process
- Monitoring - protecting the environment
- Learning lessons
  - Case studies
  - Action

marine and fisheries agency

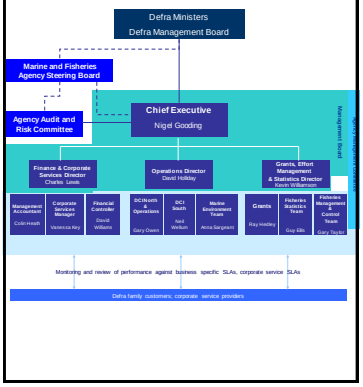


Marine and Fisheries Agency - objectives

Our vision
A trusted manager of sea fisheries and the marine environment, recognised for our fairness and valued for our professionalism, expertise and high standards

Our objectives

- **Fisheries Management**
  - To be a key partner in the management of marine fisheries
- **Enforcement**
  - To enforce fisheries regulations professionally, consistently and fairly
- **Marine Environment**
  - To contribute to the sustainable use of the marine environment
- **Information and Advice**
  - To provide specialist information and advice that facilitates the development of effective policy and helps customers to abide by it
- **Our Organisation**
  - To promote an open, diverse and fair culture in which staff are encouraged to reach their full potential



Legislation – Licensing Authorities

- Marine and Fisheries Agency
  - Marine Environment Team
    - Offshore Renewable Energy
      - Food and Environment Protection Act 1985
      - Coast Protection Act 1949
- Department for Trade and Industry
  - Electricity Development Consents Directorate
    - Offshore Renewables Consents Unit
      - Electricity Act

marine and fisheries agency

Legislation

- The Food and Environment Protection Act 1985
  - Deposit of any articles or substances in the sea or under the sea bed
    - Basis for licence decision:
      - Protect marine environment and the living resources which it supports
      - Prevent interference with legitimate uses of the sea
      - Minimise nuisance, noise
- The Coast Protection Act 1949 – Marine and Fisheries Agency
  - Works that may be detrimental to the safety of navigation
    - Construction, alteration or improvement of works below mean high water springs
    - Deposit of any object or materials below the level of mean high water springs
    - Removal of objects or material below MHWS

NB – CPA applies to export cable and any ancillary work for renewables (Electricity Act 1989, section 36, reforms made in 2004 removed the need for a CPA for energy installation construction)

marine and fisheries agency

Licence application process

- Pre-application meeting
- Optional scoping stage
  - Advice on what should be included in Environmental Impact Assessment
- Application
  - On line application with detailed Environmental Impact Assessment
- Negotiation
  - Meetings between developers, advisers and Licence Authority
- Evaluation
  - Advisers submit proposed licence conditions
  - Licence Authority check conditions and draft licence
- Determination
  - Ministerial decision
  - Licence issued

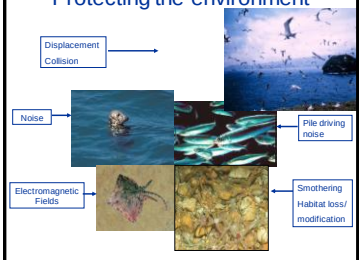
Licence Application Process – our advisers

Centre for Environment Fisheries and Aquaculture Science (Cefas)
Aquatic scientific research and consultancy centre.
- Optimise resource development and utilisation
- Understand and assess environmental impacts
- Minimise environmental costs of marine activities

Joint Nature Conservation Committee (JNCC)
JNCC delivers the UK and international responsibilities of the country nature conservation agencies - Natural England.
- Advise Government on the development and implementation of policies for, or affecting, nature conservation in the UK and internationally;
- Provide advice and disseminate knowledge on nature conservation issues affecting the UK and internationally;
- Establish common standards throughout the UK for nature conservation, including monitoring, research, and the analysis of results;
- Commission or support research.

Natural England
- Conservation of England's natural environment.
- Enjoyment and understanding of the natural environment.
- Sustainable use and management of the natural environment
- Decisions that collectively secure the future of the natural environment.

Protecting the environment



Protecting the environment – monitoring conditions

- Marine Pollution Contingency plans for spills and collision incidents
- Liaison officers to maintain communication between licence holder, contractors, fishermen and conservation groups
- Marine Mammal Observers & protocol to mitigate potential impacts
- Attenuation of electro-magnetic field strengths associated with cables
- Monitoring programme (birds, benthic organisms, fish, noise and vibration) agreed before construction commences
- Licence conditions: http://www.mceu.gov.uk/MCEU_LOCAL/FEPA/NEWSITEMS/LondonArray-letter.pdf

Case Study: Making sure licence conditions are enforceable

LESSON LEARNT: MAKE SURE LICENCE CONDITIONS CLEARLY SPECIFY REQUIREMENT AND ARE TIME LIMITED

Issue: Interpretation of licence condition to implement measures to ensure safe navigation

Situation:
- Wind farm developer and harbour authority have conflicting views:
  - Harbour Authority: installing turbines will disrupt mariners radar equipment and be a potential hazard. An additional radar system is needed immediately
  - Wind farm developer: condition not time limited. Temporary solution agreed with harbour Authority which will allow construction. Permanent solution subject to further discussion
- Request for construction (installing turbines) to be halted until permanent solution found

Result:
- Meeting called to discuss situation
- Harbour Authority tasked with implementing temporary solution
- Both to sign up to permanent solution

marine and fisheries agency

Case Study: Enforcing licence conditions proportionately

LESSON LEARNT: MAKE SURE YOU ARE ABLE TO ENFORCE LICENCE CONDITIONS PROPORTIONATELY

Issue: Spillage of grout material into the marine environment

Situation:
- Wind farm developer reports a large amount of grout leaked between transition piece and monopile
- Another leak occurs after work commences
- Licence Authority concerned that proper precautions not being taken
- Licence conditions only allow authority to revoke the licence

Result:
- Enforcement officers called in to carry out investigation
- Lawyers consulted about flexibility of FEPA – new condition drafted to allow us to suspend a licence.
- New condition added to all licences

Learning lessons

- **Project management approach to licence application process**
  - Working to targets
  - Dedicated case officer
- **More transparency about process and decisions**
  - Defined stages in the application process with indicative timescales
  - Conditions/decisions fully explained with evidence
  - More regular updates to applicants
- **Consistency**
  - Standardised licence conditions
  - Regular review of licence conditions
- **Complexity of process**
  - Published process diagram with guidance
  - Revamped website
  - Closer working with industry through organisations like BWEA
- **Better coordination with advisers**
  - Meetings to understand constraints on advisers
  - Licence conditions clarified with case officer
  - Regular meetings to talk through issues
- **Stringent management of licence conditions**
  - Standardised licence conditions
  - Firmer line on the time needed to make decisions
  - More flexible and proportionate methods for enforcement

marine and fisheries agency

Questions/Comments?

www. mceu.gov.uk

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marine and fisheries agency

RPS Energy

Impact Assessment and Monitoring of Offshore Wind Farms: UK perspective

Chris Jenner, Technical Director, RPS Energy
Minerals Management Service Alternative Energy Workshop
26th June 2007

RPS Energy

1. Introduction to RPS
2. EIA Drivers & Process
3. Round 1 to 2
4. Case Study 1 – Thames Estuary
5. Case Study 2 – Lynn & Inner Dowsing
6. Conclusions

RPS Group Plc

RPS Energy

- Europe's leading environmental, planning and engineering consultancy
- Employing over 4,000 personnel in 80 offices
- Provision of advice to the energy, civil engineering, mining and submarine cable markets
- In depth experience of nearshore and offshore surveys and related offshore structures, engineering construction and installation (> 5000 marine projects)
- Projects in over 70 countries per year
- Annual turnover of £200 Million from consulting
- Trading since 1970 & FTSE250 Company

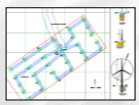
Offshore Renewables Project Experience

RPS Energy

Over 50 offshore renewable energy projects.

Key Clients:

Airtricity
AMEC
Bluewater Wind
Centrica
DONG
E.ON Renewables
Elsam Engineering
Energi E2
GE Wind Energy
Lunar Energy
Naikun Inc.
NI Electricity
Norsk Hydro
Npower Renewables
RES
Scottish Power
Scottish & Southern Electricity
Shell Wind



Selected Sites:

Burbo Bank
Cromer
Delaware, US
Docking Shoal
Gunfleet Sands 1 & 2
Gwynt y Mor
Humber
Kentish Flats
Lincs
London Array
Long Island, US
Lynn & Inner Dowsing
Naikun, Vancouver
Race Bank
Rhyl Flats
Scarweather Sands
Shell Flats
Sheringham Shoals
Walney
West of Duddon

RPS Energy

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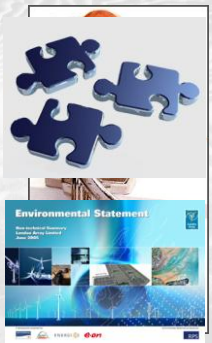
EIA Drivers

RPS Energy

- EC Directives 85/337 & 97/11/EC
- S36 Electricity Act 1989
- S34 Coastal Protection Act 1949
- FEPA 1985
- Transport & Works Act 2000
- Town & Country Planning Act 1990

EIA Process

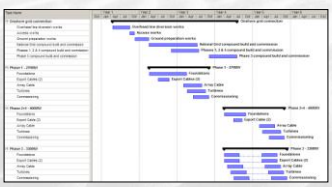
- Screening
- Scoping
- Environmental Statement
- Submission
- Determination Period
- Decision
- Licence Condition Compliance



Raising the bar

- Round 1 to Round 2 ?
- Project Design
  - → turbine capacity (>5MW…?)
  - → turbine separation/locations
  - → foundation & scour protection
  - → cable type/no./locations
  - → construction methodology
  - → construction timetable
- Environment
  - → 'frontier' areas
- EIA process
  - → Realistic 'worst-case' scenario
  - → max. envelope assessment
  - → Topic & receptor specific

EIA and Project Design



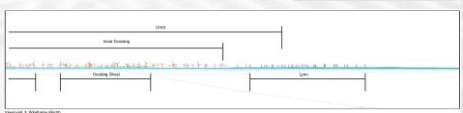
- 2 installation programmes considered
- Different 'phasing' of offshore works
- Which has a lesser or greater impact ?

Contribution of UK Research Initiatives

- Various initiatives, such as COWRIE, RAG, etc.
  - → Potential effects of EMF
  - → Baseline methodologies for aerial and boat based surveys
  - → Displacement of birds from feeding areas
  - → Potential effects of underwater noise & vibration on marine mammals
  - → Assessment of remote techniques
- Different to project specific EIA
- Output will be guidance & best practice

Cumulative Impact Assessment

- With any type of proposed development
- Of consented or submitted projects…
- ….even new projects submitted during determination period
- In-combination effects ?



RPS Energy

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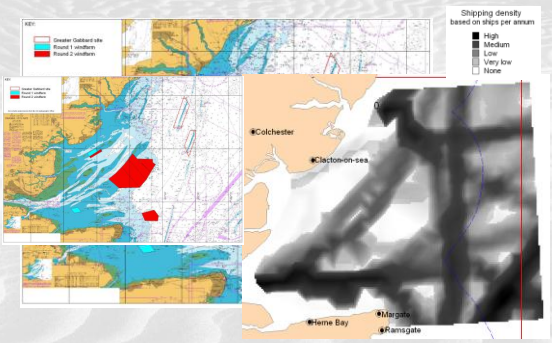
London Array

Case Study 1
Thames Estuary Projects

Case Study 1: Thames Estuary Projects

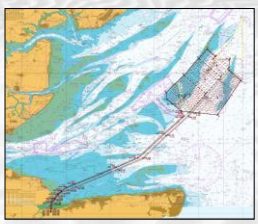
RPS Energy



Case Study 1: Thames Estuary Projects

RPS Energy

- E.ON Renewables, Shell Wind and DONG Energy.
- Located approximately 20km from the Essex and Kent coasts.
- Site selection and environmental studies commenced in 1999.
- 245 sq km.
- 271 offshore wind turbines.
- Up to 5 offshore substations.
- Up to 6 export cables.
- New onshore substation to connect 1,000MW to existing 400kV transmission system.
- Planning Application submitted June 2005.
- Awarded offshore consents December 2007.



London Array

Case Study 1: Thames Estuary Projects

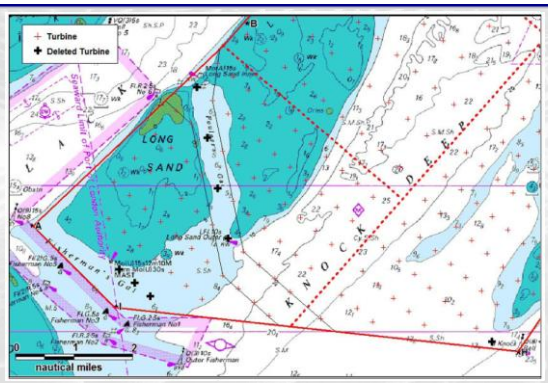
RPS Energy

3.6MW turbines (existing technology)
Hub heights ~83m
Blade diameter ~107m
Total height ~136m
(above CD)

7MW turbines (future phases)
Hub heights ~105m
Blade diameter ~150m
Total height ~180m
(above CD)

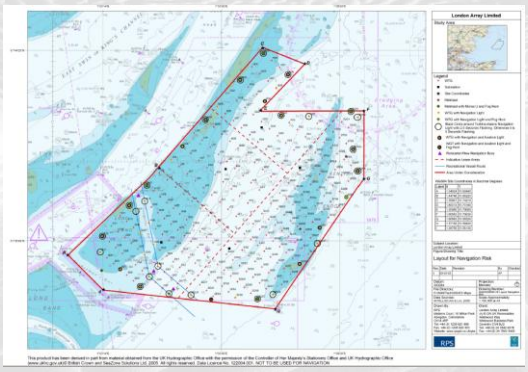
Case Study 1: Thames Estuary Projects

RPS Energy



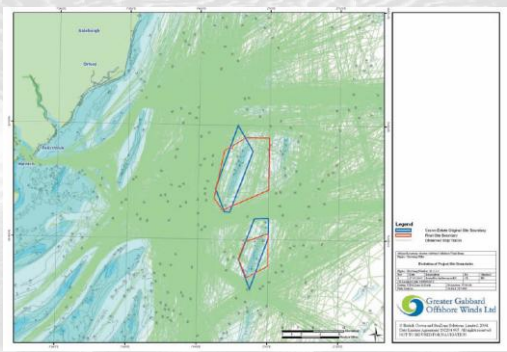
Case Study 1: Thames Estuary Projects

RPS Energy



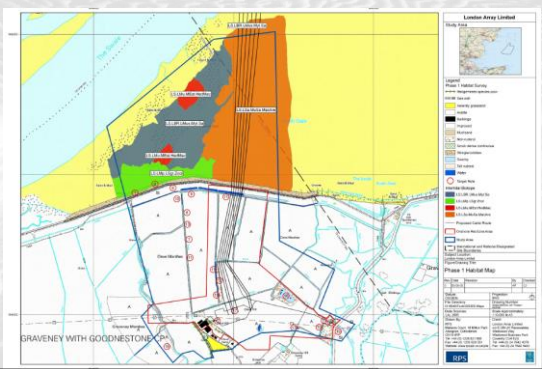
Case Study 1: Thames Estuary Projects

RPS Energy



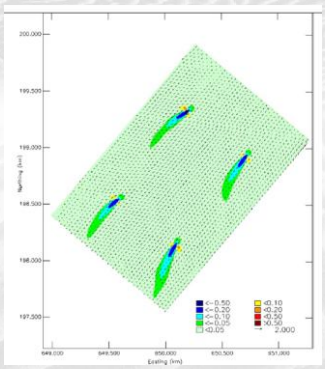
Case Study 1: Thames Estuary Projects

RPS Energy



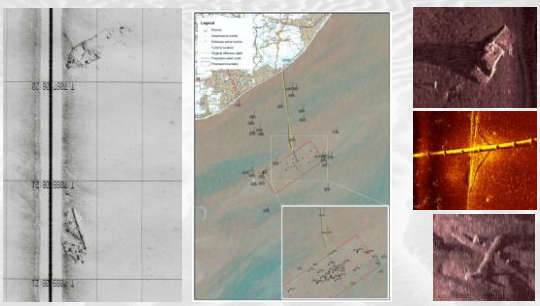
Case Study 1: Thames Estuary Projects

RPS Energy



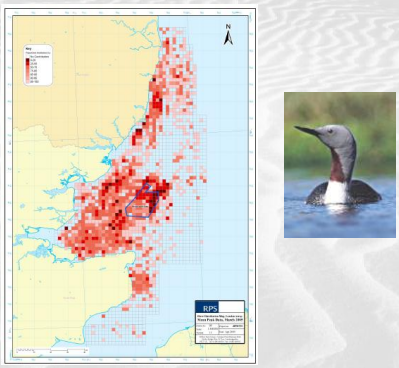
Case Study 1: Thames Estuary Projects

RPS Energy



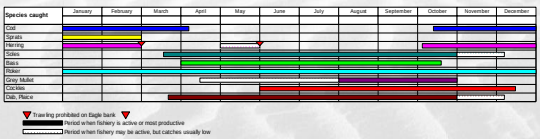
Case Study 1: Thames Estuary Projects

RPS Energy



Case Study 1: Thames Estuary Projects

- To develop better understanding of the fisheries in this area: methods used, seasonality, commercial importance
- Achieved through dialogue and meetings with local fishermen, Fisheries Officers and CEFAS Personnel
- To identify impacts on the fishing industry that may result from the development
- To determine potential methods of mitigating any impacts on the fishing industry



Case Study 2: Lynn & Inner Dowsing

EIA / Submission stage

Birds
Piling noise
Marine Mammals
Navigation
Grid Connection
Coastal Processes
Fisheries
Ecology
Consent Routes
Photomontages
Safety Zones
Fish Spawning

Case Study 2: Lynn & Inner Dowsing

Construction stage

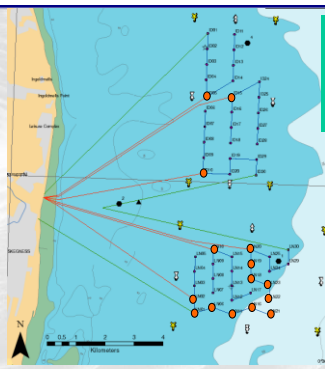
Foundations
Cable burial depth
Cable supply
Weather downtime
Turbine supply
Method Statements
Risk Assessment
Multi Contract
Contract negotiation
Installation vessels
Programme

Case Study 2: Lynn & Inner Dowsing

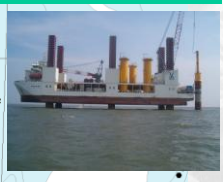
Consent Compliance - Key Issues

- Early communication to installation (sub)contractors
- Clarity on conditional monitoring
- Allocation of responsibility in a multi-contract environment
- Interface management
- Communication of change
- Auditing of compliance throughout & beyond construction phase
- Communication with regulators

Case Study 2: Lynn & Inner Dowsing



Offshore started – 21 April 2007
3 cycles complete
15/54 foundations installed
54 x Siemens 3.6MW turbines
MV Resolution



Case Study 2: Lynn & Inner Dowsing

Onshore Cable installation along roads

Onshore/Offshore Cable Joint Bay

Directional Drilling under sea defences

Case Study 2: Lynn & Inner Dowsing

MV Resolution piling (Menck 1900 hammer)

Wave Buoy

Archaeology Exclusion Zones

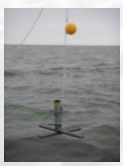
Deployment of hydrophones for underwater noise measurements

Bird surveys during construction

Case Study 2: Lynn & Inner Dowsing

Grab sampling – close to foundation that will require drilling

Underwater camera – close to foundation that will require drilling

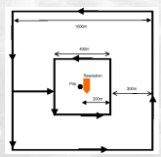


Preparation & deployment of sediment traps

Baseline monitoring before commencement of drill-dispose operations – 9-11 June 2007

Case Study 2: Lynn & Inner Dowsing

Marine Mammal observations before commencement of soft start piling (ongoing)



RPS Energy

1. Introduction to RPS
2. EIA Drivers & Process
3. Round 1 to 2
4. Case Study 1 – Thames Estuary
5. Case Study 2 – Lynn & Inner Dowsing
6. Conclusions

Conclusions

- Flooded with information - can't see the wood from the trees.
- Balance between baseline / impacts.
- Encourage focussed industry research.
- Learn from UK & DK experiences; validation of impact predictions are transferable to US.
- Fit for purpose surveys; not fit for NGO databank.
- Scope out and keep EIA's to scale.
- Implementation of consent conditions & validation through monitoring is critical to existing & future projects.

Lost in translation

RPS Energy

100MW Huittengxile Wind Farm, Inner Mongolia

EIA, January 2005
(28 pages, funded by the World Bank)

...wind turbines are so obvious that the birds can see it clearly and avoid it....

...it will form beautiful and attractive scenery. In the vast grassland, a lot of white wind turbines stand in order and rotate in the blue sky, the white cloud and green grassland.....

... the number of wind turbines will grow and the scenery will be surely more beautiful....

RPS Energy

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Wave Energy Development in the U.S. – Present Status and Future Trends

Minerals Management Service

Workshop to Identify Alternative Energy Environmental Information Needs

Herndon, VA

26 June 2007

George Hagerman

Virginia Coastal Energy Research Consortium
Virginia Tech Advanced Research Institute

Presentation Outline

Resource characteristics

- *Governed by local winds and offshore storms*

U.S. production potential

- *250-260 TWh per year (EPRI, 2004)*
- *Comparable to annual energy output of all existing conventional hydro-electric projects in US*

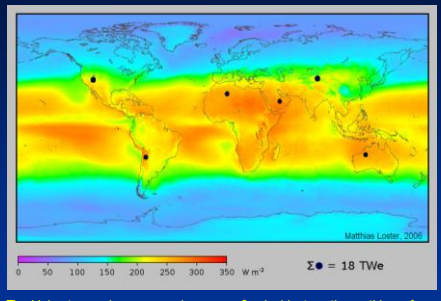
General types of conversion technology

- *Highly diverse alternatives; classified into Terminators, Attenuators, and Point Absorbers*

Conversion technology status

- *Has yet to converge on single best technical approach (if such exists)*

Global Solar Energy Distribution



The highest annual average solar energy flux incident on the earth's surface is ~300 watts per m² of horizontal area. Earth-orbiting satellites with solar panels continually facing the sun receive ~1,370 watts per m².

Winds Move ~60% of Excess Solar Energy from Equator to Poles

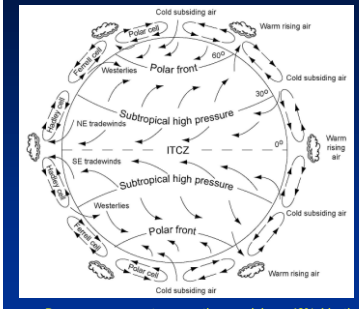
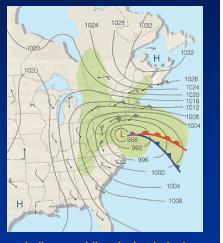
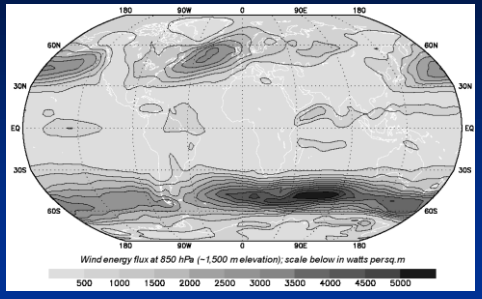


Figure below shows nor'easter forming as cold dry air picks up heat and moisture from ocean.



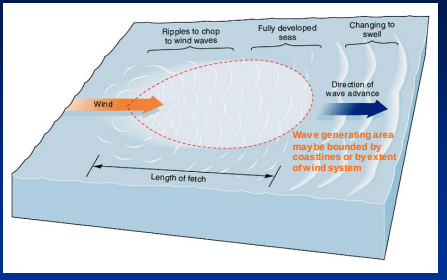
Deep-ocean currents move the remaining ~40% (via thermohaline meridional circulation)

Global, High-Altitude Wind Energy Flux Distribution



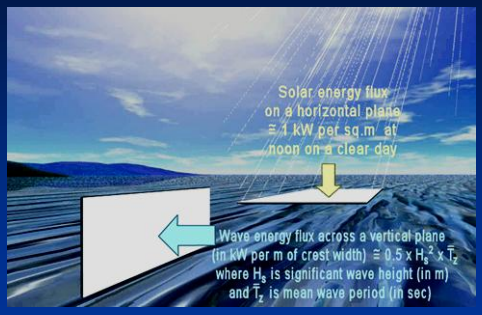
The annual average wind power density at ~1.5 km above sea level (elevation of the so-called "gradient wind") is 1 to 5 kilowatts per square meter of cross-sectional area.

Wind Over Water Generates Waves



Ocean swell can travel thousands of kilometers in deep water with negligible loss of energy. Thus wave energy produced anywhere in an ocean basin ultimately arrives at its continental shelf margins, virtually undiminished until it reaches ~200 m depths.

Calculation of Wave Energy Flux



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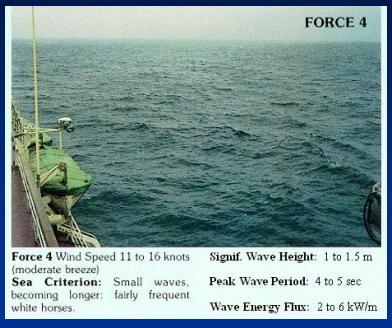
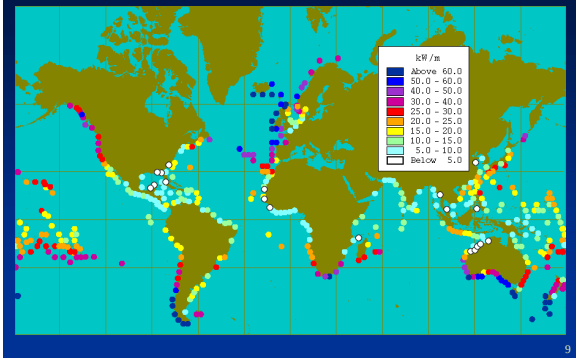
Wave Energy Flux in Typical U.S. Mid-Atlantic Sea State



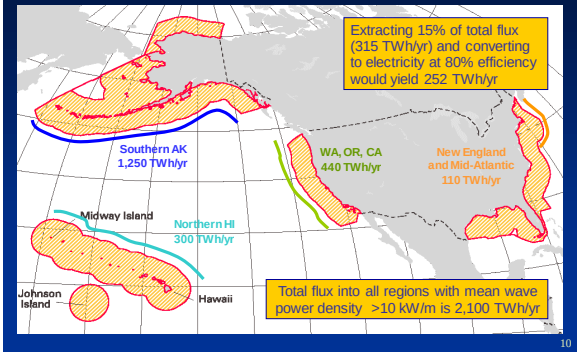
8

Global Wave Energy Flux Distribution



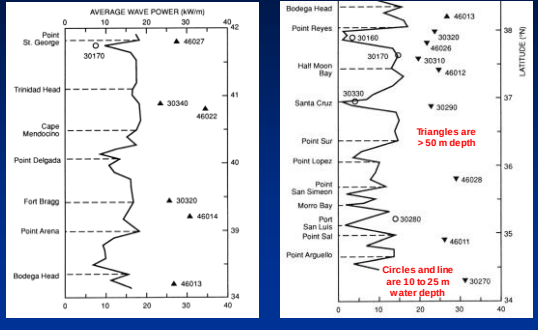
9

U.S. Offshore Wave Energy Resources



10

Power Densities Less Variable Offshore, More Variable Near Shore



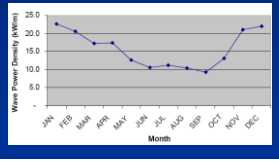
11

Substantial Seasonal Variability

West Coast (Oregon)

East Coast (Massachusetts)

Hawaii



12

Wave Energy Devices Highly Diverse

Fixed Oscillating Water Column **Terminator** (Oceanlinx)

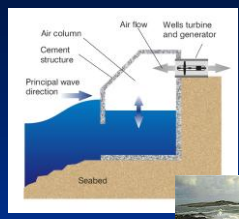
Floating **Attenuator** (*Pelamis*)

Floating Overtopping **Terminator** (*Wave Dragon*)

Floating **Point Absorber** (*AquaBuOY*)

13

OWC Terminator: Onshore LIMPET



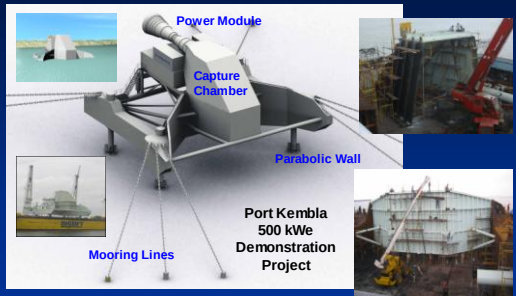
www.wavegen.co.uk

500 kWe demonstration project connected to utility grid on Islay, Scotland in November of 2000

LIMPET: Land-Installed Marine Powered Energy Transformer

14

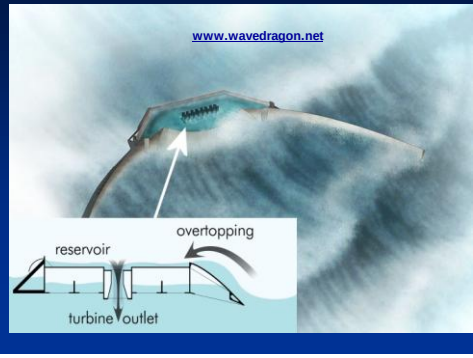
OWC Terminator: Oceanlinx Nearshore Device



www.oceanlinx.com

15

Overtopping Terminator: *Wave Dragon*



16

Wave Dragon Prototype Trials

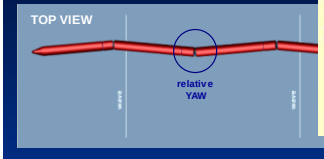
Prototype is 58 m wide (between tips of funneling side walls) and 33 m long, with a reservoir volume of 55 m^3 and a displacement of 237 metric tons. Total rated capacity is 17.5 kWe.

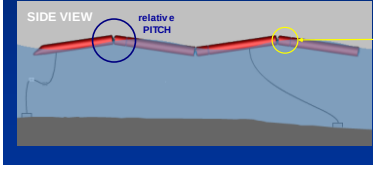
Funneling side walls are moored separately from central floating reservoir.

17

Floating Attenuator: *Pelamis*

www.oceanpd.com





Power module at front of each tube section contains two hydraulic cylinders that are stroked by relative pitch and yaw between adjacent sections

18

Pelamis Engineering Development

1998 – 2003: 1/20 and 1/33-scale models tested to physically validate numerical simulations of wave energy absorption efficiency and mooring loads (survivability)

2001 – ongoing: 1/7-scale model tested in large tank (regular waves) and Firth of Forth (random waves) to develop control system

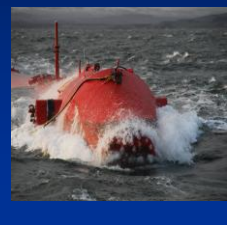
2002 – ongoing: Full-scale power module bench rig tested to qualify mechanical and electrical components and to assess MTBF (reliability) and control system performance

19

Pelamis Sea Trials and Pilot Plant

Three 750 kW modules to be installed summer 2007 in 2.25 MW pilot plant off northern Portugal

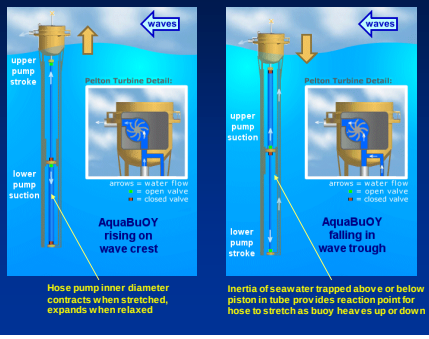
Pelamis 750 kW prototype installed in August of 2004 in 50 m water depth, 2 km offshore the European Marine Energy Centre, Orkney, UK



20

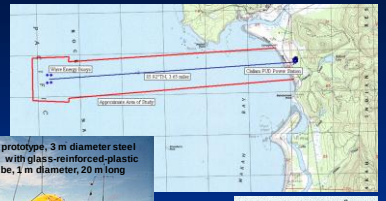
Point Absorber: Finavera *AquaBuOY*

http://finavera.com/en/wavetech



21

AquaBuOY 1 MW Project to be Installed off Makah Bay, Washington



Early prototype, 3 m diameter steel buoy, with glass-reinforced-plastic tail tube, 1 m diameter, 20 m long

22

Point Absorber: OPT *PowerBuoy*

OPT's PowerBuoy™ system extracts the natural energy in ocean waves, and is based on the integration of patented technologies in hydrodynamics, electronics, energy conversion and computer control systems. The PowerBuoy is a "smart" system capable of responding to differing wave conditions.

The rising and falling of the waves off shore causes the buoy to move freely up and down. The resultant mechanical stroking is converted via a sophisticated power take-off to drive an electrical generator. The generated power is transmitted ashore via an underwater power cable.

OPT website June 2007

www.oceanpowertechnologies.com

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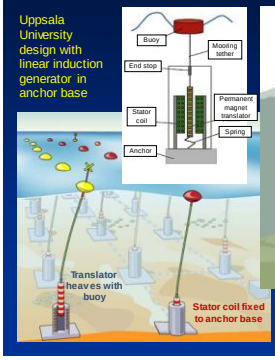
Navy Funded Demonstration Project at Kaneohe Marine Base, Oahu, Hawaii

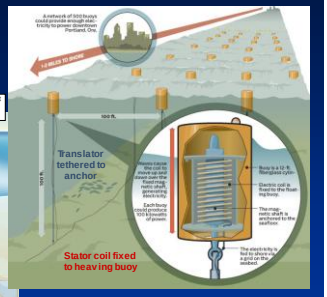
PB-40 deployed June 2004 and again in October 2005

24

Next-Generation Heaving Buoy Devices with Direct Electromagnetic Power Take-Off

Uppsala University design with linear induction generator in anchor base





Oregon State University design with linear induction generator in heaving buoy

25

US Wave Energy Projects in FERC Regulatory Process

Finavera *AquaBuOY*

- *Makah Bay, WA demonstration project entered FERC alternative licensing process in September 2003; fabrication underway now, summer 2008 deployment*
- *Coos County, OR preliminary permit issued*
- *Humboldt County, CA preliminary permit applied for*

OPT *PowerBuoy* (including OPT wholly-owned subsidiaries Oregon Wave Energy Partners)

- *Two Oregon projects with preliminary permits issued (Reedsport and Coos Bay)*
- *Two Oregon projects with preliminary permits applied for (Newport and Fairhaven)*

Type of device yet to be determined

- *Douglas County, Oregon (preliminary permit issued)*
- *Lincoln County, Oregon (preliminary permit applied for)*
- *Two PG&E "WaveConnect" Projects in Northern California*

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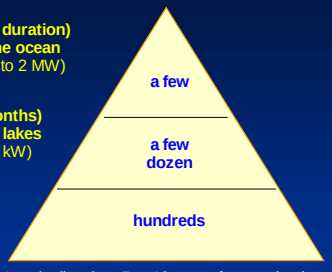
Technology Development Pyramid

Long-term (>1 yr duration) prototypes in the ocean (typically 100 kW to 2 MW)

Short-term (days to months) tests in rivers, bays or lakes (typically 10 kW to 100 kW)

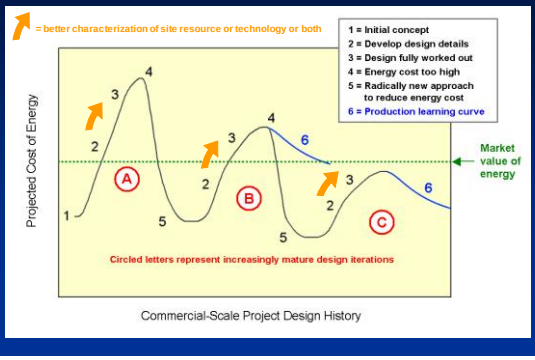
Rigorous laboratory tow- or wave-tank physical model tests (1/50- to 1/5-scale)



It typically takes 5 to 10 years for a technology to progress from concept-only (not in pyramid) to deployment of a long-term prototype

27

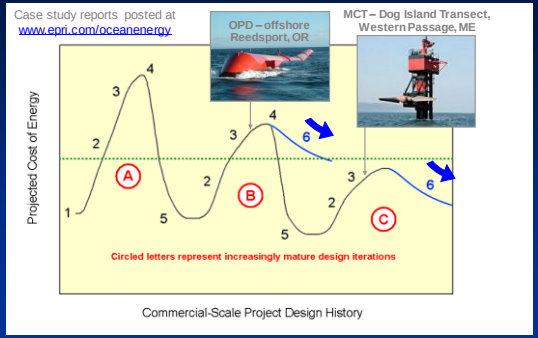
Site-Specific Design Evolution



28

Example Feasibility Case Studies by EPRI

Case study reports posted at www.epri.com/oceanenergy



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Thank You!

Email: hagerman@vt.edu

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Environmental Concerns Associated with Wave Energy Conversion Technology in the United States

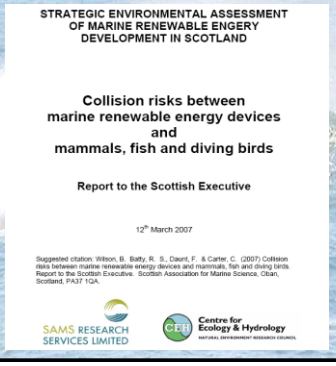
MMS Alternative Energy Workshop
Herndon, VA, June 26-28, 2007

Gregory McMurray
Marine Affairs Coordinator
Department of Land Conservation and Development
State of Oregon

Basis for this Presentation

- **MMS has just released *Worldwide Synthesis* (a week ago today)**
- **Best information presently available on wave energy is the Scottish Executive's *Strategic Environmental Analysis***
  - **Very comprehensive, using matrix approach**
  - **Some general studies already completed**
  - **About a level more targeted than the PDEIS and synthesis; for a narrower range of technology and a specific region**
  - **Entire document available at: http://www.seaenergyscotland.co.uk/**
- **Many applicable stressors and effects have already been studied in context of other activities**

Most Educational Report:


STRATEGIC ENVIRONMENTAL ASSESSMENT
OF MARINE RENEWABLE ENGERY
DEVELOPMENT IN SCOTLAND

Collision risks between
marine renewable energy devices
and
mammals, fish and diving birds

Report to the Scottish Executive

12th March 2007

Suggested citation: Wilson, B. Batty, R. S., Daunt, F. & Carter, C. (2007) Collision risks between marine renewable energy devices and mammals, fish and diving birds. Report to the Scottish Executive. Scottish Association for Marine Science, Oban, Scotland, PA37 1QA.

SAMS RESEARCH SERVICES LIMITED

Centre for Ecology & Hydrology

Language of Environmental Risk Assessment

- **Stressors**
- **Receptors**
- **Exposure**
- **Effects**
- **Mitigation**
- **Residual effects**
- **Cumulative effects**

The Stressors

- **Point Absorber**

- **Oscillating Water Column**

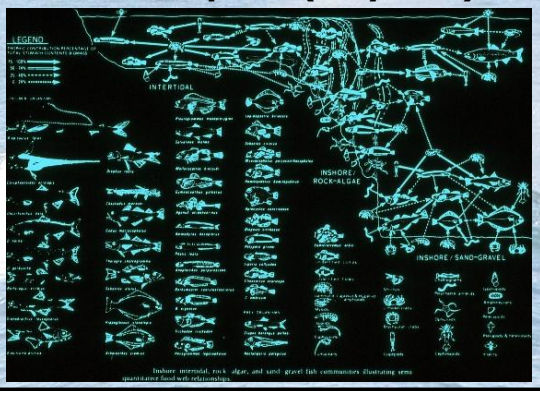
- **Attenuator**

- **Overtopping**

The Stressors - Focus on Novel Signatures or Combinations

- **Emplacement – mainly temporary disturbances (e.g., benthic smothering)**
- **Operation**
  - **Buoys**
  - **Transmission system**
  - **Anchoring system**
- **Decommissioning**
- **Routine and emergency maintenance**

The Receptors (A System)



A Matrix Approach

General Stressor and Receptor Effects Table for Wave Energy Development on the Oregon Coast.

Activity (agent or stressor)	Receptors												
	Ocean Waves	Ocean Currents	Benthic Habitats	Plankton	Fouling Community	Pelagic Fish	Forage Fish and Invertebrates	Demersal Fish	Epibenthic Macroinvertebrates	Benthic Infauna	Seabirds	Pinnipeds	Cetaceans
Emplacement													
Mooring System													
Electrical Transmission Infrastructure													
Operation													
Mooring System													
Buoy or Other Generation Device													
Electrical Transmission Infrastructure													
Chemical Coatings													
Decommissioning													
Buoy or Device Removal													
Transmission Infrastructure Removal													
Anchor Removal or Decommissioning													
Routine Maintenance													
Vessel Traffic, Maintenance Activities													

Major Issues – by Stressor

- Wave and current modification
- New hard structures – water column and benthic
- Electromagnetic fields
- Chemical toxicity
- Acoustics
- Cumulative effects
- Use/user conflicts

Wave and Current Modification

- Estimates of 3-15% wave energy reduction – major uncertainty – many variables
- Offshore distance of 2 miles appears to minimize any shadow effect
- Siting in littoral cell could be quite important
- Key receptors:
  - Waves themselves (height and energy)
  - Littoral processes
  - Sediment transport near array – may create areas of scour in shallow water (<25m)
  - Benthic habitat near array

New Hard Structures

- Fish Attraction Device (FAD) effect
- Invasive Species? (stenohaline)
- Collision danger for larger vertebrates
- Key receptors:
  - Fouling Community
  - Fish and other nekton
  - Seabirds
  - Marine mammals

Electromagnetic Fields

- Electrical (E) field and magnetic (B) field
- Elasmobranchs use electrical fields to locate prey (levels of µVolts)
- Salmon likely use magnetic fields
- Key receptors:
  - Sharks and rays
  - Prey (including humans……?)
  - Salmonids (ESA species on West Coast)

Chemical Toxicity

- Spills – hydraulic; fuel from boats
- Biofouling coatings (Cu, Sn)
- Sacrificial anodes
- Lead and/or other toxics in transmission system
- Key receptors:
  - Fouling community
  - Infauna (in the case of ablative coatings, especially TBT)

Acoustics

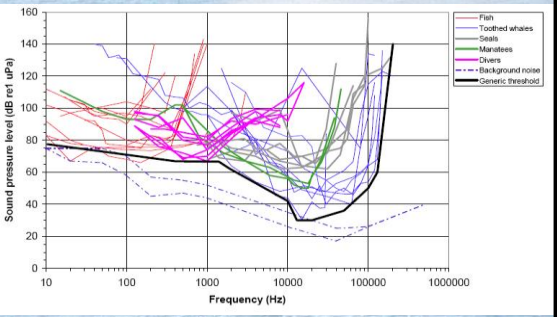
- One of best known processes in ocean
- Complex behavioral responses of vertebrates add greatly to uncertainty
- QinetiQ studies used human health criteria as proxy
  - Limited hearing loss threshold
  - Permanent hearing loss threshold
- Key receptors:
  - Fish
  - Seabirds
  - Marine Mammals

Array Effects

- Depending on signatures and residual effects, may create an ecological barrier
- Depending on process, could also result in a "volume swept clear" (e.g., propagules)
- Avoidance of barrier may have ecological cost (e.g., acoustic guidance)
- Key receptors:
  - Animals with crossing migration patterns
  - Predators or prey utilizing new structure

Acoustics 2

In-water hearing thresholds



Source: Richards, SD, EJ Harland and SAS Jones. 2007. Underwater Noise Study Supporting Scottish Executive Strategic Environmental Analysis of Marine Renewables. QinetiQ. Dorchester, UK.

Array Effects - Acoustics

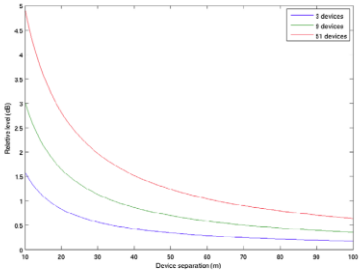


Figure 8-6: Noise level relative to the noise of a single device, at the centre device of a linear array, as a function of the separation between devices

Source: Richards, SD, EJ Harland and SAS Jones. 2007. Underwater Noise Study Supporting Scottish Executive Strategic Environmental Analysis of Marine Renewables. QinetiQ. Dorchester, UK.

Array Effects - Acoustics

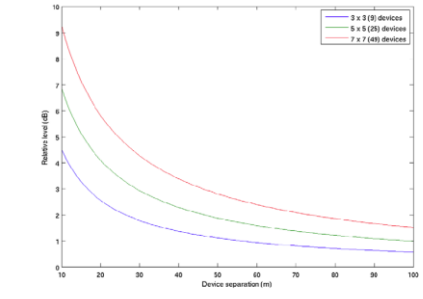


Figure 8-8: Noise level relative to the noise of a single device, at the centre device of a square array, as a function of the separation between devices

Source: Richards, SD, EJ Harland and SAS Jones. 2007. Underwater Noise Study Supporting Scottish Executive Strategic Environmental Analysis of Marine Renewables. QinetiQ. Dorchester, UK.

Mitigation

- For collisions:
  - Color
  - Spacing
  - Acoustic avoidance devices
  - No surface or subsurface traps
- For electromagnetic fields:
  - Cable trenching and shielding
  - Alternating current above 7-8? Hz
  - Faraday cage

Major Knowledge Gaps

- Array effects across the board
- Hard substrate effects in a soft-bottom environment
- Barrier effects
- Collision risk for large vertebrates
- System survivability
- Ecological costs of avoidance

Summary Matrix

Activity (stressor)	Receptor												
	A. Ocean Water	B. Ocean Sediments	C. Substrate and Benthic Habitats	D. Pinniped Haulouts	E. Fouling community	F. Pelagic Fish and Invertebrates	G. Forage Fish and Invertebrates	H. Demersal Fish	I. Epibenthic Macroinvertebrates	J. Benthic Infauna	K. Seabirds	L. Pinnipeds	M. Cetaceans
4. Mooring System						?	?	?	?	?	m	m	?m
5. Buoy or Other Generation Device	?	?		?	?	m	m				m	m	?m
6. Electrical Transmission Infrastructure				?		m	m	m					
7. Chemical Coatings				?	?								
8. Acoustic Guidance System											?	?	?

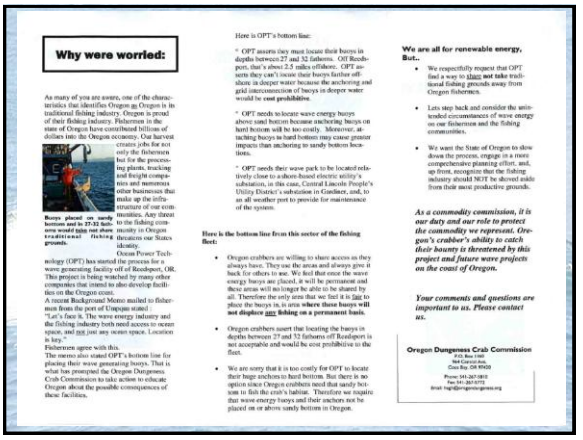
This is all just in his head.....

Cumulative Effects

- Effects across all receptors – systems view
- Effects of multiple deployments (arrays)
- Effects of size of individual arrays
- Effects of multiple arrays
- Effects of wave energy plus other existing and new uses
- Predicting effects in a changing ocean
- Two key questions:
  - How big an array is too big?
  - How many arrays is too many in a region?

Use and User Conflicts

- Fishing (commercial and recreational)
  - Salmon trolling
  - Crabbing
  - Shrimp trawling
  - Sport salmon and rockfish
- Navigation/Transportation
- Surfing
  - Effect on wave amplitude and period
  - Attraction of sharks
- Other recreation (e.g., whale watching)



Why were worried:

As many of you are aware, one of the characteristics that identifies Oregon as Oregon is its traditional fishing industry. Oregon is proud of their fishing industry. Fishermen in the state of Oregon have contributed billions of dollars into the Oregon economy. Our harvest creates jobs for not only the fishermen but for the processing plants, trucking and freight companies and numerous other businesses that make up the infrastructure of our communities. Any threat to the fishing community in Oregon threatens our States identity.

Buoys placed on sandy bottoms and in 27-32 fathoms would take out share traditional fishing grounds.

Ocean Power Technology (OPT) has started the process for a wave generating facility off of Reedsport, OR. This project is being watched by many other companies that intend to also develop facilities on the Oregon coast.

A recent Background Memo mailed to fishermen from the port of Umpqua stated : "Let's face it. The wave energy industry and the fishing industry both need access to ocean space, and not just any ocean space. Location is key."

Fishermen agree with this.

The memo also stated OPT's bottom line for placing their wave generating buoys. That is what has prompted the Oregon Dungeness Crab Commission to take action to educate Oregon about the possible consequences of these facilities.

Here is OPT's bottom line:

" OPT asserts they must locate their buoys in depths between 27 and 32 fathoms. Off Reedsport, that's about 2.5 miles offshore. OPT asserts they can't locate their buoys further offshore in deeper water because the anchoring and grid interconnection of buoys in deeper water would be **cost prohibitive.**

" OPT needs to locate wave energy buoys above sand bottom because anchoring buoys on hard bottom will be too costly. Moreover, attaching buoys to hard bottom may cause greater impacts than anchoring to sandy bottom locations.

" OPT needs their wave park to be located relatively close to ashore-based electric utility's substation, in this case, Central Lincoln People's Utility District's substation in Gardiner, and, to an all weather port to provide for maintenance of the system.

Here is the bottom line from this sector of the fishing fleet:

- Oregon crabbers are willing to share access as they always have. They use the areas and always give it back for others to use. We feel that once the wave energy buoys are placed, it will be permanent and these areas will no longer be able to be shared by all. Therefore the only area that we feel it is fair to place the buoys in, is area **where those buoys will not displace any fishing on a permanent basis.**
- Oregon crabbers assert that locating the buoys in depths between 27 and 32 fathoms off Reedsport is not acceptable and would be cost prohibitive to the fleet.
- We are sorry that it is too costly for OPT to locate their huge anchors to hard bottom. But there is no option since Oregon crabbers need that sandy bottom to fish the crab's habitat. Therefore we require that wave energy buoys and their anchors not be placed on or above sandy bottom in Oregon.

We are all for renewable energy, But..

- We respectfully request that OPT find a way to share **not take** traditional fishing grounds away from Oregon fishermen.
- Lets step back and consider the unintended circumstances of wave energy on our fishermen and the fishing communities.
- We want the State of Oregon to slow down the process, engage in a more comprehensive planning effort, and, up front, recognize that the fishing industry should NOT be shoved aside from their most productive grounds.

As a commodity commission, it is our duty and our role to protect the commodity we represent. Oregon's crabber's ability to catch their bounty is threatened by this project and future wave projects on the coast of Oregon.

Your comments and questions are important to us. Please contact us.

Oregon Dungeness Crab Commission

P.O. Box 1160
344 Central Ave.
Coos Bay, OR 97420

Phone: 541-267-3810
Fax: 541-267-0772
Email: ingi@oregondungeness.org

Regional Aspects

- **The resource (i.e., the wave climate)**
- **Differences in technology based on differences in resource?**
- **The width of the continental shelf**
- **The biota**
- **Prior knowledge (i.e., nearshore process studies and monitoring programs)**
- **The regional energy market**
- **Political will is a factor: risk is involved**

Aesthetic, other….

- **NIMBY/NIMO attitudes**
- **Actual viewshed effects – minor**
  - **Distance offshore**
  - **Lighting at night**
- **Landfall for cables – right of way**
- **Landside transmission infrastructure**
- **Workforce: fabrication and maintenance**

Adaptive Management

- **Defined as: leveraging into the future decisions that would normally be made at present**
- **Reason: lack of a real risk assessment and a mandate or desire to move ahead**
- **Characteristics:**
  - **Identify issues;**
  - **Identify baseline and monitoring data needed to assess issues status;**
  - **Identify triggers that initiate actions;**
  - **Identify management actions as necessary; and**
  - **Apply a precautionary approach.**

Summary – Take Home

- **Many generic effects are known and may be roughly predicted or modeled**
- **Effects will be time- and location-specific**
- **Some effects will be technology-specific**
- **Vertebrate behavior/responses are complex and may be species-specific**
- **Major information gaps need to be filled**
- **Some forms of mitigation are expected to be effective**
- **Siting is particularly important for array effects**
- **Cumulative effects will be quite difficult to predict**
- **User conflicts may be more likely than ecological effects to limit development**

OCS Alternative Energy and Alternate Use Update

Maureen A. Bornholdt
Minerals Management Service

OCS Alternative Energy Workshop
Herndon, VA
June 27, 2007

New Responsibilities: Energy Policy Act of 2005

Gave DOI comprehensive authority to manage future development of promising new ocean energy sources in the OCS (wind, wave, ocean current, and solar) and responsible alternate use of OCS facilities

MMS Action Plan

- Develop a regulatory program
- Manage existing OCS alternative energy projects

Build New Regulatory Framework

Using:

- Meaningful dialogue and partnerships with stakeholders
- Marine regulatory experience
- Sound science, engineering and environmental protection principles

Dialogue and Partnerships with Stakeholders

Held stakeholder meetings

- Identify stakeholders
- Describe key issues and concerns
- Characterize energy needs and trends
- Describe current and future technology development
- Identify State/Local regulations

Program & Regulatory Development

Two provisions under Section 388:

- Production, transportation, or transmission of energy from sources other than oil and gas [Alternative Energy]
- Use of currently or previously OCSLA-authorized facilities for energy-related purposes or for other authorized marine-related purposes [Alternate Use]

Key Regulatory Considerations

- Safety
- Protection of the environment
- Coordination with affected State & local governments and Federal agencies
- Fair return for use of OCS lands
- Equitable sharing of revenue with States

Competition Requirement

Secretary shall issue a lease, easement, or right-of-way on a competitive basis unless the Secretary determines after public notice of a proposed lease, easement, or right-of-way that there is no competitive interest.

Major Regulatory Elements*

- Coordination
- Lease Issuance
  Competitive & Noncompetitive
  Coordination
- Lease Administration
  Bonding & Payments
- Project Plan Reviews
  Site Assessment & Construction and Operations
- Conduct of Approved Plan Activities
  Installation, Production
  Environmental and Safety Monitoring & Inspections
- Decommissioning

*Includes compliance with Federal statutory requirements (e.g., NEPA, CZMA, ESA, MMPA, CWA, CAA etc.)

Programmatic EIS

- Involved the public early in identifying issues of concern and interest
- Supports implementation of a new Federal program
- Identifies generic impacts of alternative energy and alternate use of existing facilities
- Recommends mitigation measures

Scope of the Programmatic EIS

- Timeframe– Over the next 5-7 years
- Technologies– Wind, Wave, Ocean Current
- Geographic Location – East, West, and Gulf Coasts
- Federal Waters – greater than 3 nm, but water depths up to 100 meters

Programmatic EIS & Rulemaking Targets

Spring 2007

- ✓ Published draft Programmatic EIS
  www.ocsenergy.anl.gov
- ✓ Held public hearings

Late Summer 2007

- Issue final Programmatic EIS
- Publish Notice of Proposed Rulemaking and open public comment period

Programmatic EIS & Rulemaking Targets

Fall 2007
- Issue Record of Decision

2008
- Publish Final Rule
- Hold Public Workshops

Sound Science

MMS uses environmental studies to inform our Program decisions

Develop Strategic Studies Plan
- Contracted with Research Planning, Inc. (RPI) to conduct a 9-month study entitled "The Worldwide Synthesis and Analysis of Existing Information Regarding Environmental Effects on Alternative Energy Uses of the Outer Continental Shelf"

Sound Science

June 2007 Workshop
- Attended by subject matter experts, stakeholders, and MMS Scientific Advisory Committee
- Identify data gaps and study needs
- Develop appropriate methods
- Suggest priorities for future studies

Sound Science

Final Strategic Studies Plan
- Use June Workshop results to prepare draft Alternative Energy Strategic Studies Plan
- Seek MMS Scientific Advisory Committee input and comments
- Serve as a guide for Alternative Energy Program environmental studies
- Use studies results to inform our leasing and plan review decisions

Manage Existing OCS Alternative Energy Projects

MMS will not issue decisions until the Alternative Energy Program is in place

Cape Wind Energy Project

Cape Wind Associates, LLC, wind park proposal in Nantucket Sound, MA, consisting of 130, 3.6 MW wind turbine generators, about 4.7 miles offshore

Draft EIS will consider a range of alternatives:
- no action
- phased build-out
- smaller configuration
- sites offshore RI, MA, & ME for comparisons

Targets:
- Summer 2007 File draft EIS; open comment period
- Fall 2007 Hold Public hearings

LIOWP Project

Long Island Power Authority and Florida Power and Light Energy propose to build offshore wind park about 4 miles off the south shore of Long Island, New York

Draft EIS will consider a range of alternatives:

- no action
- one alternative site off of Long Island
- one alternative site in deepwater
- one alternative site onshore

- Targets
  - TBD

Questions?

Maureen A. Bornholdt

(703) 787-1300

www.mms.gov/offshore/RenewableEnergy/RenewableEnergyMain.htm

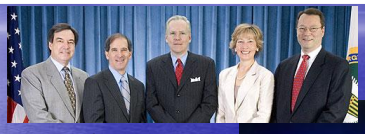
June 27, 2007

The Federal Energy Regulatory Commission: Hydropower Licensing Studies in the Ocean Environment

Overview

- Federal Energy Regulatory Commission-Hydropower Licensing
- Information for Decision Making
- Makah Bay Project Example
- Questions

Federal Energy Regulatory Commission



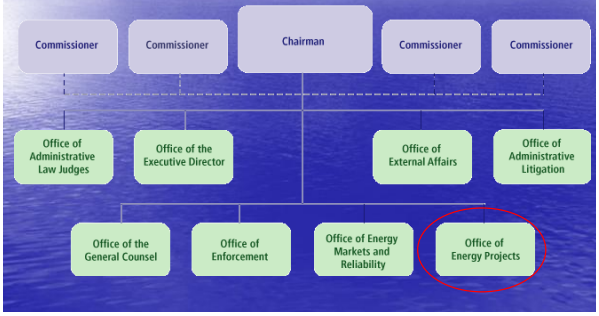
- Independent Regulatory Agency
- Five member Commission
  - Appointed by President of the United States
  - Confirmed by the Senate
  - Chairman designated by President

Regulation

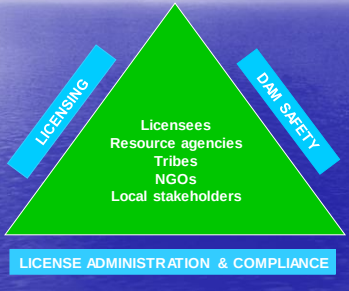
Mission: Regulate and oversee energy industries in the economic, environmental, and safety interests of the American public.

- Hydroelectric Projects
- Electric Power
- Natural Gas
- Oil Pipelines

The Commission



Hydropower Program



The Federal Power Act

Licenses must be:

- best adapted to a comprehensive plan
- for the improvement and utilization of waterpower
- for the adequate protection, mitigation, and enhancement of fish and wildlife
- for other beneficial public uses

Inland Hydro Projects in the US

Red--Federal
Blue--FERC-regulated

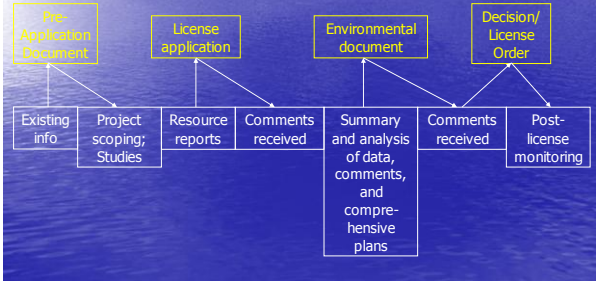
Ocean Hydro Issued Preliminary Permits and License Application

Licensing Processes

- Integrated Licensing Process (ILP)
  - Traditional Licensing Process (TLP)
  - Alternative Licensing Process (ALP)

Prefiling:	Postfiling:
• Consult with interested parties • Determine study plan and conduct studies • Prepare license application	• Solicit comments • Do environmental analysis • Make recommendation to Commission • Commission decision

Hydro Licensing Information Development

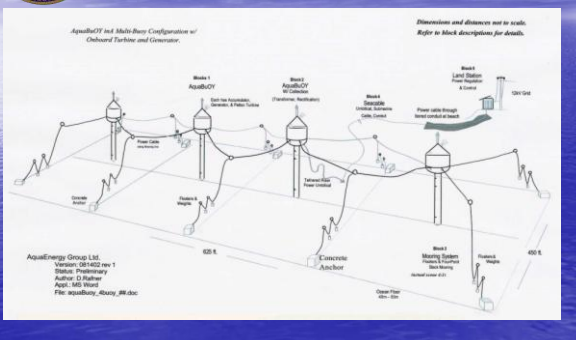


Makah Bay Wave Energy Project

Makah Bay Wave Energy Project

- Finavera Renewables Ocean Energy, Ltd.
- Four, 250-kW wave buoys ("AquaBuOYs"), submarine transmission cable, and shore station
- AquaBuOYs located over state aquatic lands
- Facilities would be placed within boundaries of Olympic Coast Marine National Marine Sanctuary (NOAA) and Makah Indian Reservation, and near Flattery Rocks Wildlife Refuge (U.S. Fish and Wildlife Service)
- Annual generation estimate: 1,500 MWh

Makah Bay Wave Energy Project



Makah Bay Wave Energy Project

- October 3, 2002: FERC determined license needed to construct and operate the proposed wave energy project
- September 4, 2003: FERC approved Finavera's request to use ALP to prepare license application
- September 2003: Initial scoping of issues, public meetings, and site visits
- October 2002-June 2005: Studies identified by stakeholder group and conducted by Finavera

Makah Bay Wave Energy Project

Finavera conducted a number of studies, including the following:

- Current Analysis: magnitude, direction
- Surface Wind and Wave Analysis
- Sediment Analysis: grain size, type, etc.
- Seafloor and Vegetative Mapping
- Literature Review: Marine plant and animal species present in the project area

Makah Bay Wave Energy Project

FERC Environmental Assessment (May 2007) determined potential minor adverse effects on:

- Seabed, benthic organisms, marine fish and mammals, and turbidity during construction
- Fish, marine mammals, and seabirds during operations (e.g., EMF, noise, entanglement, derelict fishing gear and other debris, etc.)
- Long-term loss of small amount of fishing and crabbing grounds within project exclusion zone

Makah Bay Wave Energy Project

Areas where specific information for the EA was less abundant:

- Noise assessments specific to wave energy technologies
- EMF assessments specific to wave energy generation, including unburied submarine transmission lines
- Marine mammal and seabird entanglement and collision with buoys and mooring lines

Makah Bay Wave Energy Project

FERC EA made a number of recommendations for license conditions for the project, including:

- Cable route eelgrass and benthic life surveys
- Buoy noise assessment
- Buoy and transmission cable EMF assessment
- Buoy anti-fouling paint effectiveness assessment
- Marine mammal monitoring (for entanglement)
- Cultural resources monitoring during construction
- Recreational use monitoring (buoy array as a tourist attraction)

Contacts

- Information- http://www.ferc.gov/industries/hydropower.asp (Look for link to "hydrokinetics.")
- Stephen Bowler stephen.bowler@ferc.gov
- Nick Jayjack nicholas.jayjack@ferc.gov

Appendix D

Workshop to Identify Alternative Environmental Information Needs

Biographies for Invited Speakers

Kurt Thomsen
Managing Director, Advanced Offshore Solutions, ApS

Kurt E. Thomsen is a 44 year old construction architect who in 1999 filed a patent application for the first dedicated offshore wind farm installation vessel. Following the patent application he formed the company A2SEA which today is one of the leading installation companies in the offshore wind industry. Kurt E. Thomsen and A2SEA have installed more than 75% of all offshore wind farms in the world and today are the leading repair as well as operations and maintenance companies.

Today A2SEA is an internationally recognized leader in the industry with more than 130 employees and three turbine installation vessels in their fleet. Following the successful development and growth of the company, Kurt E. Thomsen in 2006 decided to leave A2SEA and start up a consultancy company for the offshore wind industry.

Working from his office in Århus, Denmark, he has advised clients such as Cape Wind Associates, DONG Energy, Eon, EWE, Essent Renergys and Vattenfall—companies which are devoted to installing large scale offshore wind farms throughout Europe and the USA. Currently Kurt E. Thomsen is working on five offshore projects and advising on transport and installation logistics for the abovementioned companies.

Steffen Nielsen, Ph.D.
Head of Section, Danish Energy Authority

Master in Environmental Planning 1993 - thesis in technology transfer of wind-power to India – Roskilde University, Denmark.

Ph.D. in Social Science 1999 - thesis in climate change mitigation and environmental sustainable solutions in developing countries, Risoe National Laboratory, UNEP, Rescaled University.
With the Danish Energy Authority since 1998 doing:

- Policy design for renewables in the liberalised electricity marked, e.g. feed-in tariff assessments and preparation of the amendments for the electricity law in Denmark.
- Consent and approval of all offshore wind power in Denmark since the Middelgrunden project 1999.
- Coordinated the Danish environmental monitoring programme for large scale off-shore wind-power at Horns Rev and Nysted.
- Project management of a European Policy Seminar on Offshore Wind Power, producing the "Copenhagen Strategy 2005."
- Chairman for the committee for future offshore wind power development in Denmark, reported 2007.
- Speaker and chair at conferences, seminars, and workshops in Denmark and abroad.

Since 2002, officially appointed examiner at the Department of Environmental, Social and Spatial Change, Roskilde University.

Bob Thresher, Ph.D.
National Renewable Energy Laboratory

Dr. Thresher is the Director of the National Wind Technology Center in Golden, Colorado, a division of the U.S. Department of Energy's National Renewable Energy Laboratory (NREL). He earned a tenured professorship in Mechanical Engineering at Oregon State University where he taught courses in Applied Mechanics and initiated pioneering researcher in the mechanics of Wind Energy Systems during the 1970s and early 80s. He joined NREL in 1984 and has provided leadership for the growth of NREL's wind program from $5MM/year at its inception, to its current level of about $30MM/year. He has published extensively and is recognized internationally as one of the leading experts in research, development, and commercialization of wind technologies. He also serves as a member of the Advisory Panel on Ocean Energy Technologies for the Electric Power Research Institute's. In 2005, Dr. Thresher testified before the U.S. Senate Committee on Energy and Natural Resources on the research and development needed to accelerate the use of Wind and Ocean Technologies on the U.S. OCS.

Michael Hay
Head of Offshore Renewables, British Wind Energy Association

Mr. Hay is Head of Offshore Renewables at the BWEA. He is a graduate of Imperial College London with an MSc in Environmental Technology and Energy Policy where his research project was concerned with the potential role for UK regions in the development of a marine renewables industry. On completion of this work he joined the Renewables Innovation Review Team at the Department for Trade and Industry. This small external group assessed all renewable energy technologies, including wave and tidal stream, and advised Treasury on the allocation of funds in the Governments 2004 Comprehensive Spending Review. In February 2004 Mike joined BWEA in a new position that expanded its hugely successful wind mandate in order to champion the emerging wave and tidal stream energy sector. As well as co-ordinating the interests of BWEA's 117 marine members, Mike also leads the Association's offshore wind work, representing these industries in discussions with Government, offshore stakeholders, and the media.

Rachael Mills
Dept. for Environment, Food and Rural Affairs (DEFRA), United Kingdom

Rachael Mills joined the UK's Department for Environment, Food and Rural Affairs (Defra) in November 1997, spending her first few years in the Department's science group where she led work to develop knowledge transfer practices in the agricultural sector. Her Defra career was largely project management based, and she led some major projects to underpin Government policy. In 2004 she was seconded to the Department for International Development to establish best practice project management techniques within the department and to manage a Programme Office to oversee several cross departmental projects. Rachael took up the post to lead offshore renewable energy licensing within Defra in October 2006. The small team is responsible for implementing an efficient license delivery and management service for offshore renewables. In April this year, the team moved to the Marine and Fisheries Agency (an executive agency of Defra). The Marine and Fisheries Agency operates a network of enforcement, scientific, and administrative staff who carry out a range of statutory duties including enforcing sea fisheries legislation. Rachael has an Honors Degree in Zoology from the University of Liverpool (UK).

Chris Jenner
Technical Director, Renewables, RPS Group Plc

Mr. Jenner is Technical Director with RPS with specific responsibility for the marine renewables business. Chris has over 10 years experience in environmental assessment and management in UK and overseas, more recently he has spent the last 6 years working for the offshore wind industry for a number of Round 1 and Round 2 projects and proposals in U.S. and Canada. Areas of interest include environmental assessment, offshore surveys, geological seabed risk assessment, and consents compliance during construction. Chris was responsible for preparing the Environmental Statements and coordinating surveys for the Gunfleet Sands 1 & 2, London Array, and Lincs projects, peer reviewed the Sheringham Shoals and Walney Offshore Wind submissions, and is currently engaged by E.ON and Lunar Energy to manage the EIA process for future tidal stream energy projects. His current projects include acting as Consents & Environment Manager on behalf of Centrica Renewable Energy Ltd. for the Lynn and Inner Dowsing – the first offshore wind project currently under construction in The Wash.

George Hagerman
Virginia Tech Advanced Research Institute

Mr. Hagerman has over 25 years experience evaluating and optimizing the design, performance, and economics of renewable ocean energy conversion systems, including offshore wind energy, wave power, tidal power, and ocean thermal energy conversion (OTEC). He is a research faculty member at the Virginia Tech Advanced Research Institute in Arlington, Virginia, and Research Director for the newly established Virginia Coastal Energy Research Consortium, a multi-university partnership exploring offshore wind power, hybrid wind-wave power systems, and fuels derived from marine biomass as potential future energy supply alternatives for Virginia. Under the Electric Power Research Institute's collaborative wave energy and tidal stream energy feasibility studies, he was responsible for resource assessment, site characterization, and environmental issue identification in six U.S. states and two Canadian provinces.

Mr. Hagerman has a Master of Science in Marine Sciences and a Bachelor of Science in Zoology, both from the University of North Carolina at Chapel Hill. He has published more than twenty professional papers on ocean energy resources and technologies, has edited ocean energy articles and reports for a variety of non-governmental organizations, and has testified before several Congressional committees on pending ocean energy legislation.

Greg McMurray, Ph.D.
Ocean and Coastal Management Program, Oregon Department of Land Conservation and Development

Dr. McMurray was born and raised in the vicinity of Cleveland, Ohio, where he loved to catch frogs. He attended Ohio University, obtaining his Bachelor's degree in zoology in 1969, and spent his first year thereafter working in fish production for the Ohio Division of Wildlife. With a renewed interest in aquatic ecology, he earned a master's degree in biology (limnology) at the University of Akron, and came to Oregon where he completed his Ph.D. in biological oceanography at Oregon State University in 1977. After a year of postdoctoral research in San Francisco Bay with the U.S. Geological Survey, he spent six years in environmental consulting, involved largely with marine/estuarine environmental baseline assessments in the Misty Fjords National Wilderness Area, southeast Alaska. From 1984 until 1991, he continued work on marine environmental assessments for the Oregon Department of Geology and Mineral Industries, including exploration and biological baseline programs for ocean spreading center hydrothermal sulfide minerals on Gorda Ridge and nearshore placer minerals offshore southern Oregon. Dr. McMurray also spent a brief time as a technical director for Exxon USA's natural resource damage assessment studies in Valdez, Alaska, during 1989. From 1991 until 2004, he was a Principal Environmental Analyst with the Oregon Department of Environmental Quality, working much of that time as the Program Coordinator of the Pacific Northwest Coastal Ecosystems Regional Study (PNCERS), which investigated the relationships of natural versus human forcing in Oregon and Washington estuaries. He is presently the Marine Affairs Coordinator for the Oregon Department of Land Conservation and Development, where his principal duties are to staff the state's Ocean Policy Advisory Council and to facilitate the availability and use of science to inform marine natural resource management issues. Dr. McMurray and his wife, Mary, live on the edge of a swamp in Lake Oswego with their daughter, Lela, and son, Russell, where they all love to listen to the northern chorus frogs.