

# Estimation of the potential for expanding use of wind energy along infrastructure corridors, and development of pertinent reliability criteria

Final report: 31 March 2009

Volume I: Long version

Customer

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and Forschungszentrum Jülich PTJ

Team

**Bosch & Partner + Peters Umweltplanung + Deutsche WindGuard + Prof. Stefan Klinski + OVGU Magdeburg**



bosch & partner

Bosch & Partner GmbH

**Dr. Wolfgang Peters**

**Umweltplanung –  
Forschung und Beratung**



**Deutsche  
WindGuard GmbH**

PROF. DR. JUR.

**STEFAN KLINSKI**



Fachhochschule für  
Wirtschaft Berlin  
Berlin School of Economics



**UmweltPsychologie**  
Otto-von-Guericke-Universität Magdeburg

<b>0.1</b>	<b>Contents</b>	<b>Page</b>
0.1	Contents	I
0.2	List of tables	V
0.3	List of figures	VIII
0.4	List of abbreviations / Glossary	IX
<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Description of the problem of finding suitable areas for wind energy use	1
1.2	Goal of the project	4
1.3	Procedure	5
<b>2</b>	<b>Overlapping of impacts of infrastructure corridors and of wind energy plants</b>	<b>6</b>
2.1	Existing impacts from combinations of different uses	6
2.2	Impacts of infrastructure corridors and of wind energy plants	9
2.3	Description of the linear infrastructure features typically found in Germany and of their environmental impacts	11
2.3.1	Environmental impacts of highways	11
2.3.2	Environmental impacts of railways	16
2.3.3	Environmental impacts of power lines	20
2.4	Wind energy plants and their environmental impacts	24
2.4.1	Characteristics of common wind energy plants,	24

	including their major components and any typical added features	
2.4.2	Environmental impacts of wind energy plants	25
2.5	Overlapping of impacts of infrastructure corridors and of wind energy plants	28
2.5.1	Overlapping of impacts of roads and impacts of wind energy plants	31
2.5.1.1	Impairments of natural beauty (landscape scenery)	31
2.5.1.2	Noise disturbances for people	31
2.5.1.3	Noise and scare impacts on birds	39
2.5.1.4	Collision risks for birds and bats	43
2.5.1.5	Barriers for animals, especially birds	43
2.5.2	Overlapping of impacts of railways and impacts of wind energy plants	43
2.5.2.1	Impairments of natural beauty (landscape scenery)	43
2.5.2.2	Noise disturbances for people	44
2.5.2.3	Noise and scare impacts on birds	51
2.5.2.4	Collision risks for birds and bats	53
2.5.2.5	Barriers for animals, especially birds	53
2.5.3	Overlapping of impacts of power lines and impacts of wind energy plants	54
2.5.3.1	Impairments of natural beauty (landscape scenery)	54
2.5.3.2	Noise disturbances for people, and other types of disturbances for people	55

2.5.3.3	Noise and scare impacts on birds	55
2.5.3.4	Collision risks for birds and bats	55
2.5.3.5	Barriers for animals, especially birds	56
2.5.4	Derivation of existing-impacts corridors	56
2.6	Factors affecting public acceptance of wind energy plants	60
<b>3</b>	<b>Survey of existing practice in designation of priority and suitability areas for wind energy use</b>	<b>63</b>
3.1	Procedure	63
3.2	Suitability and/or priority areas along infrastructure corridors	65
3.3	Possibilities for repowering at the regional level	67
3.4	Assessment of the suitability of existing-impacts zones along infrastructure corridors	68
<b>4</b>	<b>Requirements and recommendations relative to minimum distances between wind energy plants and infrastructure corridors</b>	<b>70</b>
4.1	Introduction	70
4.2	Requirements for minimum distances between roads and wind energy plants	70
4.3	Requirements for minimum distances between railways and wind energy plants	75
4.4	Requirements for minimum distances between power lines and wind energy plants	77
<b>5</b>	<b>Legal recommendations regarding handling of minimum-distance requirements for wind energy plants</b>	<b>80</b>

5.1	Introduction	80
5.2	Legal requirements pertaining to minimum distances	80
5.3	Statements in relevant Länder wind-energy directives	81
5.4	Guideline figures in the context of regional planning	84
5.5	Other minimum-distance recommendations	85
5.6	Minimum-distance provisions in licensing procedures	85
5.7	Intermediate conclusion: On the significance of requirements and recommendations relative to wind energy plants along infrastructure corridors	86
<b>6</b>	<b>Regional-planning obstacles for designation of wind-farm areas along infrastructure corridors – analyses and potential solutions</b>	<b>87</b>
6.1	Experts' workshop	87
6.1.1	Procedures and results	87
6.1.2	Method for site location in planning processes	88
6.2	Discussion of recommendations	90
6.2.1	The regional planning (Raumordnung) level	91
6.2.2	The land-use-planning (Bauleitplanung) level	94
6.2.3	The individual-permit level: construction planning law	94
6.2.4	The individual-permit level: Noise control requirements	95

6.2.5	Legal changes	97
6.2.6	Digression: Ensuring availability of sites for repowered installations in land-use planning	100
<b>7</b>	<b>Method for determination of sites for wind energy plants in the impacts zones of infrastructure routes</b>	<b>103</b>
7.1	Overview	103
7.2	Identification of search areas for wind energy use, at the regional level	104
7.3	Use of results in the context of regional planning, land-use planning and licensing procedures	108
7.3.1	The regional planning level	108
7.3.2	The land-use-planning (Bauleitplanung) level	109
7.3.3	The individual-permit level	111
7.3.4	Intermediate result	112
<b>8</b>	<b>Application of the method to sample regions, and assessment of the relevant available total potential area</b>	<b>113</b>
8.1	Sample case: the greater Brunswick region	114
8.1.1	Derivation of search areas along roads and railways	115
8.1.2	Derivation of search areas along power lines	120
8.2	Sample case: the Uckermark-Barnim region	124
8.2.1	Derivation of search areas along roads	125
8.2.2	Derivation of search areas along power lines	128

8.3	Sample case: the central Hesse region	131
8.3.1	Derivation of search areas along roads	132
8.4	Sample case: Bremen	135
8.4.1	Introduction	135
8.4.2	Wind-energy-use planning in Bremen in comparison to such planning in other planning regions	136
8.4.3	Special aspects of approval of wind energy plants in Bremen	136
8.4.4	Sample cases with regard to approval of wind energy plants	138
8.4.5	Aspects that are applicable to other regions	143
8.5	Summary, and comparison of the results from the sample regions	144
<b>9</b>	<b>Assessment of the total area available for wind energy use along infrastructure corridors</b>	<b>148</b>
9.1	Transferability of model applications	148
9.2	Wind energy plants along roads	153
9.3	Wind energy plants along railways	159
9.4	Wind energy plants along high-voltage power lines	161
9.5	Overview consideration of the total potentially available area	164
<b>10</b>	<b>Summary</b>	<b>166</b>
<b>11</b>	<b>Literature</b>	<b>168</b>

<b>Annex</b>	<b>Remark on the experts' workshop</b> "Importance of infrastructure corridors in designation of priority and suitability areas for wind energy plants", held on 7 May 2008	
--------------	---	--

## 10 Summary

In general, it makes sense to use areas available along infrastructure corridors for installation of additional wind energy plants. Such areas offer advantages over many areas in open landscapes.

In light of the existing impacts along traffic and power-line routes, the added impacts resulting from installation of wind energy plants tend to be smaller along such routes than on sites in open landscapes that have few or no impacts.

Certain regional-planning area categories that, in light of their special importance and sensitivity have thus far been off limits to wind energy use, in the context of regional planning, tend to have reduced environmental characteristics and value when exposed to existing, strong environmental impacts in the vicinity of infrastructure corridors. As a result, new potentially available areas can gradually be identified at the regional-planning and land-use-plan (Bauleitplanung) levels and then subjected to individual-case review with regard to their actual suitability and implementation feasibility.

Using sample studies and calculations in three planning regions, the project was able to show that the total potentially available area would be considerable, even if, at the regional planning level, the amounts of areas produced via such modification of restriction categories within impacts corridors can vary widely in accordance with infrastructure-corridor type and planning region.

Existing procedures could be systematically reviewed in updating of regional plans, and in the framework of a well-planned overall concept for identifying priority areas for wind energy use. In the process, value-reducing existing impacts along infrastructure corridors should be "reassessed" in a manner that will enable additional, potentially suitable areas in the vicinity of infrastructure corridors to be made available for wind energy use. Final assessment of suitability and permissibility must then take place at the land-use-planning level (Bauleitplanung) or within the relevant procedures under immissions-control law. Areas in question should not be set aside in advance as regional-planning suitability categories, however, since the necessary decision-making latitude in the present specific case context should not be overly restricted.

Even in a conservative scenario in which modification of restriction categories along infrastructure corridors would be expected to make only 2-10% of the total relevant area additionally available, more than 5,000 MW of additional wind-energy capacity could be installed. And that figure, which is of a significant order, includes consideration of the uncertainties – which from a perspective of methods undoubtedly are present – in transferability of model results to Germany as a whole.

The described method for "reassessment" of areas previously classified as restriction areas is simple to apply at the local level. It can be of use in identifying additional new sites for wind energy plants, sites that would entail only modest additional impacts at most and thus would not be likely to conflict seriously with the aims of nature conservation and immissions protection.

**Final report**

Last revision: 31 March 09

The potential for expanding use of wind energy along infrastructure corridors

*Note:**A short version (Part III) of the present long version of the research report has been prepared that focuses on the project's main results.*