## European Commission



General Information



Concerted Action for Offshore Wind Energy Deployment (COD)

## PRINCIPAL FINDINGS 2003-2005





This ENERGIE publication is one of a series highlighting the potential for innovative non-nuclear energy technologies to become widely applied and contribute superior services to the citizen. European Commission strategies aim at influencing the scientific and engineering communities, policy makers and key market actors to create, encourage, acquire and apply cleaner, more efficient and more sustainable energy solutions for their own benefit and that of our wider society.

Funded under the European Union's Fifth Framework Programme for Research, Technological Development and Demonstration (RTD), ENERGIE's range of supports cover research, development, demonstration, dissemination, replication and market uptake - the full process of converting new ideas into practical solutions to real needs. Its publications, in print and electronic form, disseminate the results of actions carried out under this and previous Framework Programmes, including former JOULE-THERMIE actions. Jointly managed by Directorates-General XII & XVII, ENERGIE has a total budget of €1042 million over the period 1999 to 2002.

Delivery is organised principally around two Key Actions, *Cleaner Energy Systems, including Renewable Energies, and Economic and Efficient Energy for a Competitive Europe,* within the theme "Energy, Environment and Sustainable Development", supplemented by coordination and cooperative activities of a sectoral and crosssectoral nature. With targets guided by the Kyoto Protocol and associated policies, ENERGIE's integrated activities are focussed on new solutions which yield direct economic and environmental benefits to the energy user, and strengthen European competitive advantage by helping to achieve a position of leadership in the energy technologies of tomorrow. The resulting balanced improvements in energy, environmental and economic performance will help to ensure a sustainable future for Europe's citizens.

> Produced by SenterNovem PO Box 8242, 3503 RE Utrecht www.offshorewindenergy.org

## with the support of the EUROPEAN COMMISSION Directorate-General for Energy DGXVII

### LEGAL NOTICE

Neither the European Commission, nor any person acting on behalf of the Commission, is responsible for the use which might be made of the information contained in this publication. The views given in this publication do not necessarily represent the views of the European Commission.

© European Communities, 2005

Reproduction is authorised provided the source is acknowledged.

Printed in Ireland



# Concerted Action for Offshore Wind Energy Deployment (COD)

PRINCIPAL FINDINGS 2003-2005



# Introduction

The Ministerial Working Group and the Advisory Board (as foreseen in the project proposal for a Concerted action on Offshore wind energy Deployment) have taken note of the draft-findings of the COD projects on

- environment
- planning and consent procedures and
- grid integration

Both the Ministerial Working Group and Advisory Board are of the opinion that COD fulfilled its purpose to collect information and analyse findings from studies in different EU Member States in order to contribute to the establishment of a body of experience in offshore wind energy. Further work may be done to make COD's database more transparent and disseminate information and study results contained in it.

Through COD an exchange of knowledge at energy agency level on national regulatory frameworks has been developed. Apart from exchanging information on major changes within these national frameworks, further work in this respect does not seem necessary. COD's work on grid integration has resulted in a description of the European electricity grid which provides a good starting point for further work in this respect by appropriate institutions in the European electricity field. It is felt that such work should fit within UCTE's and ETSO's long term working program in coordination with the offshore wind energy sector; it should be explored to which extent the possibilities of the Wind Energy Technology Platform (to be established) and the Technology Platform on Electricity Networks of the Future should be utilized to incorporate other relevant stakeholders in this as well. The COD work on the establishment of an environmental body of experience has brought an important overview of the present state of knowledge in this up to now unknown field. It appears that within the present state of biological knowledge it will be possible to find suitable areas for wind farms without substantial adverse environmental impact from offshore wind power on either mammals, birds, fish or benthic communities. It raises the question to what extent strict application of the precautionary principle (inter alia also by assuming worst-case-scenarios) should impede speedy deployment in selected suitable areas of first generation offshore wind farms. Furthermore, the environmental benefits of offshore wind energy must be accounted for in environmental impact assessments. Even though further investigations on possible direct effects are still being implemented there appears, however, some gap to be filled as to our knowledge of biological behavioral characteristics and the scientific approaches of these, especially concerning cumulative effects on a regional level. It is therefore evident that further work on environmental aspects is necessary.

### Legal and administrative issues

COD has provided an interesting overview of national regulatory practices. It appears that there is not enough experience as yet with project developments to arrive at conclusions as to best practices with national consent schemes. Neither does there seem to be a need for harmonized approaches to trigger further or faster development of offshore wind energy activities; these would probably also be out of place in the specific national institutional environment. It appears from the analysis that some countries have based their policies on pre-selected areas for offshore wind developments. Some countries based their decision on such selection on an SEA-like basis.

Further work on this issue does not seem necessary. Co-ordination between Member States is however encouraged, especially beyond the 12 mile zone but also in exchanging information on changes in their regulatory framework through their regular channels.

### **Grid** integration

Main points of concern for the connection of offshore wind farms to the national power systems are transmission bottlenecks, power system stability, offshore transmission infrastructures and grid access, pricing and balancing. Grid integration is also strongly affected by the possibilities for Trans-European power exchange. Apart from a description of the European electricity grid, COD's work on grid integration focused on grid reinforcements, requirements from Grid Codes, aspects related to bundling of cables and the relationship between grid access, prices and balancing. The COD report may provide a good starting point for further international co-operation in this respect by appropriate institutions in the European electricity field, like UCTE's and ETSO and the wind power sector. It should be explored to which extent the possibilities of the Wind Energy Technology Platform (to be established) and the Electricity Networks of the Future Technology Platform could be utilized to incorporate other relevant stakeholders in this work as well.

### Environment

It should be realised that the present knowledge of environmental impacts in the vicinity of offshore windfarms in operation is primarily based on 1-2 years' research in connection with two offshore wind projects. Generalization of results across species and locations should therefore be done with the greatest possible care.

As to marine mammals adverse effects to date had been mainly observed during the construction phase and seem to be less invasive after operation commenced. If no fisheries are allowed within wind farm areas, positive effects may be expected on the abundance of marine mammals.

As to resting birds, present knowledge has to be confirmed and broadened to address the extent of disturbance and dis-place-ment of birds in the vicinity of the turbines. In order to expand the present body of knowledge methodological guidelines will have to developed further. It should, however, be realised that possibilities for standardisation of effect studies are to some extent restricted as birds reactions depend on various factors: location, season, weather conditions, species, natural factors like



food supply etc. Something similar applies to migrating birds. Furthermore the assessment of collision risk during both day and night time is impeded by the lack of fundamental knowledge of the behaviour of birds shown towards wind turbines and wind parks in general for the species in question. Incorporation in future research of aspects like intensity of bird migration, differences during day and night time, seasonal variability, identification of flight patterns and flight behaviour, the influence of specific weather conditions and the total number of offshore wind farms along the flight path are considered important issues. As to the impact on fish it appears that no significant adverse effects from the building and operation of wind turbines has been demonstrated. It is generally believed that wind farm areas may have positive impacts as these may serve as a refugium for fish. There appears to be no common expert opinion on how offshore wind farms effects benthos communities (especially the long term impact on composition of benthic species and communities).

The above findings clearly show that further works needs to be done to fill the knowledge gap. In the interest of standardisation and harmonisation of international research common definitions and approaches will have to be established in EIAs and SEAs (including representative cause-and-effect-chains and identification and assessment of (cumulative) environmental conflicts and their solutions in connection with offshore wind projects).

### Conclusion

A follow-up of COD's work on environmental issues is highly recommended even though substantial negative environmental impact so far has not been demonstrated. Future work should focus on issues related to site selection and issues related to population and habitats and should include the furthering of biological knowledge and methodological development (inter alia on cumulative impact)s. In the mean time development of offshore wind farms in practice will increase the body of knowledge on nature and environment and, consequently, also on possibilities for mitigating measures. Actual development of the first phase of offshore wind farms will thereby contribute to combating climate change, which provided the cause for sustainable energy developments in the first place.

COD Ministerial Working Group

COD Advisory Board

### M.G.M. Verhagen

(Chair and Manager Renewable Energy Unit, Netherlands Ministry of Economic Affairs) **C. Kjaer** (Chair and Policy Director, European Wind Energy Association)

# contents

1	ACKNOWLEDGEMENTS	6
2	OFFSHORE WIND	7
3	COD	8
4	PARALLEL ACTIONS	10
5	GUIDING PRINCIPLES	13
6	<ul> <li>LEGAL AND ADMINISTRATIVE ISSUES</li> <li>6.1 Regulatory Framework</li> <li>6.2 Harmonisation of Regulatory Frameworks?</li> <li>6.3 Streamlining of Procedures</li> <li>6.4 Pre-selection of Suitable Areas</li> </ul>	14
7	GRID ISSUES7.1Country Groupings7.2Grid Reinforcement7.3Grid Codes7.4Common Offshore Cables7.5Grid Access, Pricing and Balancing7.6Trans European Power Exchange	21
8	<ul> <li>ENVIRONMENTAL IMPACTS</li> <li>8.1 Introduction</li> <li>8.2 Environmental Impact Assessment</li> <li>8.3 EIA Experiences</li> <li>8.4 Impacts on Marine Wildlife</li> <li>8.5 Mitigation Measures</li> </ul>	28
	REFERENCES	36



# 1 Acknowledgments

This report has been prepared by the Working Group (WG) of the European-funded project Concerted Action for Offshore Wind Deployment (COD). Contributions and comments have been received by all participants in reaching these findings. Membership of the group, and task leadership, was as follows:

- SenterNovem (Ruud de Bruijne, Leon van der Palen), New Energy Works (Esther Roth): Project Co-ordinator, legal issues and legal reporting [The Netherlands]
- Danish Energy Agency, DEA (Steffen Nielsen, Jørgen Lemming): Dissemination [Denmark]
- Department of Trade and Industry (John Overton), Future Energy Solutions (Mike Payne), Garrad Hassan and Partners (Helen Snodin): Principal Findings Reporting [UK]
- Renewable Energy Information Office (Mark O'Donnell), SWS Group (Ann McCarthy): Dissemination [Ireland]
- Technical University of Berlin (Elke Bruns, Ines Steinhauer): Environmental Database and environmental reporting[Germany]
- Swedish Energy Agency, legal issues (Anders Bjorck, Susann Persson) [Sweden]
- EC Baltic Renewable Energy Centre (Katarzyna Michalowska-Knap) [Poland]
- 3E (Geert Palmers, Achim Woyte): Grid database and grid reporting[Belgium]

### Additional contributions gratefully received from:

#### **MINISTERIAL WORKING GROUP**

Mr. Michel Verhagen (chair)	Ministry of Economic Affairs, The Netherlands
Mr. Magnus Blumer	Ministry of Industry, Employment and Communications, Sweden
Mr. Arthur Kawicki	Ministry of environment, Poland
Mr. Martin Finucane	The Department of Communications, Marine and Natural Resources, Ireland
Mr. John Overton	DTI, Sustainable energy policy
Mr. Peter Helmer Steen	Ministry of Economic and Business Affairs, Denmark
Mr. Joachim Kutscher	Forschungszentrum Juelich GmbH, Germany
Ms. Cornelia Viertl	Ministry of Environment, Germany
Ms Cathy Plasman	Ministry of the North Sea, Belgium

#### **ADVISORY BOARD**

Mr Christian Kjaer (Chairman)	European Wind Energy Association
Ms Sytske van den Akker	Seas at Risk
Mr Karel Derveaux	EUREC Agency
Mr Urban Keussen	European Transmission System Operators
Mr Ruud van Leeuwen	Greenpeace International
Mr Stephan Singer	World Wildlife Fund, European Policy Office
Mr. Peter Goldman	IEA wind energy Implementing Agreement (DOE)



# 2 Offshore Wind

Member States of the EU-25 are committed to reaching renewable energy targets set in the Renewables Directive, and some have set themselves even more ambitious targets. Environmental imperatives to develop clean, sustainable energy sources are being translated into political, social and economic imperatives for deployable technologies. Of all renewables, onshore wind energy is the most proven and cost-effective at present. Onshore wind has shown what is possible for a new technology. At the same time, some important lessons have been learnt which are already proving valuable for other renewables.

It is widely recognised that a mix of renewables will be required to meet mainstream energy needs, and to provide the benefits of diversity. Offshore wind has the potential to provide substantial amounts of energy, and is, after onshore wind, the nearest to market renewable energy source. Projects are already generating appreciable amounts of energy, realising the enhanced offshore resource.

As with any new technology, there are challenges to be overcome, but the benefits of harnessing wind at sea are already firmly established at all levels. Statements from the European Union, national governments and environmental pressure groups make it clear that the need for offshore wind is not disputed. Rather, there is an appetite for overcoming its challenges. Many of these challenges are shared across projects and national borders.



# 3 COD

The Concerted Action for the Deployment of Offshore Wind Energy (COD) project was initiated in 2002, with the objective of "speed[ing] up the environmentally responsible implementation of offshore wind energy in the European Union by an early identification and possibly removing of non-technical barriers: legal, administrative, policy, environmental and grid infrastructure planning issues".

The project drew on the fact that countries promoting offshore wind shared a common goal – an aspiration for the successful and timely deployment of offshore wind – which brought with it shared challenges in realising this aspiration. It recognised that there is a great deal to be gained from sharing experiences and results on a European-wide basis.

COD's ultimate aim was to produce European guidelines on the deployment of offshore wind that would draw on best practice established in the course of the project. Work leading up to the guidelines included collation from COD member countries of the existing knowledge base on environmental, grid and legal / administrative issues. This included guidelines, reports, assessments and data.

The resulting COD resources comprise:

- a database of documents reporting on the environmental effects of offshore wind farms [22]
- a review of the situation with regard to grid integration in COD member countries [23]
- a database of administrative / legal procedures in place [24]

It is already evident that the information gathering and sharing activities under COD have been positive and helpful. Stakeholders appreciate the ready access to up-to-date information on impacts and their mitigation. There is support for continuation of COD databases beyond the end of the present COD project.

On collating available information, it is apparent that those involved in offshore wind are part of an ongoing process of building experience in managing the development and process from consents through to construction and operation. Experience from onshore wind and from the offshore construction and energy sectors has been helpful, but in many ways offshore wind is distinct, and in many areas it is difficult to be absolutely certain on the best practices to adopt. The emphasis then has been on careful management, monitoring and mitigation where potential impacts have been pre-identified.

Administrations are keen to offer streamlined consenting procedures, but often have been working within existing legislative and institutional structures. It is only recently that purpose-designed procedures are beginning to emerge.

In drawing up these guidelines, participants have been conscious of the body of work already in existence, and of the natural differences in approach between different jurisdictions. Some basic principles were agreed from the outset, as follows:

- Offshore wind is in the relatively early phases of deployment. Commercial-scale offshore wind farms are few in number, and young in age. As a consequence, clear evidence of impacts, and better or worse practices, is limited. It is therefore premature in many respects to judge best practice from its outcomes.
- A number of countries are pressing ahead with offshore wind programmes. In order to do so, consenting and EIA practices are developing in parallel. Guidance which is issued in the wake of these events may not be considered helpful and could even pose a barrier should national activities be delayed in order to comply with European-wide guidelines.
- There is already European-wide EIA guidance in the EIA Directive
- There is already a body of work which catalogues potential impacts of offshore wind [1, 2, 3]. COD recognises that this is an important step in approaching an EIA, and does not wish to replicate similar work in these guidelines. The emphasis here is on guidance, where it can be given, to approach and overcome challenges.

The need for guidelines has thus been couched by COD in terms which recognise the stage of the industry, existing work underway and differences between Member States. The focus is very much on facilitating practices applicable across Europe.

Looking back, it is important that wherever possible, offshore wind can draw on experiences both within and outside the wind energy industry, in order to avoid any repetition of earlier mistakes. Looking forward, experiences in wind energy moving offshore will also to an extent set the scene for other marine renewables such as wave and tidal energies, and there will be shared lessons of mutual benefit.



# **4** Parallel Actions

The COD project was initiated by the project partners in Spring 2002. In the course of COD, a number of other complimentary activities have progressed the development of policy in support of offshore wind energy at the European level.

In March 2002, Ministers of States bordering the North Sea met for the fifth time in Bergen, Norway, to promote concerted political action on management of the North Sea environment [4]. The "Bergen Declaration" [5] included a chapter on the "Promotion of Renewable Energy." It states that:

"The Ministers welcome the development of renewable energy, inter alia, offshore wind energy, that has the potential to make a significant contribution to tackling the problems of climate change. They agree to take action in order to exploit this potential fully and safely, taking into account the global and European commitments linked to the Kyoto Protocol."

In realising this potential, the Declaration calls for guidance on areas suitable for development of offshore wind, taking into account *"local wind conditions, ecological importance, shipping, the possibility of connections to national electricity grids and other users of the North Sea."* 

Ministers agreed that "offshore wind energy parks should be developed taking account of environmental impact data and monitoring information as it emerges and taking account of exchange of information and experience provided through the spatial planning process." They noted, given its early stage of development, the opportunity to apply the precautionary principle to offshore wind, and the potential for the SEA process to result in an evaluation of both cumulative impacts and positive climate change benefits.

The COD project seeks to further a number of the aspirations set out in the Bergen convention through specific tasks on the environment and grid connection, and through an emphasis on sharing experiences gained through the permitting process.

The OSPAR Commission for the protection of the marine environment of the North East Atlantic facilitates joint action on combating pollution, and promoting sustainable development of, the North East Atlantic. It is governed by the 1992 OSPAR Convention, which has been signed and ratified by all of the Contracting Parties to preceding Oslo and Paris Conventions

OSPAR has latterly undertaken work on offshore wind energy under its strategy for non-polluting human activities. To-date it has published guidance on common aspects of assessment of offshore wind applications [1], and a summary of potential impacts and benefits, and knowledge gaps (which recognises that although effects can be identified, whether they are significant enough to be labelled an impact requires further investigation) [2]. OSPAR states in [1] that "wind energy can contribute considerably to the national goals of  $CO_2$  reduction and seems indispensable....As a consequence, the use of wind energy is expanding in Europe, which includes making use of offshore wind energy potential. While, on the one hand, avoiding  $CO_2$  emissions by means of the use of wind turbines is welcome, the construction of wind farms at sea requires consideration and mitigation of the impacts that such installations may have on the marine environment."



In September 2004, as part of its presidency of the EU, the Netherlands hosted a Policy Workshop on offshore wind. The resulting agreed declaration states that:

"The development of Offshore Wind Energy is important in the light of Kyoto objectives on CO<sub>2</sub> reductions and also in the transition towards renewable energy resources and for security of supply (including reduction on import dependency). Furthermore, it will contribute significantly to the Lisbon strategy and EU objectives on technological development, exports, employment and regional development. Consequently, large scale development of offshore wind energy has unmistakably big advantages [6]."

Commenting on the conference declaration, the EU Council of Energy Ministers [7] agreed that:

"Taking into account the large potential of wind energy, and notably offshore wind energy in the EU, the statements and recommendations of the recent EU Policy Workshop Development of Offshore Wind Energy in Egmond, the Netherlands, are worth noting. These recommendations refer to specific actions on market development, environment, grid integration..."

The Ministers went on to welcome the follow-up 2005 offshore wind energy conference in Copenhagen.

In March 2004 Greenpeace published "SeaWind Europe" [8], which examines the ramifications – environmental, technical, social and economic – of offshore wind providing 30% of the EU's electricity. While ambitious, it shows what could be possible with the vision and ambition to develop renewable energy on such a scale. Greenpeace says that "success on this scale would not only deliver enormous environmental benefits from this clean, safe energy source, but would also generate an economic boom in Europe worth hundreds of billions of euros and create up to 3 million jobs."

A year later, Greenpeace published "Offshore Wind. Implementing a New Powerhouse for Europe" [9], which examines in detail environmental and grid integration challenges presented by the development of a large amount of offshore wind in European seas. In it, Greenpeace states that "Offshore wind is one of the most important technologies in the switch from fossil and nuclear fuels to clean, renewable energy source....Moreover, offshore wind power is essential to achieve the CO<sub>2</sub> emissions reduction targets of the European countries and their individual member states, which came into force along with the Kyoto protocol. It has the potential to become an essential part of global electricity supply."

In its policy briefing for the G8 world leaders meeting at Gleneagles [10], WWF International says that "in comparison to the \$150 to 200 billion/year spent on fossil fuel subsidies, renewable energy development continues to receive far less funding and policy support than is warranted." It goes on to support a global target of 12% of electricity from wind energy by 2020 (the WindForce 12 target [11]).

On the interaction between wind energy and the environment, WWF International states that: "Even though the construction and operation of wind turbines does have an impact on the natural



environment - for instance through its visual appearance in the landscape, or some bird kill by turning rotors - WWF argues that these impacts need to be seen in relation to the impacts and environmental damages caused by the use of conventional energy sources." [12]

At the same time as these European and international activities, nation states have been developing their own consent procedures for offshore wind energy, and addressing issues arising from its development, in particular environmental and social effects, and grid system integration. It is experience and lessons from these national activities which is the focus for COD – collating and sharing the wealth of information which has amassed to-date, and promoting the ongoing benefits of mutual learning and shared challenges.



# **5 Guiding Principles**

Some over-riding principles can be established which guide the approach to more detailed matters. These are:

### Information sharing

The benefits of information sharing are agreed. It is considered helpful to:

- Maintain and promote databases of readily-available information, and provision of abstract information in English.
- Provide support for internships for capacity building in government agencies
- Monitor and review progress

### **The Precautionary Principle**

In an environment context, the precautionary principle advocates that where impacts are unknown, but potentially damaging, the decision on whether to proceed or not should be weighted in favour of protection of the environment – that is, to not risk irreversible damage. This is often quoted as a need to curb development where environmental impacts are unknown.

In the case of offshore wind, and other environmental technologies, environmental impacts will arise as a result of a decision to proceed and as a result of a decision not to proceed. There may be uncertain local impacts of a development, and certain impacts of a failure to mitigate global impacts of energy use. The precautionary principle in this case then is not to advocate no development in the face of uncertainty. Rather it is to ensure that responsible action is taken against climate change, and that development which is necessary as a result, is undertaken responsibly.

### **Openness**

It is very desirable to engender a culture of honesty and openness with the public and locally affected communities. A feeling of disenfranchisement can lead to suspicion, which is not helpful. Good practice is indisputably keeping communities informed throughout the development process.

## Flexibility for best practice to evolve

Guidelines should be flexible enough to be adapted to reflect a fluid situation on best practice.

# 6 Legal & Administrative Issues

An obvious barrier to the realisation of offshore wind is the absence of a legal route by which a facility is granted permission for construction. Where legislation is in place, it may not be ideally suited to a new technology such as offshore wind energy. Driven by an immediate need, procedures in a number of countries have progressed over the last few years, such that the situation now is rather more developed than at the inception of the COD project. There was a perception that harmonised procedures might be desirable, but it has become clear that the benefits or otherwise of harmonisation are outweighed by an imperative to have useable, streamlined and transparent consent procedures.

As projects move further offshore and increasingly begin to occupy EEZ areas, projects will increasingly come to the attention of more than one member state. There are already procedures in place to cover environmental impacts in more than one country, but projects physically located in a number of jurisdictions need to secure separate planning permissions. The extent to which this is a barrier is not yet apparent.

Member States (MS) are obliged to reduce the regulatory and legislative framework for authorisation procedures according to EC Directive 2001/77 [13], which says that:

"Member States or the competent bodies appointed by the Member States shall evaluate the existing legislative and regulatory framework with regard to authorisation procedures or the other procedures laid down in Article 4 of Directive 96/92/EC, which are applicable to production plants for electricity produced from renewable energy sources, with a view to:

- reducing the regulatory and non-regulatory barriers to the increase in electricity production from renewable energy sources,
- streamlining and expediting procedures at the appropriate administrative level, and
- ensuring that the rules are objective, transparent and non-discriminatory, and take fully into account the particularities of the various renewable energy source technologies"

A number of projects have reviewed the status and development of legal procedures [14, 16]. For the European Commission, The 2002 SEALEGAL report details international, European and national legislation relevant to planning and constructing offshore wind plant. This was intended in part as a guide for developers in navigating the sometimes complex procedures involved. To illustrate the pace of development, just 3 years later some of the national material has already been superseded by new legislation.

The COD project has reviewed current legal and administrative procedures in represented countries, and commented on the rationale for any recent changes. This can be viewed as an update to the SEALEGAL commentary. In order to be of ongoing relevance, it is essential to keep this information upto-date. The detail of this review can be found in the COD final report.

Having reviewed the status of legislative procedures, COD has gone on to consider what might be learnt from experience to-date. Procedures are largely in their formative stages, with long-term outcomes yet to be seen. Moreover, different administrations will vary in their objectives and the way in which "success" is judged. Thus, without pre-judging desirable outcomes, COD is seeking to draw together observations by way of informing the future development of new procedures and refinement of existing legislation.

Four main themes emerged from a summary and comparison of legal and administrative practices in the eight COD countries:

- The regulatory framework: managing and processing wind farm applications
- Harmonisation of regulatory frameworks
- Streamlining of procedures;
- Pre-selection of areas suitable for offshore wind energy deployment.

## 6.1 Regulatory Framework

Consent procedures in place tend to reflect existing MS legal frameworks, and for the most part remain subject to ongoing refinement. Changes are driven by a "learning by doing" approach, an urge to improve or streamline existing procedures, or a need to develop a proprietary regime specifically for offshore wind.

Differences between MS – maritime heritage, regulatory practices and other factors – all contribute to differences in consent regimes. Nonetheless one can observe that development activity is stimulated where a framework is implemented.

The development path of offshore wind can be thought of as a filtering process of initial interest in offshore wind which spans a wide spectrum of both potential sites and developers, to an eventual smaller core of projects which are consented. All regimes share this general characteristic, but within this there are a number of differences.

In filtering sites, an option is to pre-select suitable areas.

In filtering developers, an option is to set minimum criteria for participation.

In filtering developers with sites, two broad types of mechanism can be defined: a tender system and an open 'first come first served' system.

Some factual data outlining the characteristics of regimes in each COD country are presented in the table following.

	Leading principle: tender or first come first served (FCFS)?	Pre-selection of areas	ls SEA performed?	Assessment financial standing applicants	Does applicant get exclusive rights to area prior to permits? And when?	Number of new applications	Issued permits, but not yet built or under construction:	Offshore wind farms built or under construction (MW)
Jnited Kingdom	Tender	Yes	No, but pre- selection based on SEA-like principles	Yes	Yes	Round 2: 11 applications	12 (Round 1) and 12 licences to investigate for	Blyth (3,8 MW) North Hoyle (60 MW) Scroby Sands (60 MW)
Denmark	Tender	Yes	ž	Yes	Yes as soon as the winner of the tender is found, exclusive rights to preliminary surveys and depending on the EIA-procedure and public hearing - also exclusive rights to the area are granted.	2 new tenders (Horns Rev 200 MW + Rodsand 200MW)		Vindeby (5MW) Tuno Knobs (5MW) Mittelgrunden (40 MW) Horns Rev (160 MW) Frederikshaven (10,6 MW) Samso (23 MW) Nysted (158 MW)
The Netherlands	FCFS	Ž	2	°N	Yes, as soon as complete applicatioon and approved EIA - report is delivered	57	2 (NSW and Q7)	Construction of NSW (108 MW) started, to be completed in 2006.
reland	FCFS	Ŷ	Ž	Yes	9Z	Codling Bank, Bray and Kish Banks (to be expected)	1 (Sure Partners, 520 MW)	Arklow Banks (25 MW)
Selgium	Tender (application for competition)	Yes	Ž	Yes	Yes	9 (according to MUMM)	Seanergy: Viakte van de Raan (has all permits, but will not be built). C-Power II: Thornton Bank	
Sweden	FCFS	Yes	2	Yes	Ŷ	2: Karskronavind (Vattenfall in Kalmarsund) and Kriegers flak	3 (Lillgrund and Utgrunden and Klasarden)	Bockstigen (2,5 MW) Utgrunden (10 MW) Yttre Stengrund (10 MW)
Germany	FCFS	Not yet, but formal procedure still in progress (finished approx. in 2005)	Yes (due to changes in legislation in June 2005)	Ŷ	Ŷ	33 (27 North Sea, 6 Ballic Sea)	10 in (EEZ)	Construction of (Borkum West project starts in 2007/2008
boland	Consent regime under construction	Ŷ	Ž	No	Ŷ	0	0	0



FINAL REPORT

As stated above, new or purposely modified consent regimes for offshore wind lead to development activity. There are however some important differences in the stage at which development interest attenuates to a manageable, realistic level.

A tender process, whereby developers compete for something which is in limited supply – a suitable site or a power purchase contract – seeks to select suitable development parties at a relatively early stage in the process. A "first come first served" approach allows a large number of developers the opportunity to move further into the process before projects are selected through the planning system.

The former approach means that the consenting authorities see potentially fewer applications from developers who have been pre-filtered variously on criteria including financial standing, technical expertise and experience in offshore development. The latter approach means that developers compete on the speed with which they can deliver an acceptable planning application – developers need to commit much more before being awarded any rights, and potentially this is a strong incentive to separate out serious players. But if accompanied by an attractive market, authorities can be overwhelmed by applications, and the focus tends to be on achieving consent, rather than project build.

The above commentary is only relevant to regimes which have a market-based mechanism for implementing offshore wind. A number of early projects in Denmark and Sweden were implemented as demonstration projects, and not under open-market conditions.

There are still rather few realised projects developed as a commercial concern, in an open market. In fact this only applies to projects in the UK, which has pioneered commercial developments, learning a great deal from earlier demonstration projects in other countries.

The UK has operated a tender-type system for rights to develop projects. Generally speaking, and without wishing to judge one system over another, one can observe that a tendering system has some advantages for the consenting authority, principally that it allows prior knowledge, and thus planning for, the number of applications likely to be received. The main advantage for government is that it can prescribe specific criteria which allow it to rank applications or developers on the basis of criteria it considers to be important, thus improving the chances of achieving its objectives.

Observation: requirements for acquiring concessions or licenses to deploy offshore wind energy are basically the same in all countries involved – determined in large part by European law on environmental assessment. However, it is not the amount of information applicants have to deliver, but rather what, and when, which can create a threshold for intending developers. In particular, investigative work looks expensive prior to allocation of development rights.

Observation: Gathering of information means making investments, which is weighed against the benefits of receiving some form of exclusive rights. Granting of exclusive rights at an early stage reduces risks to investments at the development stage.



Conclusion: each consent regime leads to some activity, whether in receipt of concession or planning applications, or even in actual deployment of offshore wind energy. There is too little experience in the COD-countries to draw any conclusions if one consent regime performs better than another. Indeed, diversity could be viewed by some as spreading the risk of imperfections in each approach.

Recommendation: competent authorities should specify clearly information and other requirements.

## 6.2 Harmonisation of Regulatory Frameworks?

On legislation and consent regimes, the Background Document of the Policy Workshop in Egmond aan Zee (2004) observes that existing procedures are based on national legal frameworks. It goes on to say that harmonisation may not be necessary for EU-wide deployment.

COD also notes that there have been no prominent calls for harmonisation on a European or bilateral basis. However, nations and their energy agencies do exchange information on their consent regimes and their experiences, and find this to be beneficial

Looking to the future, offshore wind farms are likely to be larger and further offshore, increasing the prospect of projects spanning two or more jurisdictions. This could lead to a desire for some harmonisation or, at least, co-ordination between respective authorities.

Conclusion: for the COD-countries' authorities, no need, request or tendency to harmonise consent regimes or legal frameworks between nations can be recognised. On the other hand, harmonisations in itself is not necessary to trigger the development of offshore wind energy activities.

Recommendation: in order not to delay the implementation of cross-border projects, anticipate the need for a transnational development strategy, aiming to tune and co-ordinate procedures across adjacent jurisdictions. The intention is not necessarily to form one strategy, but to ensure that national differences are not obstructive.

Recommendation: the exchange of knowledge of regulatory frameworks, consent regimes and procedures based on evaluation and experiences with applying these, should continue in the future.

## 6.3 Streamlining of Procedures

As noted earlier and also in the Background Document for the Egmond aan Zee policy workshop, EU MS are obliged under the Renewables Directive 2001/77 to "evaluate the existing legislative and regulatory framework....with a view to reducing the regulatory and non-regulatory barriers to the

increase in electricity production from renewable energy sources, streamlining and expediting procedures....and ensuring that rules are objective, transparent and non-discriminatory...."

As concluded earlier, existing procedures are based on national legal frameworks, and to-date no tendency to harmonise procedure can be recognised.

Intending developers of offshore wind farms generally require multiple permits. A so-called "one stop shop" offers one main point of contact, the main competent authority involved, who has efficient and effective communications lines with other relevant authorities. The one-stop-shop is mandated to make decisions, informed by opinions from experts on the subjects of, for instance, legal issues, or environmental impacts. This is regarded as "streamlining" procedures and to some extent as a way to expedite these procedures.

The exact interpretation of "streamlining" in the EC Renewables Directive is not yet defined, but a onestop-shop would appear to qualify, and certainly seems desirable. When evaluating whether MS's have met this part of the Directive, evaluation criteria could include:

- Reduction in development lead times;
- Consent of high quality projects;
- Reducing the cost of gaining permits;
- Reducing the cost of issuing permits.

It goes beyond the COD project to judge whether member states ensure that the rules within their consent regime are objective, transparent and non-discriminatory.

As recommended earlier, evaluation and comparison of consent regimes and experiences, leads to valuable knowledge that is already being exchanged.

Some of the COD-countries have gained experience with permitting offshore wind, and even altered authorisation procedures based on these experiences. It is premature to evaluate the outcome of these and future actions, and specifically whether there is a reduction of regulatory and non-regulatory barriers to increases in renewable electricity production.

Conclusion: the United Kingdom, The Netherlands, Denmark and Ireland all apply a one stop shop system.

Observation: the idea to streamline procedures originated from the perception that these procedures pose a bottleneck. Many countries have taken early action in this respect, and the question arises whether, in these cases, consent regimes remain a bottleneck for the (fast) development of offshore wind energy.

Recommendation: the definition of streamlining and expediting of procedures should be made more precise, for example via determination of specific, measurable, acceptable, realistic and time related goals at which authorities can aim for, evaluate and improve.



## 6.4 Pre-selection of Suitable Areas

Some of the COD countries have made a pre-selection of preferred areas for offshore wind energy development. Although only named as such in the UK, this can be considered an activity that would be akin to a Strategic Environment Assessment (SEA). An SEA gives both authorities and applicants the opportunity to assess cumulative environmental consequences and benefits of a programme for offshore wind, and to identify at an early stage mitigatory action. Furthermore, performing an SEA gives a better indication of what topics need to be addressed in detail in the applicants' Environmental Impact Assessments (EIA).

The SEA EC-Directive [17] obliges MS to perform an SEA for the approval of plans or programmes such as offshore wind energy development. It would seem that an SEA-type activities for offshore wind have already yielded advantages, and thus it should be in MS interests to comply with this Directive. Also, in line with the earlier recommendation on co-ordination between adjacent jurisdictions for crossborder projects, the same recommendation would apply to co-operation on SEA activities.

Conclusion: some of the countries have pre-selected preferred areas for offshore wind energy development, and some even on an SEA-like basis.

Recommendation: perform an SEA in order to identify and assess (cumulative) environmental conflicts and their solutions, and to give better insight in the topics that need detailed consideration in project related EIA's. Authorities could consider doing this on a transnational ofr international level.



# 7 Grid Issues

Barriers affecting the connection of offshore wind farms to the national power systems are one major topic of the COD project. The main areas of emphasis are transmission bottlenecks, power system stability (and grid code requirements which seek to address this), offshore cable connections, grid access, energy pricing, and aspects of Trans-European power exchange.

In most of the participating countries, some or all of these subjects have been studied by government bodies or transmission system operators (TSOs). These studies from the eight participating countries have been reviewed by COD, with a focus on the relevant grid issues. The results of this review can be found, country by country, in the final COD report.

From these country summaries, it is possible to group countries by shared grid-related characteristics. COD has then gone on to make conclusions and recommendations to support the removal of grid as a barrier to offshore wind deployment. While actions required are for the most part similar across Europe, the emphasis and approach will vary according to the technical characteristics of the grid system, as well as political and market oversight of grid access and pricing.

## 7.1 Country Groupings

From the analysis of information from the eight countries a number of issues can be identified that are common to several of these countries. Depending on the geographical situation or historically evolved grid topologies, countries can be clustered according to the synchronous zone to which their power system belongs. These clusters of countries correspond to a large extent to the regions between which there is limited mutual exchange capacity, as indicated by the priority axes of the European TEN-E action [18].

### **Central and Western Europe**

Belgium, the Netherlands, Germany, Poland and the western part of Denmark make part of the UCTE grid. This grid is highly meshed and contains a large traditional generation capacity providing high short-circuit power. The grid is very stiff. Therefore, the impact of offshore wind power on the grid frequency is generally not considered a problem. In addition, the problem of voltage control is considered minor if in the future wind turbines with reactive power control and voltage ride through capabilities are applied.

With exception of the coast of Holland, the coastal areas in Central and Western Europe are rural. Industrial areas are typically situated inside the country. Therefore, in these countries, energy from offshore wind farms will have to be transported to the load centres. On its way through the transmission system this power often has to compete for transmission capacity with power imported from abroad or on transit.



Power injection from offshore wind farms in these countries is limited by the availability of large substations in the coastal regions and by the transmission capacity to the load centres. The necessary grid reinforcements in Germany, the Netherlands and Belgium have already been identified. Adequate grid reinforcements are under consideration, including innovative approaches such as long high-voltage DC cables to form an overlay grid onshore. The main uncertainty for offshore wind energy is the timing of these reinforcements. In particular, the permitting procedure for 400-kV overhead lines can be very protracted, and uncertain. In this situation, TSOs will initiate the required major grid reinforcements only when substantial applications for grid reinforcement have been filed. On the other hand, project developers will make considerable investments only when the grid connection of a wind farm at the time of commissioning can be guaranteed.

### The British Isles

The power systems of the islands of Ireland and Great Britain each form a separate synchronous zone connected to each other, and to continental Europe, only by weak high-voltage DC links. Therefore, an issue for the grid integration of large wind farms (on- and offshore) is power system stability. As such, in Ireland and the UK, large wind farms are now required to participate in primary (frequency) control, at least in situations where the power system stability is threatened. Moreover, reactive power control and voltage ride through capabilities are specified in grid codes.

In Ireland and the UK grid bottlenecks are also considered an obstacle to offshore wind energy. There is now a transparent process by which new transmission capacity can be built in response to the development of new generation projects, without (as a rule) requiring political intervention. The costs for these reinforcements are not considered an obstacle for wind generation if viewed in the context of total power system costs, although where costs allocated to a particular region or group of projects, grid reinforcements can become a barrier. It is likely that the grid connection of some offshore wind farms could be delayed (or prevented, if planning permission is not granted) because of the time required to obtain permissions and construct new transmission capacity. Squaring the circle of providing investment guarantees for transmission capacity, prior to knowledge on which offshore wind projects will proceed is also a source of delay for initiating work on reinforcements.

### Scandinavia

The Danish power system is split into two synchronous zones. In times of low load offshore wind farms connected to the transmission system in the western part of the country together with wind energy onshore add to the power generation in the north of Germany. Power from offshore wind farms connected to the transmission system in the eastern part is injected into the Nordel synchronous zone. The Nordel synchronous zone is characterized by a large amount of hydro power. Hydro power plants can be controlled very fast and they could complement the slower-controllable thermal-dominated generation in the UCTE system. Technically, they could be used to balance fluctuations from wind power in Western Denmark and Northern Germany. However, this is not realised yet practically due to the present settlement model for the power exchange via the high-voltage DC connections between Western Denmark and the Nordel system [19].

In addition, in Sweden offshore wind power will mainly be generated close to the loads, i.e. in the south of the country. Therefore, it has a potential to mitigate congestion of the north south transmission links supplying the south of Sweden with power from the hydro plants in central and northern parts of the country.

Conclusion: a number of issues affecting the grid integration of offshore wind energy have been identified. Some of them are emphasized more or less in different countries depending on characteristic properties of the different power systems. However, most identified issues are in different ways common to all participating countries. These issues are:

- grid reinforcement,
- requirements from grid codes,
- offshore cables,
- grid access, pricing and balancing,
- Trans European power exchange.

Conclusions and recommendations are drawn for each of these issues. Some of these issues have already been addressed in the declaration of the EU policy workshop about the development of offshore wind energy in Egmond aan Zee (Netherlands) in October 2004.

## 7.2 Grid Reinforcement

There is no doubt that considerable grid reinforcements will become necessary in all participating countries in the coming five to ten years, if aspirations for offshore wind energy are to be met. These reinforcements can take 10 to 15 years due to the long lead times for land acquisition and permits. Although the necessary reinforcements have been documented in some countries, no TSO is preparing the necessary reinforcements in practice.

For a developer, a guarantee for consent of a project, and availability of a timely grid connection, are necessary pre-condition to ordering and financially backing substantial grid reinforcements. However, in accordance with national legislation, TSOs will initiate planning procedures for grid reinforcement only when the reinforcement has been ordered by the developer. Reinforcement must be initiated early in the development process, and is subject to uncertainty. Hence, developers and TSOs are caught in an impasse.

Conclusion: The large-scale deployment of offshore wind energy requires grid reinforcement. The longer this is postponed the more the deployment of offshore wind energy will be retarded. In some



cases where a timely grid reinforcement can not be expected, innovative alternatives may be applicable in order to facilitate the grid connection of a wind farm. Such alternatives are dynamic line ratings and high-voltage DC transmission links on shore.

Recommendation: the need to provide early funds for strategic infrastructure is not new, and has previously simply been funded by governments. Under the now liberalised market frameworks, governments should consider ways of removing the impasse between TSOs and developers. Approaches which have been considered and / or used in MS include: government backing "at risk" investment made by TSOs until such time as it is utilised; use of European funds to provide strategic infrastructure; sharing investment risk across electricity market participants.

## 7.3 Grid Codes

Grid codes list the power system operators' requirements for grid connection of plant to the transmission or distribution system – with different requirements and / or parameters for each. Large offshore wind farms will tend to connect increasingly to the transmission system, as opposed to typical European onshore wind farms which tend to be distributed plant.

In all participating countries there is a general trend towards the requirement of active control of large wind farms within the boundaries of the legal frameworks: the wind farm has to contribute actively to the stability of the power system. In detail, the requirements in the different countries differ significantly regarding the specified set-points for the various control actions, and also in terms of the required capabilities.

Active control typically includes the possibility for the TSO to curtail the wind farm's power output when the grid stability is at risk. This possibility can interfere with the requirement for priority dispatch of electricity from renewable sources, but can also result in more efficient use of existing infrastructure. Since the curtailment of wind farm output power should affect only small amounts of energy, this conflict of interest can probably be solved relatively easily either on a contractual or on a regulatory basis.

Recommendation: curtailment of wind farm output should not be seen as a barrier to priority despatch. As it has zero fuel costs, wind energy plant should be curtailed only when necessary for stability of the system.

Recommendation: The set points required by a TSO typically reflect the circumstances in a given power system. Wind turbine manufacturers find it difficult to adapt the control capabilities of their machines to a number of different sets of requirements in different countries. Therefore, the required control capabilities for large wind farms should be harmonized all over Europe while the specific set-points should also in future be determined by the TSO responsible for the specific power system.



## 7.4 Common Offshore Cables

Studies carried out in different countries show that bundling of offshore cables from several wind farms offshore is beneficial. A multitude of cables crossing the coastal areas and dykes can negatively affect the ecosystem and deteriorate the protection of the coast line. In contrast, the connection of several wind farms via a common cable to the connection point onshore contributes to streamlining the procedure for grid connection. Via such a common cable connection the effective grid connection point would likely be situated offshore. In some cases, the bundling of offshore cables can save costs. However, the cost reduction due to bundling of offshore cables should not be overestimated.

Although these advantages are well known, offshore transmission cables from different wind farms are currently not bundled. Although it has been considered, discussions tend to be mired in commercial and regulatory issues. There is a lack of true strategic planning or legal provisions to impose planning of offshore transmission infrastructures in the different countries.

Finally, the bundling of offshore wind farms would lead to radial offshore grid infrastructures. These would be spatially limited in the beginning but they could become the initial nodes of an international offshore grid to emerge by stepwise interconnection.

Recommendation: In order to kick off the development of common infrastructure, its facilitation should be considered in the national and international regulatory framework.

## 7.5 Grid Access, Pricing and Balancing

According to Article 7 of the European RES-E directive [13], electricity from renewable sources may receive priority access to the power system, and priority dispatch insofar as the operation of the national power system permits. Respective laws have been introduced in most participating countries; however, the implementation of these requirements into national law is different in each country.

In practice, the decisive factor, besides the physical access to the grid, is the price for electricity from renewable sources on the electricity markets. Priority access is only useful when market parties are willing (or forced by law) to buy electricity from renewable sources at sufficiently high prices.

Especially in countries where renewables are supported via tradable certificates, the revenues for electricity from wind energy depend firstly on the market price for the tradable certificate and secondly on the market value of the remaining brown energy. The certificate value is typically limited by the penalty for unfulfilled quota obligations, and in some countries also by fixed minimum prices. The value of brown energy is determined by the



conventional market. In countries with fixed feed-in tariffs, revenues are in part or wholly determined by law.

Due to the variability of wind energy, this electricity price can be relatively low, especially in countries where imbalance is penalized. In order to increase the market value of energy from large wind farms, good short-term predictions are necessary, possibly in combination with concepts of adapted demand control, back-up generation or storage.

Conclusion: priority access is useful only when combined with a market for wind energy.

Recommendation: in order to improve the value of wind-generated electricity, short-term forecasting of output should be supported and developed.

## 7.6 Trans European Power Exchange

Historically, interconnections between countries and their power systems where intended for international support in case of contingencies and, to a limited extent, for bilateral trade based on long-term contracts. With the establishment of the internal European electricity market, an increasing fraction of the available capacity is now used for international trade. This latter capacity is mainly traded bilaterally, and not explicitly used for the levelling of power fluctuations introduced by wind energy.

In order to enable wind energy to contribute significantly to power supply all over Europe, the spatial variation of wind power needs to be utilized to the maximum possible extent. Because weather systems can span whole regions at a time, this implies power flows between synchronous zones, and within the UCTE – in particular between the main block and the Southern European countries. To supplement the technical infrastructure, market mechanisms need to be developed enabling international trades as close as possible to real time, to facilitate programmed transfers of wind energy.

Currently transmission capacity between these regions is limited, and it is an objective to reinforce the power system, especially according to a number of priority axes as defined in the European TEN-E action. However, the current version of the TEN-E action sees the importance of cross border transmission capacity for the grid integration of wind energy mainly in the very regions where large increases in wind energy deployment are anticipated. The importance of transcontinental transmission to benefit from the spatial dimensions of meteorological phenomena has not yet been acknowledged.

Transcontinental offshore transmission and overlay grids have been proposed as the most economic measures to increase the share of wind power and other renewable sources that the European power systems can absorb. However, in practice most actors still perceive these concepts as not competitive



solutions onshore in the short and medium-term. Possibly, spatially limited radial offshore grids could form the initial nodes of such a grid.

Recommendation: market mechanisms which allow trades close to real time should be implemented to allow value to be realised from short-term exchanges of wind-generated electricity

Recommendation: an increased amount of cross-border capacity is useful for benefiting, at the European level, from the spatially diverse characteristics of wind farm output. This should be taken into account in the next revision of the TEN-E action



# 8 Environmental Impacts

## 8.1 Introduction

This document aims to improve the consistency of the impact assessment process and to assist decisionmakers in determining applications, and developing appropriate mitigation and monitoring, dependent on the prevailing circumstances. It is recognised that all sites have different environmental characteristics and that, because of this, each site will have its own site specific effects and mitigation. But the more information that is publicised, the better the knowledge basis to draw upon. This in turn will enable environmental management practices to improve. The development of guidelines also enables decisions at the strategic level to be cognisant of working procedures and issues at the project level.

Another aim is to establish what is already known, and to consider whether definitive statements will help to focus future assessment and monitoring on areas that would yield new results.

To facilitate an overview of environmental assessment work and its outcomes, the COD members submitted relevant written material into a structured database . Material was limited to that which referred directly to offshore wind. The implication is that studies and other documents relating to the marine environment, but not to offshore wind specifically, are not included. This by no way implies a judgement on the relevance of these studies to EIA for offshore wind, it simply reflects the focus of the COD project.

COD findings reported here reflect the database as updated in June/July 2005. At that time it contained more than 280 entries. Further information can be found in the final COD environmental report, and related papers [21].

## 8.2 Environmental Impact Assessment

The main purpose of EIA is to ensure that the impacts of a development or activity are identified and mitigated where possible. The process of EIA has developed considerably over the last few years and there are many guidance documents. The EIA process should commence as early as possible in the planning of a project and should continue into a project's lifetime (i.e. monitoring of operations, if applicable) and decommissioning.

It is not the effects of a development per se, but the significance of effects, which are the focus of impact studies. The process should be transparent and decision makers accountable. Where assumptions have been made based on sparse information, this should be made clear. It is recognised that for the marine environment, there can be a sparsity of baseline information, and that the assessment of environmental implications is also often based on best judgement. Ideally, the prognosis of effects should be based on measurable indicators. However, in the marine environment the availability of quantifiable indicators can be limited. Observation: Judgements will be based on a level of appreciation and experience of the situation, but it is worth reiterating that the assessment of environmental effects is a risk-based approach and that not all effects are predictable.

Cumulative effects can be defined as combinations of offshore wind farm impacts against the background level of already existing adverse impacts, e.g. pollution, fishing, sand and gravel quarrying. Furthermore, additional impacts from the project itself, e.g. increased shipping, should also be considered.

At the same time as pressures caused by human activities, there are also natural cumulative pressures (e.g. naturally poor breeding conditions) which can aggravate living conditions of populations.

Observation: It can be difficult to allocate a specific, observed effect, to a single cause.

Assessment of cumulative effects for multiple wind farm plans at the regional or national level is effectively Strategic Environmental Assessment (SEA). The boundary between project-level cumulative effects and policy-level SEA is not specifically defined, but SEA is designed to come before EIA, and EIA is generally regarded as a more detailed project-level assessment. There is limited experience across Europe in formal application of SEA, but there has been more SEA-like activity.

Recommendation: SEAs should, ideally, cover a large spatial scale, to ensure that all potential effects can be considered. SEA is presently in its infancy, but it may prove useful to have a transnationally approved scheme to detail the information requirements and methods (criteria) to perform an effective SEA on offshore wind exploitation.

Delineation of national and international protection areas at sea can be helpful in considering protection needs in spatial planning procedures. At the same time it is sometimes difficult to gain ready access to this information, or it may be that protected areas are difficult to define where data is lacking.

Conclusion: Spatial planning or, at least, geographical definition of marine interests in coastal zones, is a valuable planning tool. It helps to diminish conflicts between different marine uses at an early stage in the process.

Recommendation: Encouragement should be given to define areas of different marine interests, and to improve the availability of the resulting geographical data.

Recommendation: Consider the value of European-wide SEA assessment criteria and procedures.

## 8.3 EIA Experiences

Offshore wind exploitation is a relatively new type of marine activity, and proven effects will clearly only be known subject to experience. As its development has progressed, it is evident that offshore



wind deployment is considered, or has been, an opportunity to improve knowledge on the marine environment per se, as well as on the specific effects of offshore wind.

The range of subjects investigated in EIAs is similar in each country. But, the depth and duration of investigation of individual subjects differ, due in part to the specific legal consenting requirements in each country.

To-date, knowledge on environ-mental effects has been premised on single case results. There is limited comfort in drawing generic conclusions as yet. This is in part because of site specific differences (e.g. North Sea or Baltic Sea; water depth, structure of sea bed, location to the coast; occurrence of endangered species).

In many countries guidelines on investigation requirements have been issued to standardise methods and assessment approaches. Collating the required environmental data and assessments does not seem to be a major constraint to getting a licence for offshore projects any more.

Fulfilling the precautionary principle (i.e. by assuming worst-case scenarios), investigations of effects on the marine environment may be very comprehensive. Ongoing research, and exchange of information and experiences means that, countries are now building a body of knowledge on environmental effects of offshore wind energy.

The development of criteria and standards for evaluation of impacts is still at the beginning. Results of evaluation differ dependent on the prevailing protection aims or development aims. Validation of criteria still needs more research on the causal interferences of the marine environment and offshore wind facilities.

Recommendation: Progress in knowledge can best be achieved in two ways. First, by implementing offshore wind farms which are subject to careful monitoring of effects. This appears to be the only way to also gain knowledge on large-scale effects and potential cumulative effects. Second, by implementing programmes of investigation into the wider marine environment, to gain a better understanding of the baseline, and of other pressures on the marine environment.

Recommendation: As knowledge improved, authorities could consider reducing both the amount and the nature of the information to be supplied by permit applicants,

Recommendation: as best practice methods emerge, authorities could consider standardising research methods and evaluation criteria.



## 8.4 Impacts on Marine Wildlife

## Marine Mammals

The following table [22] gives an overview on the main potential adverse effects that have been suggested in the context of marine mammals, and evidence to-date on actual effects.

POTENTIAL IMPACT	COD PRELIMINARY RESULTS
Physiological damage leading to direct and indirect loss of individuals (e.g. acute hearing damage due to ramming or pile-driving noise).	No case of direct loss of individuals documented to-date. Impacts of noise and vibration (i.e. during construction) on the mortality or birth rate of marine mammals not yet reported on.
Temporary reduction of habitat size and displacement of species due to construction and maintenance activities.	Monitoring results at Danish Horns Rev Wind farm confirm that during the construction phase, seals and cetaceans avoid the area. Speculation that for instance curiosity might attract seals and cetaceans to the building site, could not be proven. In all sites known as sites frequented by seals or cetaceans, impacts arising from boat movements and the installation of piles have to be assessed.
Permanent reduction of habitat size due to operational noise emissions from the wind farm and other activities.	To what extent wind farms lead to a diminution of suitable habitats is still being discussed. There are observations that marine mammals avoid wind farm areas whereas others observe that after construction marine mammals do not show any change in behaviour. It is still in question whether disturbance by follow-up effects like boat traffic (tourism, maintenance) will have significant long-term effects.
Disturbance of intra-species communications (e.g. masking of communication).	Noise emissions are expected to be at lower frequencies than those used by dolphins and porpoises for echolocation to hunt prey, so they should not be affected.
Barrier effects for migrating animals due to noise emissions during the operational phase, or to electro-magnetic fields.	It is widely agreed that no significant barrier effects for migrating animals are known to date.

Observation: From preliminary Danish monitoring results, it appears that offshore wind farm-induced effects are less severe than might have been anticipated. However, knowledge gaps and uncertainties on cumulative effects from other sea users, suggests that further work and, in the meantime, careful assessment and monitoring, is merited.

Recommendation: it makes sense to as far as possible avoid "hot spots" like densely populated areas or sanctuaries, to reduce potential risks to a minimum.

Recommendation: it is good practice to apply mitigation measures, i.e. reduce noise emissions, avoiding sensitive life cycles, repel marine mammals during construction phase

Recommendation: minimising boat traffic in or around wind farms in sensitive areas should be taken into consideration.



### **Birds**

The table below summarises potential and observed impacts for seabirds and resting birds, and, separately, for migrating birds.

POTENTIAL IMPACT	COD PRELIMINARY RESULTS
SEABIRDS AND RESTING BIRDS Permanent loss of habitats due to displacement (avoidance)	The significance of avoidance behaviour and its follow-up effects depend on the overall availability of suitable areas. Avoidance behaviour is a species-specific topic.
Collisions (bird strike)	The actual number of bird collisions is not known. Those birds showing avoidance have a lower collision risk.
Barrier effects (e.g. fragmentation effects on the ecological habitat net-work, such as breeding or feeding areas)	Compared to migrating birds, sea birds and resting birds seem less at risk, as they may habituate to the wind farm facilities.
<b>MIGRATING BIRDS</b> Collisions (bird strikes): Increased mortality due to collisions of birds with wind turbines.	Accurate numbers of collision victims are not known. They may vary between one and thousands of dead birds/year/turbine. Monitoring results suggest that collision rates are far lower than originally postulated. However, migrating birds are exposed to a higher collision risk. There is a consensus that collisions are likely to be more frequent in poor visibility conditions (e.g. night-time flights).
Avoidance and barrier effect (disturbances at important stopover-sites): Increased consumption of energy reserves during migration due to avoidance reactions, possible loss or impairment of orientation.	The disturbance effect has not yet been quantifiable. Giving reason for deviation of flight routes and obstruction of potential resting areas, offshore wind farms of large extent diminish foraging and resting conditions, which may decrease reproduction rates. The effect of diminishing unaffected areas has to be seen in the context of the overall intense use.

In Denmark (Baltic Sea) and Germany (North Sea and Baltic Sea) studies have helped to identify "hot spots" of migration routes. However delineation of bird migration routes remains problematic, because changing flight conditions (wind, visibility, day or night) lead to varying behaviour and hence routes

To-date, the effects of any habitat loss and barriers are not measurable. For sea-birds, approaches like a sensitivity index would help to avoid highly sensitive areas. It is agreed that detection and measurement of collision requires improvement.

Recommendation: the assessment of cumulative effects on bird populations is a high priority. European-level co-operation on the assessment of consecutive impacts along bird migration routes would be beneficial.

Recommendation: approaches to quantify collision risks by modelling and monitoring need further work. It seems beneficial that investigation and evaluation approaches should be harmonised to facilitate comparison of results.

Recommendation: besides spatial approaches (delineation of sensitive areas), the development of models could assist in predicting the effects due to habitat loss and change.

## **Benthos**

The table below summarises the present status for benthos.

POTENTIAL IMPACT	COD PRELIMINARY RESULTS
Change of species composition / loss of (protected) species due to the introduction of artificial substrates.	According to Danish monitoring studies a change of species composition is observed. The significance of these changes is contended.
Long-term elimination of benthic communities or benthic species due to covering of the seabed by wind-turbine foundations.	Damaging biogenic reefs by scouring or smothering by scour protection is considered a serious risk, because of their conservation interest and low capacity for regeneration.
Change of habitat conditions by altered sedimentation and current.	It is assumed that the maximum total volume of sediment that could be released during construction is approximately one thousandth of the level of sediment habitually in motion across the site.
Change caused by the increase of sediment temperature in the area of electric cables.	Burying cables in the sea bottom would mitigate a rise in sediment temperature

Observation: the significance of effects on benthos communities is subject to much discussion. Benthos communities are highly stressed by many activities which contribute to a loss or a change of habitat conditions.

Observation: if fisheries, especially demersal trawling, were excluded from wind farm areas, this could be expected to have positive effects on the abundance of benthos communities, as periodic disturbance of habitats would cease.

## Fish, sharks and rays

Effects on fish, sharks and rays are summarised in the table below.

POTENTIAL IMPACT	COD PRELIMINARY RESULTS
Introduction of new habitats (artificial hard substrate) causing a change the occurrence of fish stocks.	If fishing, especially demersal trawling, is excluded from wind farm areas, this is expected to have a positive effect on the abundance of fish stocks.
Electro-magnetic fields from cables influencing orientation mechanisms.	The prognosis of impacts due to electromagnetic fields is not yet well understood, as the nature of effects, particularly behavioural changes like avoidance, can neither reliably be predicted nor quantified.

Observation: based on present knowledge, no significant negative impacts on fish and elasmobranchs have been found. However, cumulative effects do merit ongoing assessment and monitoring.

Observation: it is difficult to consider the impact of wind farms on fish stocks in isolation.

Observation: the closure of wind farm areas to fisheries is supposed to have a positive effect on fish stocks. The increase of biomass (benthos communities) as a nutrient source for fish would support this supposition.



## Landscape / Seascape

There are a limited number of studies which report on the actual effects of offshore wind farms on landscape and seascape. Some studies contain methodological approaches for the assessment of visual impacts. The main relevant effects on landscape and seascape are described as:

- change of specific or typical features, or the general appearance of landscape / seascape by the introduction of wind turbines,
- disturbance by intrusion of technical elements in the natural environment,
- decrease of recreational qualities due to change of landscape / seascape.

Effects on landscape and seascape play an important role in decision making if the intended site is located near to the coast or to islands. Impacts appear to be evaluated differently depending on the acceptance of wind energy by the local population.

Observation: Landscape and seascape effects influence social acceptance of offshore wind technologies.

Observation: Evaluation of visibility and land / seascape effects differ from country to country.

Recommendation: Exchange of experiences should be supported, both on assessment methods and on mediation. Visualisation methods should be readily interpretable by the local population.

Recommendation: information strategies for local populations can be expected to reduce conflicts and promote understanding of the wider role of wind energy. Enfranchisement of the local population in decision making processes is good practice.



## 8.5 Mitigation Measures

Considering environmental requirements during site selection is a very effective way to avoid negative impacts. However, some effects may be unavoidable, or unknown at the beginning, and hence mitigation during construction, operation and decommissioning is very valuable.

The following table lists mitigation measures to reduce or eliminate impacts on the environment.

MITIGATION / AVOIDANCE	MEASURES
Reduction of visual intrusion	At 15 km and over, visibility decreases significantly. Three rotor blades are perceived as most pleasing. Light-absorbing paint and compact, systematic placement of the turbines can also improve perceptions of visual intrusion. Lowering visual intrusion can conflict with safety interests. For safety reasons illumination during nightimes is required. Illumination should employ strategies which narrow the angle of the light source.
Reduction of collision risks by (manoeuvrable) boat	Navigation exclusion zones minimise the risk of boat collision where there is heavy traffic. However this is not always necessary as risk assessments return a very low risk of collision If boats are allowed in wind farm areas, visibility of the towers during day and night is necessary, as well as mapping on navigational charts.
Reduction of collision risks of birds	Best avoidance can be achieved when taking bird protection needs into account during site selection (e. g. avoiding bird protection areas and migration corridors or routes).
Reduction of noise	Noise reduction during pile-driving requires technical innovation. Deterring sensitive species (e.g. by pingers) is recommen-ded. Scheduling construction work during less sensitive lifecycle phases is a common mitigation measure. To ensure minimal impact on both fish and mammals, pile-driving should start gently to allow individuals to move away from the noise source.
Reduction of electromagnetic fields	Insulation of cables prevents the surrounding seabed from heating. Guidance on appropriate burial depths to minimise emission levels is needed.
Reduction of scour	Scour protection is essential to ensure the stability and safety of the facility. Conditions which would allow to replace scour protection with other measures to ensure stability, must be considered very carefully.





- OSPAR Commission, 2003. "Guidance on a Common Approach for Dealing with Applications for the Construction and Operation of Offshore Wind Farms." Meeting of the OSPAR Commission, Bremen, 23-27 June 2003. OSPAR 03/17/1-E, Annex 7.
- [2] OSPAR Commission, 2004. "Problems and Benefits Associated with the Development of Offshore Wind Farms." Biodiversity Series. ISBN 1-904426-48-4. Available at: http://www.ospar.org/documents/dbase/publications/p00212\_Wind%20farms\_Problems%20and%20benefits.pdf
- [3] European Renewable Energies Federation, 2004. "Good Planning Guide for Renewable Energy Installations. A guideline for overcoming obstacles in administrative planning procedures in Europe." Available at: http://www.erefeurope.org/downloads/pdf/2004/goodplanningguide.pdf
- [4] The Fifth International Conference on the Protection of the North Sea is recorded at: http://odin.dep.no/md/nsc/
- [5] "Bergen Declaration". Fifth International Conference on the Protection of the North Sea. 20-21 March 2002, Bergen, Norway. Available at: http://odin.dep.no/filarkiv/156076/Engelsk.pdf
- [6] Declaration of the EU Policy Workshop "Development of Offshore Wind Energy in Europe", Netherlands 2004, The Netherlands Ministry of Economic Affairs and COD. Available at: http://www.ez.nl/content.jsp?objectid=26480
- [7] From Energy Council meeting, 29 November 2004.
- [8] Greenpeace, 2004. "SeaWind Europe." Available at: http://www.greenpeace.org/raw/content/international/press/reports/sea-wind-europe.pdf
- [9] Greenpeace, 2005. "Offshore Wind Implementing a new power house for Europe. Available at: http://www.greenpeace.org/raw/content/international/press/reports/offshore-wind-implementing-a.pdf
- [10] WWF International, 2005. "Background Brief. G8 leaders meet in Scotland, UK, 6-8 July 2005. Technology and Climate Change." Available at: http://www.panda.org/downloads/climate change/g8technologybrieffinal.pdf
- [11] European Wind Energy Association, Greenpeace, 2004. "WindForce 12. A Blueprint to achieve 12% of the world's electricity from wind power by 2020." Available at: http://www.ewea.org/documents/WF12-2004\_eng.pdf
- [12] WWF, undated. "Wind energy. Success Story or pie in the sky?" Website material at: http://www.panda.org/about\_wwf/what\_we\_do/climate\_change/our\_solutions/renewable\_energies/wind.cfm
- [13] Directive 2001/77/EC of the European Parliament and of the Council 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market. Available at: http://www.managenergy.net/products/R80.htm
- [14] 3E, EWEA, 2002. "Sea Legal. Enabling Offshore Wind Developments." Available at: http://www.ewea.org/documents/offshore%20-%20EWEA%20version%20.pdf
- [15] Simmons & Simmons Trenité, 2004. Analyse bestuurlijke en juridische regelgeving offshore windparken.
- [16] IEA, 2005. "Offshore Wind Experiences." Available at: http://www.iea.org/textbase/papers/2005/offshore.pdf
- [17] Reference for COD final report.
- [18] Reference for EC SEA Directive



- [19] For further information see: http://europa.eu.int/comm/ten/energy/documentation/index\_en.htm TU Berlin (2005): International Exchange of Experiences on the Assessment of the Ecological Impacts of Offshore Wind Farms / Workshop March 17th-18th 2005 at the Berlin University of Technology. Final report –Draft 26.04.2005.
- [20] V. Akhmatov, H. Abildgaard, J. Pedersen, and P.B. Eriksen. Integration of Offshore Wind Power into the Western Danish Power System, Proc. 2005 Copenhagen Offshore Wind International Conference and Exhibition, Copenhagen, Denmark, October 26-28, 2005, 9 pp.
- [21] Directive 2001/77/EC of the European Parliament and the Council of 27 September 2001 on the promotion of electricity from renewable energy sources in the internal electricity market, Official Journal of the European Communities, 27 October 2001
- [22] COD Work Package 4: Report on Environmental Issues of Offshorewind Wind Developement
- [23] COD Work Package 8: Report on Grid Issues
- [24] COD Work Package 3: Report on Legal and Administrative Issues

## Notes


## Notes


### OPET NETWORK: ORGANISATIONS FOR THE PROMOTION OF ENERGY TECHNOLOGIES

The network of Organisations for the Promotion of Energy Technologies (OPET), supported by the European Commission, helps to disseminate new, clean and efficient energy technology solutions emerging from the research, development and demonstration activities of ENERGIE and its predecessor programmes. The activities of OPET Members across all member states, and of OPET Associates covering key world regions, include conferences, seminars, workshops, exhibitions, publications and other information and promotional actions aimed at stimulating the transfer and exploitation of improved energy technologies. Full details can be obtained through the OPET internet website address http://www.cordis.lu/opet/home.html

#### ADEME

27, rue Louis Vicat 75737 Paris, France Manager: Mr Yves Lambert Contact: Ms Florence Clement Telephone: +33 1 47 65 20 41 Facsimile: +33 1 46 45 52 36 E-mail: florence.clement@ademe.fr

#### ASTER-CESEN

Via Morgagni 4 40122 Bologna, Italy Manager: Ms Leda Bologni Contact: Ms Verdiana Bandini Telephone: +39 051 236242 Facsimile: +39 051 227803 E-mail: opet@aster.it

#### BEO

BEO c/o Projekttraeger Biologie, Energie, Umwelt Forschungszentrum Juelich GmbH 52425 Julich Germany Manager: Mr Norbert Schacht Contact: Mrs Gillian Glaze Telephone: +49 2461 61 5928 Facsimile: +49 2461 61 2880 E-mail: g.glaze@fz-juelich.de

#### BRECSU

Bucknalls Lane, Garston WD2 7JR Watford United Kingdom Manager: Mr Mike Trim Contact: Mr Mike Trim Telephone: +44 1923 664754 Facsimile: +44 1923 664097 E-mail: trimm@bre.co.uk

#### CCE

Estrada de Alfragide, Praceta 1 2720 Alfragide Portugal Manager: Mr Luis Silva Contact: Mr Diogo Beirao Telephone: +351 1 4722818 Facsimile: +351 14722898 E-mail: dmre.cce@mail.telepac.pt

#### CLER

ZB rue Basfroi 75011 Paris France Manager: Ms Liliane Battais Contact: Mr Richard Loyen Telephone: +33 1 46590342 Fracsimile: +33 1 46590392 E-mail: cler@worldnet.fr

#### CMPT

Exploration House Offshore Technology Park Aberdeen AB23 8GX United Kingdom Manager: Mr Jonathan Shackleton Contact Ms Jane Kennedy Telephone: +44 870 608 3440 Facsimile: +44 870 608 3480 E-mail: j.kennedy@cmpt.com

#### CORA Altenkesselerstrasse 17 66115 Saarbrucken Germany Manager: Mr Michae

Manager: Mr Michael Brand Contact: Mr Nicola Sacca Telephone: +49 681 9762 174 Facsimile: +49 681 9762 175 E-mail: sacca@sea.sb.uunet.de

#### CRES

19 km Marathonos Ave 190 09 Pikermi, Greece Manager: Ms Maria Kontoni Contact: Ms Maria Kontoni Telephone: +30 1 60 39 900 Facsimile: +30 1 60 39 911 E-mail: mkontoni@cres.gr

#### Cross Border OPET- Bavaria-Austria

Wishuberstr. 3 93059 Regensburg Germany Manager: Mr Johann Fenzl Contact: Mr Toni Lautenschlaeger Telephone: +49 941 46419-0 Facsimile: +49 941 46419-10 E-mail: fenzl.zreu@t-online.de

#### ENEA-ISNOVA

CR Casaccia S Maria di Galeria 00060 Roma, Italy Manager: Mr Francesco Ciampa Contact: Ms Wen Guo Telephone: +39 06 3048 4118 Facsimile: +39 06 3048 4447 E-mail: enea\_opet@casaccia.enea.it

#### Energy Centre Denmark

DTI P.O. Box 141 2630 Taastrup, Denmark Manager: Mr Poul Kristensen Contact: Cross Border OPET Bavaria Mr Nils Daugaard Telephone: +45 43 50 70 80 Facsimile: +45 43 50 70 88 E-mail: ecd@teknolgisk.dk

#### ETSU

Harwell Didcot OX11 ORA Oxfordshire United Kingdom Manager: Ms Cathy Durston Contact: Ms Lorraine Watling Telephone: +44 1235 432014 Facsimile: +44 1235 433434 E-mail: lorraine.watling@aeat.co.uk

#### EVE Edificio Albia I planta 14, C. San Vicente, 8 48001 Bilbao, Spain Manager: Mr Juan Reig Giner Contact: Mr Guillermo Basanez Telephone: +34 94 423 50 50 Facsimile: + 34 94 435 56 00 E-mail: jreig@eve.es

FAST 2, P. le R. Morandi 20121 Milan Italy Manager: Ms Paola Gabaldi Contact: Ms Debora Barone Telephone: +39 02 76 01 56 72 Facsimile: +39 02 78 24 85 E-mail: paola.gabaldi@fast.mi.it

#### ICAEN

Avinguda Diagonal, 453 bis, atic 08036 Barcelona Spain Manager: Mr Joan Josep Escobar Contact: Mr Joan Josep Escobar Telephone: +34 93 4392800 Facsimile: +34 93 4197253 E-mail: edificis@icaen.es

#### ICEU

Auenstrasse 25 04105 Leipzig Germany Manager: Mr Jörg Matthies Contact: Mrs Petra Seidler / Mrs Sabine Märker Telephone: +49 341 9804969 Facsimile: +49 341 9803486 E-mail: krause@iceu.manner.de

#### ICIE

Via Velletri, 35 00198 Roma, Italy Manager: Mariella Melchiorri Contact: Rossella Ceccarelli Telephone: +39 06 8549141-8543467 Facsimile: +39 06 8550250 E-mail: icie.rm@rm.icie.it

#### IDAE

Paseo de la Castellana 95, planta 21 28046 Madrid, Spain Manager: Mr José Donoso Alonso Contact: Ms Virginia Vivanco Cohn Telephone: +34 91 456 5024 Facsimile: +34 91 555 1389 E-mail: vivanco@idae.es

#### IMPIVA

Plaza Ayuntamiento, 6 46002 Valencia Spain Manager: José-Carlos Garcia Contact: Jocquin Ortola Telephone: +34 96 398 6336 Facsimile: +34 96 398 6201 E-mail: ximo.ortola@impiva.m400.gva.es

#### Institut Wallon

Boulevard Frère Orban 4 5000 Namur Belgium Manager: Mr Francis Ghigny Contact: Mr Xavier Dubuisson Telephone: +32 81 25 04 80 Facsimile: +32 81 25 04 90 E-mail:xavier.dubuisson@iwallon.be

#### Irish Energy Centre

Glasnevin 9 Dublin Ireland Manager: Ms Rita Ward Contact: Ms Rita Ward Telephone: +353 1 8082073 Facsimile: +353 1 8372848 E-mail: opetiec@irish-energy.ie

#### LDK

7, Sp. Triantafyllou St. 113 61 Athens, Greece Manager: Mr Leonidas Damianidis Contact: Ms Marianna Kondilidou Telephone: +30 1 8563181 Facsimile: +30 1 8563180 E-mail: ldkopet@mail.hol.gr

#### NIFES

8 Woodside Terrace G3 7UY Glasgow United Kingdom Manager: Mr Andrew Hannah Contact: Mr John Smith Telephone: +44 141 332 4140 Facsimile: +44 141 332 4255 E-mail: glasgow@nifes.co.uk.

#### Novem

Swentiboldstraat 21 P.O. Box 17 6130 AA Sittard Netherlands Manager: Mr Theo Haanen Contact: Mrs Antoinette Deckers Telephone: +31 46 42 02 326 Facsimile: +31 46 45 28 260 E-mail: A.Deckers@Novem.nl T.Haanen@Novem.nl

#### NVE

P.O. Box 5091, Majorstva 0301 Oslo, Norway Manager: Mr Roar W. Fjeld Contact: Mr Roar W. Fjeld Telephone: +47 22 95 90 83 Facsimile: +47 22 95 90 99 E-mail: rwf@nve.no

#### **OPET** Austria

Linke Wienzeile 18 1060 Vienna, Austria Manager: Mr Günter Simader Contact: Mr Günter Simader Telephone: +43 1 586 15 24 ext 21 Facsimile: +43 1 586 94 88 E-mail: simader@eva.wsr.at

#### OPET EM

Swedish National Energy Administration c/o Institutet för framtidsstudier Box 591 S- 101 31 Stockholm Manager: Ms Sonja Ewerstein Contact: Mr Anders Haaker Telephone: +46 70 648 69 19/ +46 85 452 03 88 Facsimile: +46 8 24 50 14 E-mail: sonja.ewerstein@stem.se.

#### **OPET Finland**

Technology Development Centre Tekes P.O. Box 69, Malminkatu 34 0101 Helsinki, Finland Manager: Ms Marjatta Aarniala Ms Marjatta Aarniala Contact: Telephone: +358 105215736 Facsimile: +358 105215908 E-mail: marjatta.aarniala@tekes.fi

#### **OPET Israel**

Tel-Aviv University 69978 Tel Aviv Israel Mr Yair Sharan Manager: Contact: Mr Yair Sharan Telephone: +972 3 6407573 Facsimile: +972 3 6410193 E-mail: sharany@post.tau.ac.il

#### OPET Luxembourg

Avenue des Terres Rouges 1 4004 Esch-sur-Alzette Luxembourg Mr Jean Offermann Manager: (Agence de l'Energie) Contact: Mr Ralf Goldmann (Luxcontrol) Telephone: +352 547 711 282 Facsimile: +352 54 77 11 266 E-mail: goldmann@luxcontrol.com

#### Black Sea Regional Energy Centre

#### (BSREC)

8, Triaditza Str. 1040 Sofia Bulgaria Manager: Dr L. Radulov Contact: Dr L. Radulov Telephone: +359 2 980 6854 Facsimile: +359 2 980 6855 E-mail: ecsynkk@bsrec.bg

## EC BREC - LEI FEMOPET c/o EC BREC/IBMER

Warsaw Office ul. Rakowiecka 32 02-532 Warsaw, Poland Manager: Mr Krzysztof Gierulski Contact: Mr Krzysztof Gierulski Telephone: +48 22 484832 Facsimile: +48 22 484832 E-mail: grewis@ibmer.waw.pl

Energy Centre Bratislava c/o SEI-EA Bajkalská 27 82799 Bratislava, Slovakia Manager: Mr Michael Wild Contact: Mr Michael Wild Telephone: +421 7 582 48 472 Facsimile: +421 7 582 48 470 E-mail: ecbratislava@ibm.net

#### Energy Centre Hungary

Könyves Kálmán Körút 76 H-1087 Budapest Hungary Manager: Mr Andras Szalóki Contact: Mr Zoltan Csepiga Telephone: +36 1 313 4824/ 313 7837 Facsimile: +36 1 303 9065 E-mail: Andras.szalóki @energycentre.hu

#### **OPET Bothnia**

Norrlandsgatan 13, Box 443 901 09 Umea - Śweden Blaviksskolan 910 60 Asele -Sweden Manager: Ms France Goulet Telephone: +46 90 16 37 09 Facsimile: +46 90 19 37 19 Contact: Mr Anders Lidholm Telephone: +46 941 108 33 Facsimile: +46 70 632 5588 E-mail: opet.venet@swipnet.se

#### Orkustofnun

Grensasvegi 9 IS-108 Reykjavik Iceland Manager Mr Einar Tjörvi Eliasson Contact: Mr Einar Tjörvi Eliasson Telephone: +354 569 6105 Facsimile: +354 568 8896 E-mail: ete@os.is

#### CEEETA-PARTEX

Estonia FEMOPET

EE0001 Tallinn, Estonia

Manager: Mr Villu Vares

Contact: Mr Rene Tonnisson

Telephone: +372 245 0303 Facsimile: +372 631 1570

E-mail: femopet@femopet.ee

FEMOPET LEI - Lithuania

Lithuanian Energy Institute

Manager: Mr Romualdas Skemas

Contact: Mr Sigitas Bartkus Telephone: +370 7 35 14 03 Facsimile: +370 7 35 12 71

FEMOPET Poland KAPE-BAPE-

ul. Nowogrodzka 35/41 XII p. PL-00-950 Warsaw

Contact: Ms Marina Coey Telephone: +48 22 62 22 794 Facsimile: +48 22 62 24 392

Manager: Ms Marina Coey

E-mail: kape4@pol.pl

FEMOPET Slovenia

Jozef Stefan Institute

Jamova 39 SLO-1000 Ljubljana

Slovenia

Energy Efficiency Centre

Manager: Mr Boris Selan Contact: Mr Tomaz Fatur Telephone: +386 61 1885 210 Facsimile: +386 61 1612 335

E-mail: tomaz.fatur@ijs.si

E-mail: bartkus@isag.lei.lt

3 Breslaujos Str. 3035 Kaunas, Lithuania

GRAPE

Poland

c/o KAPE

Paldiski mnt.1

Rua Gustavo de Matos Sequeira, 28 - 1 . Dt . 1200-215 Lisboa Portugal Manager: Mr Aníbal Fernandes Contact: Mr Aníbal Fernandes Telephone: +351 1 395 6019 Facsimile: +351 1 395 2490 E-mail: ceeeta@ceeeta.pt

Estonian Energy Research Institute

#### RARE

50 rue Gustave Delory 59800 Lille, France Manager: Mr Pierre Sachse Contact: Mr Jean-Michel Poupart Telephone: +33 3 20 88 64 30 Facsimile: +33 3 20 88 64 40 E-mail: are@nordnet.fr

### SODEAN

Isaac Newton s/n Pabellón de Portugal - Edifico SODEAN 41092 Sevilla Spain Manager Mr Juan Antonio Barragán Rico Contact: Ms Maria Luisa Borra Marcos Telephone: +34 95 4460966 Facsimile: +34 95 4460628 E-mail: mailto:mborra.sodean@sadiel.es

#### SOGES

Corso Turati 49 10128 Turin, Italy Manager: Mr Antonio Maria Barbero Contact: Mr Fernando Garzello Telephone: +39 0 11 3190833/3186492 Facsimile: +39 0 11 3190292 E-mail: opet@grupposoges.it

#### VTC

Boeretang 200 2400 Mol Belgium Manager: Mr Hubert van den Bergh Ms Greet Vanuytsel Contact: Telephone: +32 14 335822 Facsimile: +32 14 321185 E-mail: opetvtc@vito.be

#### Wales OPET Cymru

Dyfi EcoParc Machynlleth SY20<sup>8</sup>AX Powys United Kingdom Manager: Ms Janet Sanders Contact: Mr Rod Edwards Telephone: +44 1654 705000 Facsimile: +44 1654 703000 E-mail: opetdulas@gn.apc.org

### FEMOPET

#### Latvia FEMOPET

c/o B.V. EKODOMA Ltd Zentenes Street 12-49 1069 Riga Latvia Manager: Ms Dagnija Blumberga Contact: Ms Dagnija Blumberga Telephone: +371 721 05 97/ 241 98 53 Facsimile: +371 721 05 97/ 241 98 53 E-mail: ekodoma@mail.bkc.lv

#### OMIKK

National Technical Information Centre and Library Muzeum Utca 17 H-1088 Budapest Hungary Manager: Mr Gyula Nyerges Mr Gyula Nyerges Contact: Telephone: +36 1 2663123 Facsimile: +36 1 3382702 E-mail: nyerges@omk.omikk.hu

#### FEMOPET Romania ENERO

8, Energeticienilor Blvd. 3, Bucharest 79619 Romania Manager: Mr Alexandru Florescu Contact: Mr Christian Tintareanu Telephone: +401 322 0917 Facsimile: +401 322 27 90 E-mail: crit@mail.gsci.vsat.ro

## Sofia Energy Centre Ltd

51, James Boucher Blvd. 1407 Sofia Bulgaria Manager: Ms Violetta Groseva Contact: Ms Violetta Groseva Telephone: +359 2 96 25158 Facsimile: +359 2 681 461 E-mail: ecencentre@enpro.bg

**Technology Centre AS CR** Rozvojova 135 165 02 Prague 6 Czech Republic Manager: Mr Karel Klusacek Contact: Mr Radan Panacek Telephone: +420 2 203 90203 Facsimile: +420 2 325 630 E-mail: klusacek@tc.cas.cz

### FEMOPET Cyprus

Andreas Araouzos, 6 1421 Nicosia Cyprus Manager: Mr. Solon Kassinis Contact: Mr. Solon Kassinis Telephone: +357 2 867140/ 305797 Facsimile: +357 2 375120/ 305159 E-mail: mcienerg@cytanet.com.cy

### NOTICE TO THE READER

Extensive information on the European Union is available through the EUROPA service at internet website address http://europa.eu.int/

The overall objective of the European Union's energy policy is to help ensure a sustainable energy system for Europe's citizens and businesses, by supporting and promoting secure energy supplies of high service quality at competitive prices and in an environmentally compatible way. European Commission DGXVII initiates, coordinates and manages energy policy actions at transnational level in the fields of solid fuels, oil & gas, electricity, nuclear energy, renewable energy sources and the efficient use of energy. The most important actions concern maintaining and enhancing security of energy supply and international cooperation, strengthening the integrity of energy markets and promoting sustainable development in the energy field.

A central policy instrument is its support and promotion of energy research, technological development and demonstration (RTD), principally through the ENERGIE sub-programme (jointly managed with DGXII) within the theme "Energy, Environment & Sustainable Development" under the European Union's Fifth Framework Programme for RTD. This contributes to sustainable development by focusing on key activities crucial for social well-being and economic competitiveness in Europe.

Other DGXVII managed programmes such as SAVE, ALTENER and SYNERGY focus on accelerating the market uptake of cleaner and more efficient energy systems through legal, administrative, promotional and structural change measures on a trans-regional basis. As part of the wider Energy Framework Programme, they logically complement and reinforce the impacts of ENERGIE.

> The internet website address for the Fifth Framework Programme is http://www.cordis.lu/fp5/home.html

Further information on DGXVII activities is available at the internet website address http://europa.eu.int/en/comm/dg17/dg17home.htm

> The European Commission Directorate-General for Energy DGXVII 200 Rue de la Loi B-1049 Brussels Belgium

> > Fax +32 2 2950577 E-mail: info@bxl.dg17.cec.be