

GENERAL INFORMATION

PETUS description of tool in use						
Name of the case	Middelgrunden Wind Farm					
Name of the tool	Environmental Impact Assessment (EIA), supported by WindPro					
Country	Denmark					
City / region	Copenhagen					
Total area (km ²)	89 km ²					
Population	502, 000					
Density (people/km ²)	5640 people/km ²					
Tool user's profile	<p>Københavns Belysningsvæsen - the municipal utilities of Copenhagen, now called Københavns Energi - and Middelgrundens Vindmøllelaug I/S - a private co-operative – collaborated on the proposal development for an off-shore wind power project at a former dump site near Copenhagen's harbour.</p> <p>KMEK - Copenhagen Environment and Energy Office was the primary facilitator of the process; even though a number of different companies were involved in the EIA. KMEK is a local association, which provides free, impartial information and guidance on energy conservation, renewable energy, waste minimization, etc. Its biggest project is the offshore wind farm on Middelgrunden. -KMEK answer more than 1500 enquiries every year and also initiates and run different projects to promote ecological development in Copenhagen. It is an independent organization with 10-20 employees (in 2001)(including engineers, architects, biologists) and 400 members, mainly private members but also firms, housing co-ops, etc. KMEK is one of the 24 Danish environment and energy offices. KMEK cooperates closely with these offices and the Danish Organisation for Renewable Energy.</p>					
a. Organisation name (municipality, NGO, national or regional department, company, etc.)						
b. Field of activity						
c. Detailed contact/feedback (project website, e-mail, address, tel., fax)						
Reviewer, date	Morten Elle, November 25, 2004					
Short description of the case						
<p>Middelgrunden Wind Farm is a Wind Farm placed in the sea near Copenhagen Harbour, visible from large parts of the city. The finished project consists of 20 2 MW wind turbines placed off-shore. Off-shore wind farms are an essential part of the strategy for more renewable energy. The public view on wind farms is generally quite positive. Wind turbines have traditionally been built by small private co-operations, involving a number of shareholders.</p> <p>The size of the wind turbines has been increasing considerably in the last 25 year period. Hence, wind farms are large facilities that have to be evaluated using an EIA-procedure. The visual impact of the wind farm is one of the important impacts. In order to facilitate a realistic public debate on the visual impact of Middelgrunden Wind Farm, the specific tool WindPro was used.</p>						
<p>Why was the case chosen?</p> <p>Even though wind farms are considered an environmentally friendly technology in a Danish context, the evaluation of the impact on the environment has to be carried out. Environmental Impact Assessment (EIA) is a traditional way of doing this, which is compulsory in most European countries. This case illustrates the function of EIA and the support from the special tool WindPro.</p>						
<p>To which PETUS key-problem is this case study related?</p> <p>Visual Impacts of Energy Supply Systems</p>						
Sector	Waste	Energy	Water	Transport	Green/blue	Building & Land Use
		x				
Scale of project	Component	Building	Neighbourhood	City	Region	
				x		

Status of project	Starting up	Ongoing	Finished	Start date	End date (exp.)
				x	April 1996
Key words Offshore wind farm, EIA, Wind Pro, public ownership, public consultation, renewable energy					
Project a. Object (building, city park, wind farm, etc.) b. Type of activity (regeneration, renovation, new development, etc.) c. Type of product (plan, scheme, design project, etc.)	a.) Wind Farm b.) New development c.) Project				
Tool a. Character (according to WP3final0704.doc) b. Benchmarks (qualitative or quantitative) c. Availability (paid/ free)	a.) Generic tool (EIA), special sector specific tool (WindPro) b.) Status Quo as a benchmark/reference c.) Available for free in the generic form (EIA) Paid for software package (WindPro) http://www.emd.dk/WindPRO/Price%20List/				
Decision-making process a. Stage of the tool implementation (preliminary, midterm, etc.) b. Level (political, technical, etc.) c. Public participation	a.) Late in the process – the project has to be almost completely designed before the EIA can be carried out b.) The EIA is carried out by technicians but the decision – whether to go ahead with the project or not – is taken by politicians c.) Public participation – in the form of an audit is a compulsory part of the EIA				
Other (optional, if needed)					

DETAILED INFORMATION

A. Detailed description of project and tool	
1. Description of context (existing strategies, laws, policy, action plans, etc.): EU, national, regional, municipal	In the Danish Energy Action Plan, <i>Energi 21</i> , the government proposes an increase of the share of renewable energy in Danish energy supply from the present (2003) 9 % to 35 % in 2030. Wind turbines have a special position in Denmark. More than 100,000 families are members of a wind energy cooperative, and the public have installed 80% of all Danish wind turbines. Until recently, cooperatives were a very important and dominant factor in the development of the Danish wind energy sector.
2. Description of project a. Background (What caused the initiation of the project?; What was the problem? Who initiated the project?); b. Objectives/aims (sustainability statement – what issues of sustainability were attacked); c. Time interval and stages of project realisation; d. Financing – amount, sources, institutions involved, partnerships, levels. e. Other sectors involved in the particular project/problem (conflicts and/or links)	Middelgrunden Wind Farm was initiated by the NGO KMEK. Copenhagen Environment and Energy Office organized and facilitated Middelgrunden Vindmøllelaug. Middelgrunden Vindmøllelaug is a private co-operative with about 8,300 persons shareholders. Middelgrunden Wind Farm consists of 20 2MW turbines. The maximum height of the wingtip is 111 meters. The turbines are located close to Copenhagen Harbour and are very visible when approaching the city from the North. The turbines are placed in a circular arc with a 12.5 km radius. The total length is 3.4 kilometres. Copenhagen Energy owns half of the turbines. The Middelgrunden Vindmøllelaug owns the other half.

	<p>The primary goal for both owners has been to increase the production of electricity in an environmentally friendly way. Furthermore they want to demonstrate Copenhagen as the Environmental Capital of Europe. Copenhagen considers Middelgrunden Wind Farm to be a pre-study for later Danish offshore Wind Farms. Middelgrunden Vindmøllelaug wants to engage the population of the metropolis in sustainable development.</p> <p>Middelgrunden Vindmøllelaug financed 10 of the wind turbines having a total expense of 180 mill. DKK, - around 24 mill. €, invested by the 8300 shareholders.</p> <p>The green/blue sector and the transport sector have been involved in the project – the establishment of the Wind Farm could be in conflict with interests in nature and in conflict with air and sea transport (and telecommunication)</p>
<p>3. Description of tool</p> <p>a. Character (according to WP3final0704.doc) - calculation tools, process tools, assessment methods, generic tools, simulation tools, guidelines, framework tools, schemes, indicators and monitoring, checklists, case-specific tools;</p> <p>b. Availability of the tool (web-based / paper, paid / free, etc.)</p> <p>c. Based on existing tool or newly elaborated;</p> <p>d. Adaptation of the tool to the local context (are there local experts involved in tool's development?)</p> <p>e. Other tools implemented to support the project development</p>	<p>An environmental impact assessment has been carried out, following the Danish guidelines for EIA of offshore Wind Farms. EIA is a generic tool, the guidelines try to specify the use of the tool in relation to the specific problem: off shore Wind Farm. The tool is not web-based.</p> <p>A summary in English of the EIA can be found on http://www.middelgrunden.dk/MG_UK/project_info/vvm_engl_ish.pdf.</p> <p>Much attention has been paid to the visual impact of the wind farm. In the first proposal, the wind farm consisted of 27 turbines, placed in a 3 x 9 matrix. This proposal was rejected in the first audit in 1997, due to the (imagined) negative visual impact. In the public debate the argument was that the wind farm would cover most of horizon. The thought of 111 m tall turbines was scaring to some people – apparently they had difficulties in getting a realistic image of what the farm would look like from the distance.</p> <p>Afterwards a number of alternative layouts of the wind farm were visualized with WindPro. WinPro is a tool developed by the Danish company EMD International A/S especially to visualize wind farms, the tool is described on http://www.emd.dk. WindPro gives a very realistic image of the visual impact, the 111 m tall turbines does not seem large from 2 kilometres distance.</p> <p>Parts of the visualization can be seen on http://www.middelgrunden.dk/MG_UK/project_info/visualization.htm - the total visualization project is reported in: Møller og Grønborg: <i>Vindmøllepark på Middelgrunden II. Æstetisk vurdering og visualisering</i>. København 1998 (In Danish only).</p>
B. Tool implementation	
<p>1. Argumentation for choosing the tool</p> <p>a. What were the reasons for the implementation of the tool? (voluntary or requested by what local, national, etc regulation)</p> <p>b. Who took the initiative for choosing /elaboration the tool?</p> <p>c. What were the criteria for choosing the tool?</p> <p>d. Was there knowledge of other tools and were</p>	<p>It is compulsory by law to carry out an EIA for such a large project as Middelgrunden Wind Farm. Danish law implements the Council Directive of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment 85/337/EEC.</p> <p>Denmark has developed a special EIA for wind turbines.</p>

they considered?	WindPro is a tool developed especially to give a realistic image of the visual impact of a wind farm – it could do, what was needed.
2. Barriers for the tool implementation What were the main problems in the tool implementation? (Regulation, information available, public awareness, lack of clear SD definitions and benchmarks, communication etc.)	<p>The main problem of carrying out an EIA is the large request for specialist information – this requires engaging a number of specialists to cover the different fields of expertise needed.</p> <p>The EIA procedure for wind turbines focuses especially on the visual impact (including disturbing reflections from the wing) and noise. In the off-shore construction of Middelgrunden, the following environmental aspects were considered (among others):</p> <ul style="list-style-type: none"> • The risk of leaking debris and heavy metal contamination from the former dumpsite (Middelgrunden), • Noise propagation, • Influence on the free flow of water in Oeresund, <ol style="list-style-type: none"> 1. Risk of collisions with vessels, 2. Impact on flora and fauna, 3. Risk of finding shipwrecks and deposits from the Stone Age of archaeological interest.
C. Influence of the tool on the decision-making process	
1. Description of the decision-making process/ procedures a. Stages b. Levels (political, technical, etc.) c. Sources of information used during the dmp; d. Who are the decision-makers? e. Who made the final decision for the project implementation? Was it political or technical decision?	<p>The initiative was taken in 1996. The first public hearing (visual impact) held in June - September 1997. The second public hearing (visual impact) took place June - September 1998. The Third public hearing (environment) took place July - October 1999. Planning permissions were obtained in May 1999 and the official opening of the wind farm in May 2001. A number of specific studies were used in the different stages, carried out by a number of specialists.</p> <p>The decision process alters between technical decisions and political decisions. The final decision was made by the Ministry of Energy and Environment in Denmark.</p>
2. Tool in decision-making process a. At what stage was the tool implemented? By whom? (experts, politicians, etc.) b. How did the tool output influence the process (added or skipped levels/stages in the existing decision-making process, etc.)? c. Quantitative goals or benchmarks defined? (If YES, which – and what were they compared to?) d. Was the tool used to support argumentations?	<p>The first public audit in 1997 resulted in public resistance, mainly due to the visual impact of the proposed 3 x 9 wind turbines. This led to a very detailed study of a number of detailed alternative layouts of the wind farm, and subsequently a reduction of the number of turbines from 27 to 20, using WindPro to illustrate the visual impact of the different layouts.</p> <p>The visualization in 1998 was very realistic and has, according to the contact person in Copenhagen Environment and Energy office, had a positive impact on the second public audit. The Middelgrunden project obtained planning permissions in May 1999. The wind farm started production in February 2001, with the official opening in May 2001.</p> <p>The goal was linked to the production of electricity. The energy production is estimated to 89 million kWh of electricity annually, corresponding to roughly 3% of the electricity consumption in Copenhagen. Nature will be spared annually a pollution of 258 tons of sulphur dioxide, 231 tons of nitrogen oxides, 76000 tons of carbon dioxide and 4900 tons of dust and clinker. These figures are calculated on the basis of the emissions of a 'normal' Danish electricity production, using the estimated budget for electricity production. The average production is</p>

	<p>quite close to the budget.</p> <p>Both the EIA and WindPro was – at the end – supporting the argument that Middelgrunden Wind Farm is an environmentally sound project</p>
<p>3. Transparency of decision-making process</p> <p>a. How was the information of the dmp disseminated? - directly (decision makers – public) or indirectly (decision makers - NGO, PR company, etc. - public); sources of dissemination used (mass media, internet, brochure, etc.)</p> <p>b. How was the public involved?</p> <p>c. Was there a public discussion over the project and at what stage of the project development?</p>	<p>Public authorities distributed the official information on the EIA, using the usual way of information in newspapers etc. Most of the information was, however, distributed by KMEK and Middelgrunden Vindmøllelaug. They distributed thousands of brochures, had campaigns in the streets of Copenhagen, and established a website: www.middelgrunden.dk.</p> <p>The fact that Middelgrunden Vindmøllelaug had to sell 40500 shares lead to publicity about the project. Middelgrunden Vindmøllelaug had an interest in putting the project on the public agenda in a positive way.</p> <p>There was a public debate at almost all stages of the project. It was not only the public audits in the EIA procedure that involved the public.</p> <p>The public was involved from the start in the project – it was necessary in order to be able to establish a co-operative with thousands of members. Even more people were involved in the hearings on the visual impact, which lead to a fierce debate in the mass media. The visualization of different alternative lay-outs using WindPro before the second public hearing was quite decisive for the positive outcome of the second hearing. This tool effectively supported the argumentation – that the visual impact was quite tolerable. Public participation was carried out in Sweden as well - as a consequence of the Convention on Environmental Impact Assessment in a Transboundary Context. http://www.unece.org/env/eia/eia.htm</p>
D. Expert assessment/analysis/comment of the tool effectiveness	
<p>1. Assessment by tool users</p> <p>a. Were there measurable improvements as a result of the tool implementation? If YES, what? If no: why not?</p> <p>b. Were there any spun-off's or unintended consequences?</p> <p>c. General view on the tool? Lessons learned?</p> <p>d. Potentials for further use of the tool?</p> <p>e. Will the actors recommend it or use it in other cases - why / why not?</p>	<p>Middelgrunden Vindmøllelaug writes on its website http://www.middelgrunden.dk/MG_UK/project_info/organizati.on.htm:</p> <p><i>'The cooperative, with its 8,300 members has, through a dialogue with all kinds of interest groups, generated a widespread understanding and acceptance for the chosen location and layout of the park. The ministerial considerations and the approval of the project have been delayed by the preparation of the new liberalised electricity market. The chosen offshore site is situated outside the frames of municipal and regional planning. Instead, The Danish Energy Agency held a direct hearing including authorities and interest groups. The computerised visualisation of the project has been a very important part of the process so far.</i></p> <p>This can be read as a recommendation of the use of WindPro.</p> <p>The use of WindPro can partly be seen a spin-off effect of the EIA procedure.</p>
<p>2. Reviewer's assessment of the tool (usefulness,</p>	

<p>sustainability relevance, who are the actors excluded? etc.) Suggestions and needs for further development of the tool</p>	<p>The visual impact of the wind farm was improved by using the EIA and the specific tool WindPro.</p> <p>The main problem with EIA is that it a very general tool, leaving the user with a number of questions, especially concerning how to weigh the different impacts together. Hence, the specific guidelines concerning different specific problems – as offshore wind farms – are very important.</p>
<p>E. Additional information on the case study available</p>	
<p>Websites</p>	<p>www.middelgrunden.dk www.dkvind.dk; http://www.unece.org/env/eia/eia.htm</p>
<p>References <i>concerning the case but also the key words or problem</i> (papers, articles, reports, laws, etc.)</p>	<ul style="list-style-type: none"> • Copenhagen Energy and the Middelgrunden Wind Turbine Co-operative: <i>'Environmental Impact Assessment of the wind farm at the Middelgrunden Shoal – non-technical Summary of the EIA, 1 st revision, January 2001'</i>, Copenhagen. • <i>'The Energy Balance of modern Windturbines'</i>, Windpower note no. 16/1997 • Council Directive of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment 85/337/EEC Reference: Official Journal NO. L 175 , 05/07/1985 P. 0040 - 0048
<p>Other sources (Interviews, conferences, discussions, etc.)</p>	
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