Locating Sites for Locally Unwanted Land Uses: Successfully Coping with NIMBY Resistance

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1. Introduction

Since the late 1970s, the Not In My Backyard ("NIMBY") phenomenon has become a challenge for urban planners, policymakers, developers and regulators in developed countries. NIMBYism characterizes a negative social response to locally unwanted land uses ("LULU's") such as nuclear waste repositories, land fills, mining activities, power plants, hazardous waste disposals or transport infrastructure. In addition, also social facilities like affordable housing projects, detention centers or homeless shelters can be objects of massive public resistance. Even "good" facilities that enjoy high support in general expressed in opinion surveys (e.g. wind energy farms or urban infill development) are faced with massive opposition at the "grassroots level".

For facility managers, it is a frustrating experience that many efforts to site a new development have ended in failure, in serious delays or in cost overruns due to unexpected mitigation and compensation measures. In contrast, local opponents often point to an unfair distribution of benefits and costs of "dirty" facilities and criticize technical dominated and hierarchical oriented planning approaches. What are the key factors that need to be considered and what are key mistakes that need to be avoided in a successful siting process of risk-related facilities? The intensity of public opposition against an unwanted facility or land use seems to be a function of three factors, the nature of the proposed activity, the nature of the region or community selected as a site, and the way in which the siting process is organized. Obviously, for engineers, urban and environmental planners, the latter is of crucial importance. Numerous studies show that the way in which urban planners and engineers deal with NIMBY attitudes held by local residents highly influences the viability of resistance and the outcome of planning. To effectively cope with social opposition against unwanted infrastructure, procedural fairness and transparency in planning is demanded.

Against this background, this chapter intends to enhance the understanding of the social aspects of the NIMBY phenomenon as a crucial prerequisite to effective and successful siting approaches. Planning recommendations are based on two "schools of innovation":

- the first considers siting as a social process of negotiating benefits and costs of unwanted land uses within a democratic decision arena;

- the second refers to an understanding of siting as a rational, knowledge-based process of systematically selecting site alternatives in a transparent manner.

The chapter is organized in three main parts. The first part (section 2) briefly describes the nature and social drivers of NIMBY responses. The literature related to the complexity of NIMBYism will be summarized. The other two sections introduce procedural standards as well as siting methods and techniques to carefully address NIMBY concerns. Section 3 portrays planning techniques to promote consensus building based on the results of social sciences. Section 4 describes innovative planning methods of siting "dirty" land uses based on standards of multicriteria decision making.

2. The Social Background of Negative Responses to Unwanted Land Uses

2.1 NIMBY concerns

Siting conflicts are extremely diverse in terms of the facilities that are considered as "locally unwanted", the locations involved, the impacts that might arise and the articulated reasons for opposition. Opponents of proposed facilities fear health risks and a decline in quality of life due to noise, traffic or threats to scenic beauty. An important motive is an expected decline in property values due to unattractive land uses in the neighborhood. Fischel (2001, p. 144) supposes that the rate of homeowners amongst LULU opponents is above average. Therefore, from a solely economic perspective, opposition is viewed as a rational "risk-averse" strategy by individuals who perceive a negative balance between the benefits they will gain from hosting a facility nearby, and the cost they have to bear (Lober 1995). Actually, there is clear evidence of a strong influence of spatial variables to the extent of NIMBY opposition. People who live closest to a facility are more likely to respond negatively. Lober (1995, p. 500) assumes an inverse relationship between distance and opposition. Individuals perceive lower risks form a planned facility the greater the distance they live from it.

However, NIMBYism cannot be narrowed to resistance of those people who live in the immediate affected area. Public opposition is also driven by people with broader interests in relation to environmental, social or political concerns. Opposition groups may include national-level non-government organizations that provide organizational and financial resources, based on their concerns about environmental protection, social justice or ethical standards (Schively 2007, p. 257). Sometimes, these groups do not only criticize the location of a noxious facility, but rather the principal demand of a technology or land use.

Another important issue is the different ways NIMBY responses are being expressed. Opponents often argue that the facility is not needed or does not belong in the area. The latter challenges land uses, which are not flexible in their location. This applies to resource extraction activities or renewable energy use. Here, "it is the site that chooses the project, not the reverse" (Kahn 2000, p. 22). Next to the question of location, NIMBY groups often criticize the siting process and the planning and participation procedures as insufficient, arbitrary or unfair.

In many cases NIMBYism resulted in the abandonment of the project under consideration. This can lead to a lack of access to needed services, associated with an excessive demand for transportation to receive service (e.g. transport of noxious waste to facilities in other states). Critics charge that NIMBYism has the potential to produce serious "gridlock situations" with negative effects on economic prosperity and social welfare. Another consequence of "successful" NIMBY opposition is the use of service strategies that are less efficient from an environmental or economic point of view, or the use of land that is not as suitable for siting a facility. Some scholars even assume that NIMBYism is jointly responsible for "leapfrogging" types of urban sprawl because planers and facility managers prefer sites with larger distances to "socially sensitive" land uses (e.g. residential areas) where less opposition can be expected.

2.2 Social and psychological drivers

The economic and social roots of NIMBY disputes can be explained by the specific spatial distribution of costs and benefits of an unwanted development (Lober 1995; Davy 1997). Lober (1995, p. 500) points to the fact that the net costs, though small to society, are relevant for individuals who live nearby the facility, thus stimulating NIMBY responses. In contrast, the net benefits to each member of the society are small, resulting in a limited incentive to politically support the facility. In other words, the regional benefits of a development are exceeding the local costs in total. However, from the perspective of an affected resident, the costs at the local level significantly outpace the low per capita benefits at the higher regional level. Table 1 provides a simple example to demonstrate this siting-intrinsic dilemma (Davy 1997): the operation of a hazardous waste facility is expected to yield a total benefit of 100,000 units of utility to a region with 1,000,000 residents. As a consequence of the development, 1,000 residents near the site incur a loss of 10,000 units of utility. In total, there is a net benefit of 90,000 utility units – without any doubt, the project would be profitable. For the 1,000 residents that are directly affected by the development, however, the relation of per capita costs and per capita benefits seems to be highly undesirable.

Benefits		Costs	
Total	Per capita (gained regionally)	Total	Per capita (incurred locally)
100,000	0.1	10,000	100

Table 1. Distribution of benefits and costs of a hazardous waste facility (Davy 1997)

This theoretical "benefit-cost-distribution" model actually corresponds with experience gained from real planning cases. As Wolsink et al. (2000) notes, "people generally do not come forward with positive responses to planners' agendas". Siting hearings and consultations are forums "where criticism is not only accommodated, it is solicited" (Kahn 2000). Taken wind energy farms as an example, Bell et al. (2005) suggest, that the design of planning processes unintentionally contributes to a bias of public perception of the acceptability of planned facilities. A planning scheme that starts with an initial siting proposal made by facility developers and a subsequent announcement to the public followed by the defense against public criticism provides protest rather than support. Bell et al. suppose a "democratic deficit", taking into account that opinion surveys indicate high support to wind energy use whereas particular wind energy projects often fail due to local opposition.

2.3 Controversial assessment of the NIMBY phenomenon

NIMBY responses have been subject of highly different characterization in the planning and social science literature. Both, negative and positive assessments exist. Some scholars regard

NIMBY and LULU opposition as being motivated by narrow self-interest. Following this characterization, a relatively small group of individuals may effectively put a facility project down ignoring the preferences of the majority. Moreover, NIMBY resistance could have the effect of successfully biasing decision makers' perceptions of community preferences. This effect is intensified by the fact that NIMBY opponents are typically older, more highly educated, wealthier, more likely to be homeowners, and thus more likely to be vocal and politically influential (Schively 2007, p. 257).

Other researchers consider NIMBY opposition – to a certain extent – as a normal form of "grassroots" democracy. NIMBYism stimulates a democratic discourse that ensures a higher quality of siting decisions. Active opposition against proposed development projects sensitizes decision makers and developers to the needs and concerns of affected residents and motivates to implement more sophisticated forms of participation, empowerment and consensus building.

3. Consensus Building Through Procedural Fairness

Social scientists claim that planners, regulatory agencies and politicians have narrowed siting approaches to a task of technical optimization. Such "orthodox" siting, as it is addressed by Davy (1997, p. 3), focuses on four main criteria:

- Profitability: facilities under consideration must yield a benefit to the operator regardless of its status as private or public.
- Functionality: the development of a facility must consider all technical aspects to ensure a functional operation.
- Safety: the development must avoid all harm, risks, and other adverse effects to human health and environment.
- Legality: the facility must meet legal standards.

This traditional approach presupposes – following Davy – that profitable, functional, safe, and legal facilities should be built. However, ensuring that these attributes are met does not necessarily guarantee public support. Based on numerous cases of "informative failures" of facility siting projects, Freudenburg (2004, p. 154) observes an ongoing ignorance of the advice of social research. He claims that planners, regulators and facility managers still ignore perception-related impacts of facilities such as health risk or community stigmatism and demonstrate unprofessional reactions to critics as being emotional, misinformed or irrational.

Owens (2004) warns against simplifying siting controversies to a clash of national or regional interests and local concerns. Following this view, opposition against projects tends to be marginallzed as being subordinated to "higher interests". The proclamation of national needs or the essential importance of projects may cover a lack of real consensus about need and could be a source of mistrust of the "real" interests of projects proponents. "This storyline overlooks the fact that need itself – and conceptions of 'the natural interest' – are often contested; it implies falsely, that issues raised in the form of local inquiry must thereby be 'local' in nature; and it assumes that generic and local considerations can be separated, and dealt with in a neatly hierarchical fashion "(Owens 2004, p. 110). Owens claims that a constructive debate about the desirability of facilities (or land uses) has often been the result of local controversies at the "grassroots" level. Should we aim to meet demand following a traditional "predict and provide" scheme or should we manage demand in another way? The public planning and permit system should encourage such broader, more strategic considerations of planning problems than preventing them.

Another serious source of mistrust is the observable or assumed tendency of locally unwanted land uses to be allocated in socially distressed or "politically weak" areas regardless of technical suitability criteria. As Freudenburg (2004, cited from Owens 2004, p. 104) cynically noticed, "it's funny how technical criteria tend to be satisfied on the poor side of town".

The crucial challenge for successful siting of problematic land uses is consensus building. Incorporating consensus building efforts into siting processes requires more than simple public hearings where "top-down information" on what is planned and the likely effects of the plan is presented. Schively (2007, p. 261) points out, that negotiation is "perceived as the fairest and most acceptable mechanism for siting … facilities". At the same time, empirical evidence shows that informal processes seem to be more effective in promoting consensus than "official" consultation. Because such forms of communication and negotiation are time-consuming and associated with results difficult to anticipate, facility managers aim to avoid them. However, the likelihood of consensus situations – and actually successful siting – increases with the quality of communication and the perception of procedural fairness by the affected stakeholders. Risk-communication must encompass the full range of stakeholders concerns. Next to technical issues, the study of potentially adverse effects, carried out by the permit agency or the facility proponent, should also address risks associated with reductions in property values and impacts on the quality of life or the image of the host community. Arguments of residents should never be marginalized as irrational, emotional or ignorant to the facts.

Furthermore, a siting procedure and the final decision should be acknowledged as being fair. Fairness demands for an open minded discussion of all benefit and cost factors of the project under consideration. Planners and regulatory agencies are well advised to avoid a "MAD approach to decisions making – to Make, Announce, and then Defend a choice of a preferred site" (Freudenburg 2004, p. 165). If the affected community is confronted with irreversible decisions, a siting approach tends to exacerbate social opposition and reduce trustworthiness of public institutions. Fairness also includes "geographic fairness". As Kunreuther and Susskind (1991) note, it is not fair to locate a critical mass of noxious facilities in a single community or region, even if local residents are willing to accept them. Finally, the aim for fairness could incorporate compensation for the host community or region. In order to limit the intrinsic dilemma of an unequal benefit-cost-distribution with siting decisions, transfer payments to the host community can be an effective means of consensus building. However, compensation may not be successful in cases, when moral or ethical concerns are the key drivers of local opposition.

Based on a national workshop held in 1989, US siting experts issued guidelines for an effective facility siting process (Table 2). The so called "facility siting credo" summarizes the above reflected recommendations of social and political researches and may be used as some kind of checklist for examining the procedural appropriateness of any planning scheme that deals with LULU siting.

Guidelines for an effective facility siting process	
Institute a broad based participatory process	Representatives of all affected groups should be invited to participate in and be assisted at each stage of the siting process
Achieve agreement that the status quo is unacceptable	A siting process must begin with an agreement that a facility is needed. The relevant stakeholders need to understand the consequences of doing nothing
Seek consensus	A serious attempt should be made to involve all the relevant stakeholders to address their values, concerns, potential needs and wants
Work to develop trust	Lack of trust is perhaps the most important barrier to reaching consensus. Those attempting to site a facility must recognize potential sources of mistrust
Choose the solution that best addresses the problem	Problems must be addressed with a facility design and a solution that stakeholders can agree as appropriate
Guarantee that stringent safety standards will be met	No community should be asked to compromise its basic health or safety so that a facility can be built. Preventive measures for reducing the hazard should be encouraged and the proposed facility must meet all health, safety and environmental standards
Make the host community better off	If facilities respond to real needs the magnitude of benefits should be large enough for transfer payments to be made to the host community
Fully address all negative aspects of the facility	When impacts cannot be prevented or mitigated to the satisfaction of the affected parties, various forms of compensation can be negotiated
Use contingent sites through agreements	Some concerns about the management of facilities can be resolved by specifying contingent agreements that spell out what will be done in case of accidents, interruption of service or changes in standards
Seek acceptable sites through a volunteer process	Encourage communities, regions or states to volunteer sites indicating that it is not an irreversible commitment and that there are potential benefit packages (e.g. new revenues, employment, tax reductions) that come with the facility
Consider a competitive siting process	Assuming that multiple acceptable volunteer sites are found, facility sponsors should consider a competitive process of site selection
Work for geographic fairness	It is inappropriate to locate too many noxious facilities in a single locale even if a community is willing to accept them
Set realistic timetables	It is appropriate and helpful to set and enforce realistic deadlines
Keep multiple options open all the time	It is never a good idea to have just one possible site for a LULU even at the final stage of the process

Table 2. “The facility siting credo” (cited from Kunreuther & Susskind 1991)

4. Implementation of Multicriteria Site Selection Methods

4.1 The nature of spatial multicriteria decision making

The siting of noxious facilities or other kinds of locally unwanted land uses is a typical spatial decision problem. It involves a set of geographically defined alternatives, from which a choice is to be made based on a transparent set of evaluation criteria. The decision problem covers five components: (1) a set of goals that represents the normative foundation of the final decision, (2) a set of evaluation criteria or attributes on the basis of which the decision or policy maker evaluates alternatives, (3) a set of geographical alternatives and (4) information regarding the outcome or consequences associated with each alternative (Malczewski 1999).

Multicriteria methods are usually categorized as discrete or continuous, depending on the domain of alternatives. The first approach (called multiattribute decision making) deals with a discrete, limited number of predefined alternatives. The latter (multiobjective decision making) operates with variable decision values to be determined in a continuous domain of a quasi infinite number of feasible alternatives (Malczewski 1999). Table 3 gives an overview on the different nature of both types of multi-criteria decision making.

Criterion	Multiattribute decision making	Multiobjective decision making
Domain	Discrete (pre-specified alternatives)	Infinite (unlimited number of alternatives)
Objectives	“Open” objectives evaluation criteria related to objectives	Explicit goals (e.g. min-/max- targets)
Assessment and Aggregation	Performance table with criteria scores Aggregation of criteria scores with defined rules (preferences as weights)	Use of objective functions with given restrictions Preferences as weights related to different objective functions
Dominant data types in GIS environments	Vector	Raster
Result	Selection of the “best“ alternative (ranking)	Calculation of “feasible” alternatives
Well-known methods (examples)	Analytic Hierarchy Process (AHP) Outranking-methods Utility Analysis	Goal programming

Table 3. Multiattribute and multiobjective decision making

Usually, siting approaches combine methods of multiattribute and multiobjective decision making. A "top-down" screening that makes use of Geographic Information Systems (GIS) often uses a set of exclusionary criteria to limit the geographical scope of more detailed analysis of potential sites. Subsequently, a set of specified alternatives are ranked with suitability criteria.

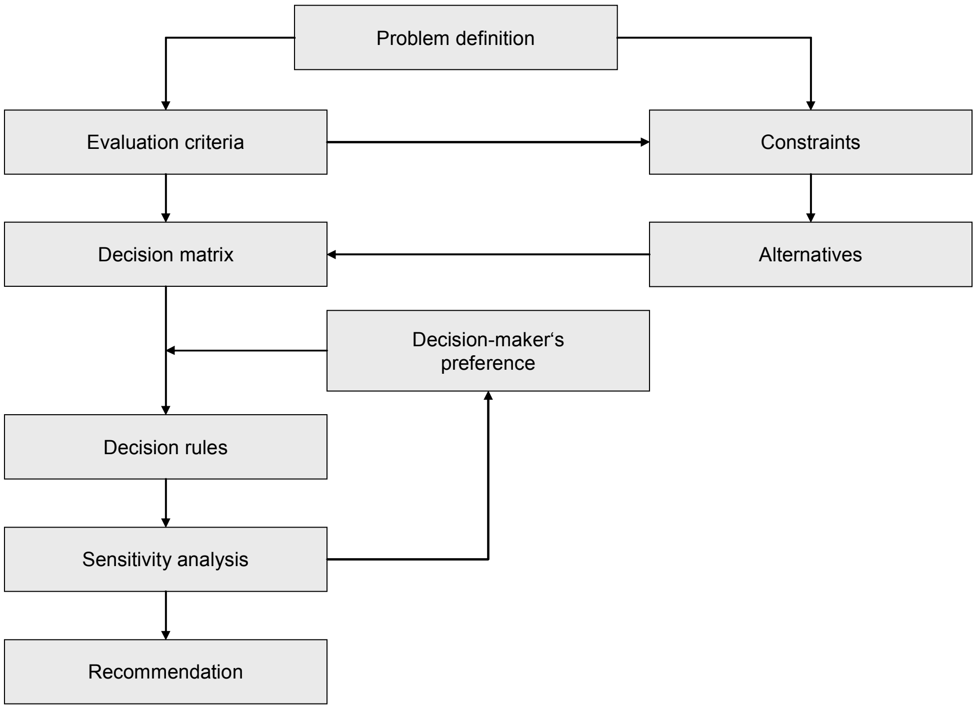


Fig. 1. Framework for spatial multicriteria decision making (adapted from Malczewski 1999)

Figure 1 outlines the basic approach of a multicriteria decision analysis (Malczewski, 1999). After defining the problem – here, a suitable site for a specific land use has to be found within a given normative decision space – certain evaluation criteria are determined. The evaluator should formulate a comprehensive set of objectives that reflects all concerns relevant to the decision problem and objective-related measures (attributes). After excluding areas that are considered as non-suitable by using constraint criteria, a set of feasible alternatives describe the decision space. A constraint represents natural or political/social restrictions on the potential alternatives. Constraint analysis is usually carried out with conjunctive and disjunctive screening methods or with the use of target constraints (e.g. as demanded minimum or maximum attribute values). Subsequently, the specified alternatives are described with a decision matrix that displays all attributes of all alternatives (also called performance table). The normative basis of the final evaluation is the degree to which the objectives are fulfilled, measured by attributes. However, at least two methodological steps have to be made before ranking the alternatives according to their objective-related performance. First, the process of ranking decision alternatives typically involves criteria of different importance to the decision situation. The evaluator or decision maker has to assign weight factors to each criterion. Weights indicate the relative importance of objectives or attributes to other criteria under consideration. Secondly, the alternative's attributes are normally measured in different scales, whereas most multicriteria methods require that attributes are expressed in a similar scale. Therefore, a standardization procedure has to be carried out (e.g. a linear transformation procedure.

With a given set of alternatives, the decision matrix with standardized attributes, and the predefined weights, the final decision is just a formal step. The decision maker has to select a decision rule that provides an ordering of all alternatives according to their objective-related performance. What kind of decision rules is considered as appropriate depends on the specific decision situation. In many cases, a simple additive weighting will meet the requirements; additive weighting means to calculate a total score for each alternative by multiplying the (standardized) attribute values by their weight factors and summing the products over all attributes. The alternative with the highest individual score is regarded as the preferred one. However, this kind of aggregation is restricted to decision situations where linearity of attributes can be assumed. Linearity means that the desirability of an additional unit of an attribute (e.g. hectare, kilometer, individuals) is constant for any level of that attribute.

Alternatively, the decision maker can use value/utility function methods to aggregate the attribute values for the final decision. Here, attribute utility functions are used to transform attribute values into an interval-utility scale (compare the comments to Utility Analysis).

What is the contribution of multicriteria decision methods in coping with siting conflicts? Methods like the Analytic Hierarchical Process (AHP) or even simple computer-assisted overlay mapping techniques can help to overcome opposition by supporting a transparent, trustful planning process. Transparency of information (data sources and indicators used) and normative assumptions (e.g. criteria weights) is a prerequisite of effective communicating about risks of planned facilities. In contrast to a solely "political" decision based on a set of qualitative expressions of preferences and a non-quantitative aggregation, formal multicriteria decision methods allow critics to "decompose" the decision for a site (or the exclusion of alternatives) in every detail.

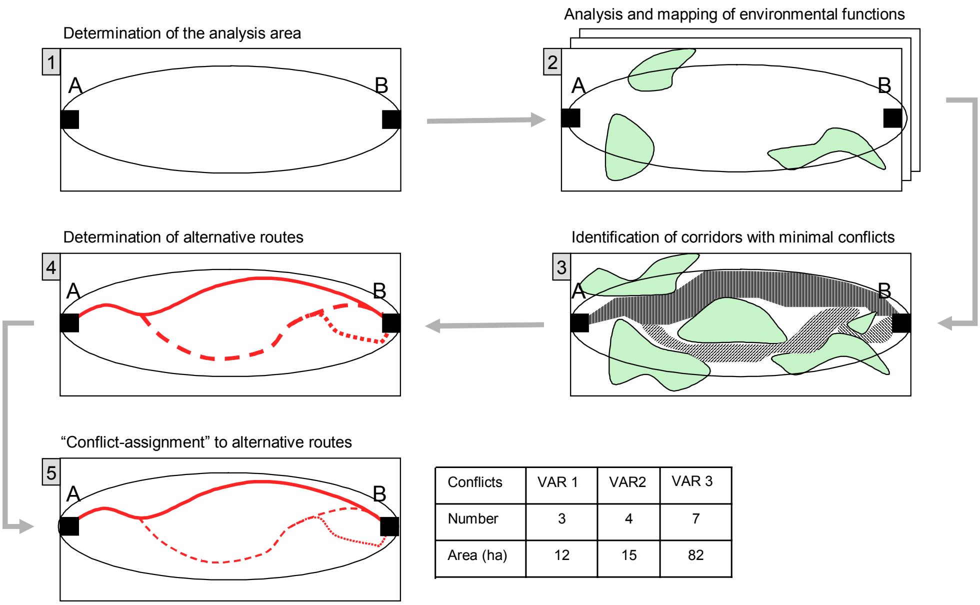
Of course, "top-down" siting procedures should be reflected against bottom-up considerations derived from local hearings or more sophisticated forms of consensus building. Freudenburg (2004, p. 157) strongly recommends the incorporation of local knowledge into technical site selection approaches: "The problems with […] top-down approaches often become more evident, for example, in the face of the fact that local citizens may know more about certain characteristics of local sites than will be available in the aggregated data used by the GIS analyst, leading to conversations along the lines of, 'If this is supposed to be a scientific process, how could you have "overlooked" something that everyone [here] knows?'" The results of multicriteria analysis should never be presented as the ultimate technical solution of a decision problem which makes any kind of further consideration needless. Therefore, quantitative multicriteria decision techniques following a rational and logical planning credo on the one hand and forms of local negotiation and consensus building on the other hand are complementary not exclusionary.

4.2 Overview on multicriteria analysis methods

There are numerous methods for structuring a decision problem, evaluating feasible alternatives and prioritizing alternative decisions that can be implemented in siting procedures (see Malczewski 1999 and Malczewski 2006 for an overview on methods). In this subchapter, only some of them will be briefly described.

4.2.1 GIS-based overlay mapping

Overlay mapping is one of the most frequently used methods in environmental planning. Its basis approach is relatively simple. Following a given problem definition, certain evaluation criteria resp. attributes are presented in the form op maps or map layers in a GIS environment. Each map can be regarded as an individual suitability map with respect to the land use under consideration. Based on defined aggregation rules (see above), these maps will then be combined to provide an overall suitability map. GIS software provides the operator with a broad range of tools related to map algebra techniques. Therefore, if appropriate geodata sources are available, overlay mapping is quite easy to implement.



Conflicts	VAR 1	VAR2	VAR 3
Number	3	4	7
Area (ha)	12	15	82

Fig. 2. GIS-based identification of infrastructure corridors with minimal environmental conflicts

Figure 2 shows the workflow of an overlay mapping approach used in transport planning in Germany. The procedure intends to identify a suitable corridor for a road or railway track in an early stage of planning. The “suitability” of potential corridors is assessed by their potential conflicts with environmental and social values. After determining the study area (phase 1), environmental and social values that might indicate natural or social constraints for infrastructure planning (e.g. protected habitats that might be dissected or sensitive urban functions that are affected by noise emissions) have to be mapped and organized in a GIS layer structure (phase 2). Based on a spatial overlay of potential constraints and conflicts, alternative corridors with an expected minimum number of conflicts are determined (phase 3 and 4). Finally, all alternatives are compared with respect to their conflict intensity (phase 5). A simple summation of function-specific conflicts can be used here.

Another overlay mapping method, popular in German environmental planning, is called Ecological Risk Assessment (ERA). The method attempts to estimate the "ecological risk" of projects in situations that are characterized by a high degree of uncertainty. In ERA, "risk" means the possibility of threats to valued natural assets and ecological components. The estimated risk is regarded as the product of natural vulnerability and the level of perturbation (or disturbance) due to the project under consideration. Risk modeling in ERA follows the common rule that the higher the vulnerability and the level of perturbation, the higher the risk of an environmental damage.

The method is organized in three steps. In step 1, the potentially affected area by the project and its physical features has to be analyzed. Step 2 attempts to assess the level of vulnerability based on a thorough analysis of valued ecological components (or functions). The results of this analysis are stored as a series of GIS layers. With step 3, the ecological risk has to be estimated. Usually, a simple matrix with ordinal scales for addressing vulnerability and perturbation features is used for this final step (Figure 3). Map algebra functions technically support this kind of risk modeling in a GIS environment.

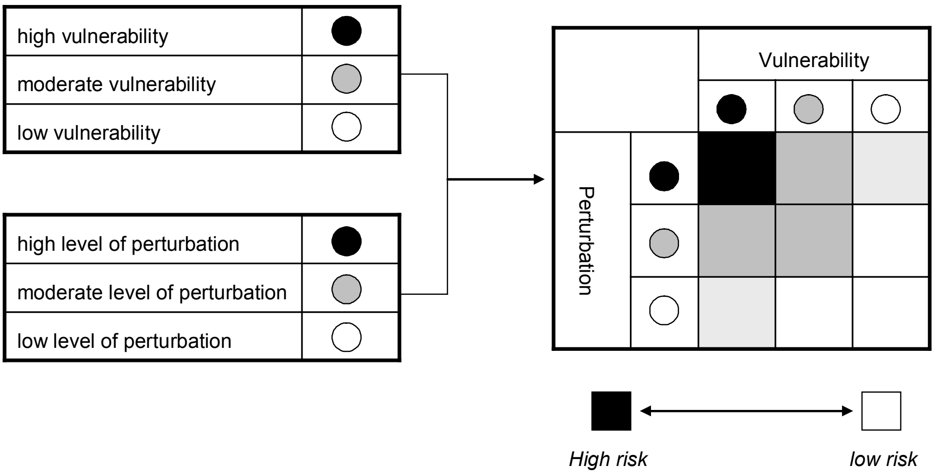


Fig. 3. Risk-assessment scheme in Ecological Risk Assessment (ERA)

4.2.2 Analytical hierarchical process

The Analytic Hierarchical Process (AHP) – developed by Thomas Saaty in 1980 (Saaty 1980) – requires the operator to decompose a decision problem in form of a hierarchy of objectives, criteria and alternatives (Figure 4). The method involves one-on-one comparisons between each element of a certain hierarchy level. Pairwise comparisons are used to assign relative weights on the objectives and criteria based on a standard ratio scale (Table 4). Saaty introduced different approaches to calculating relative weights based on a pairwise comparison matrix. The result is a composite set of priorities for the lowest tier of the hierarchy, namely the alternatives.

One of the main advantages of the method is the fact that it is able to process information of different scales. Qualitative judgements ("A is much more important than B") are handled in the same way as numeric values ("A is 5.4 whereas B is only 2.9").

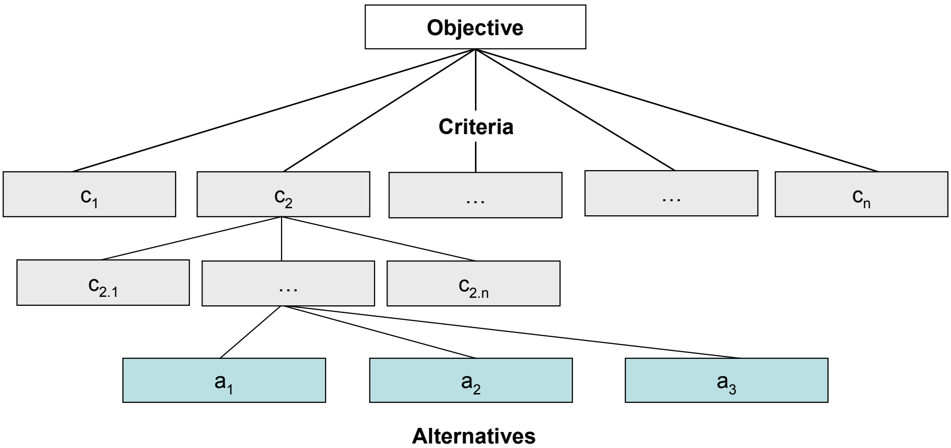


Fig. 4. Hierarchical structure of a decision problem within the AHP process

Scale	Meaning/Interpretation
1	same
3 (1/3)	a little bit larger (smaller) or more important (less important)
5 (1/5)	significant larger (smaller) or more important (less important)
7 (1/7)	much larger (smaller) or more important (less important)
9 (1/9)	very much larger (smaller) or more important (less important)

Table 4. The AHP standard scale for pairwise comparisons

4.2.3 Utility analysis

Next to Cost-Benefit Analysis, Utility Analysis (UA) is one of the best-known multicriteria analysis methods used in environmental and infrastructure planning in Germany (see Figure 5). The key principle of UA approaches is the transformation of attribute values of different scales into an interval (value) scale, usually a standard scale ranging from 0 to 100 or 0 to 1.0. The transformation process requires criteria-specific transformation functions (also called utility functions), which reflect the decision maker's preferences. The transformed values are aggregated into a total utility value that represents the performance of an alternative. Weights are used to express the different importance of the employed criteria. The multiplication of (criteria resp. attribute specific) utility values by the determined weights leads to partial utility values. In the standard procedure of UA, the final aggregation is carried out as a simple summation of partial utility values. The alternative with the highest total utility value is the preferred one.

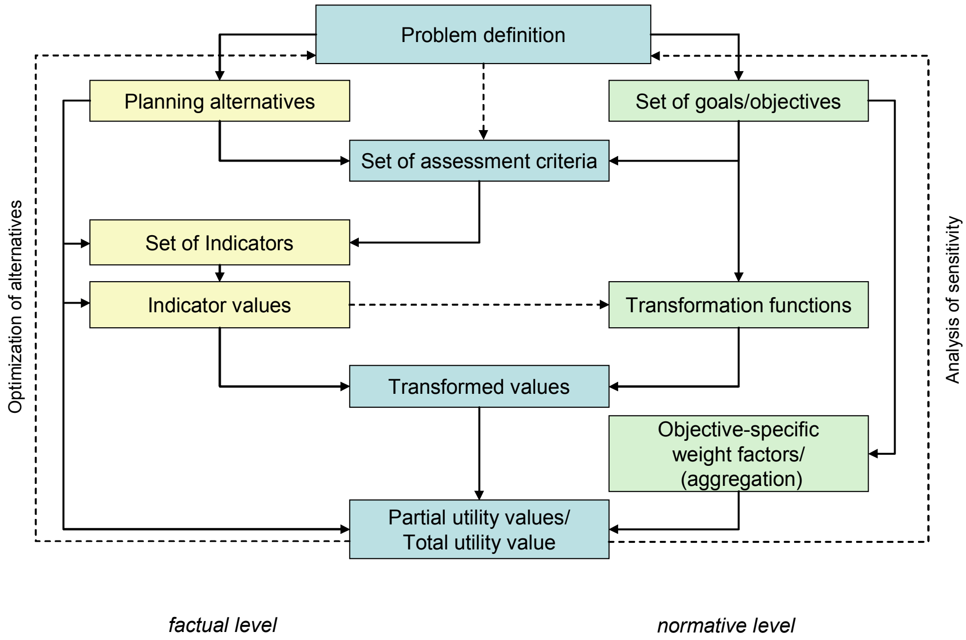


Fig. 5. Basic scheme of Utility Analysis methods (adapted from Bechmann, 1989)

It should be emphasized that UA approaches underlie one crucial assumption: the additivity of attributes. The additivity assumption requires that there are no interaction effects between the selected attributes. Complementarities between attributes may lead to inappropriate results. Therefore, the implementation of UA methods should be based on a thoroughly carried out theoretical analysis of the decision situation.

4.3 Case study: the siting of wind energy farms in Germany

Due to massive public funding, Germany experienced a tremendous growth in wind energy production in recent years. Currently, more than 18,000 wind energy plants with a capacity of 20,000 MW are installed throughout the country with spatial hubs in coastal and "flat" regions of the North. In 2006, the share of wind energy to total electricity consumption was more that 6%. Like in other western countries, wind energy planning in Germany is characterized by high public support of wind energy use in general but massive opposition against local windfarm projects.

After experiencing a phase of chaotic spread of wind mills in the 1990s, the German legislator adopted some amendments to federal regional and urban planning codes in order to achieve a more controlled wind energy planning. Henceforward, the use of wind energy outside urbanized areas ("Außenbereich") was regarded as privileged. "Privileged" means that certain kinds of land uses are permitted in general without making any arrangements for their location. Developers must get permission unless public concerns are opposed to a specific (privileged) land use. Taken wind energy use as an example, relevant concerns could encompass negative effects to scenic values, threats to well-being of residents nearby

proposed mills or nature and species protection goals. However, the legal barriers for permit agencies to deny permission are quite high.
At the same time, regional and local planning administration got the right to effectively manage the location of wind energy mills by means of spatial concentration zones as well as "no-go" zones for future wind energy production. The most powerful instrument of regional and local land use planning is called suitability area ("Eignungsgebiet") where specified land uses (e.g. wind mills) are to be concentrated (see § 7 Sec. 4 No. 3 of the Federal Regional Planning Act). Within the suitability area, the land use under consideration has priority against rivaling land uses. Outside the area, the land use is totally prohibited.
Based on numerous court decisions and planning guidance documents provided by state agencies, a standard procedure of wind energy planning (and the siting of wind mills) has been implemented in regional and local land use planning. Most importantly, the courts consider negative planning associated with a total ban for privileged land uses as illegal. The Federal Administration Court has pointed out that the exclusion of wind energy production from parts of the jurisdiction is justifiable only in cases when the land use plan secures the priority of wind mills against other land uses on other suitable lands. Simply spoken, a community that dislikes wind mills is not allowed to ban them from their territory by exclusionary zoning. German courts demand a coherent planning concept that acknowledges the privileged status of wind energy production outside urbanized areas without violating the legal rights of other land users. Therefore, an area-wide and integrated suitability analysis is regarded as crucial to meet the legal requirements for wind energy planning.
The suitability analysis is usually organized as follows:

- In step 1, areas that are regarded as non-suitable for wind mills are excluded from further analysis; Table 5 outlines a set of exemplary criteria for the exclusion of "no-go areas".
- In step 2, areas with wind speeds below commercial standards have to be excluded from further analysis.
- Step 3 aims to model the conflict potential in the remaining areas after excluding no-go areas and areas with unsuitable resource quality. For this purpose, a set of criteria indicating conflicts with other land uses is used. Areas with a critical spatial overlay of conflicts are excluded. Often, a simple additive weighting is used to determine those areas.
- Step 4 excludes smaller areas below a threshold value (e.g. 20 hectares) to avoid a spatial dispersion of small wind farms. However, the relevance of step 4 depends on whether regional or local policy makers prefer a lower number of larger wind farms (with more than 10 or 20 mills).
- Finally, step 5 undertakes an individual assessment of remaining areas with technical and economic criteria (e.g. accessibility by road or tracks, connectivity to existing power lines) as well as small-scale conflict criteria (e.g. soil features, distance to farms or small settlements).

This stepwise suitability analysis can be effectively supported by GIS tools. Both, raster and vector data analysis will be relevant for solving the siting task.

Criterion	Value
Distance to urbanized areas	< 700 m
Distance to four-lane motorways	< 40 m
Distance to two-lane federal and state roads	< 20 m
Distance to railway tracks	< 50 m
Nature protection areas	Area with a 200 m buffer
Nature protection areas of European importance (FFH and bird protection areas)	Area with a 1.000 m buffer
Distance to rivers and creeks	< 10 m
Protected forest areas	Area with a 200 m buffer
Areas for groundwater protection	Area

Table 5. "No-go areas" for wind mill siting in Baden-Württemberg

5. Conclusion

The NIMBY syndrome is by no means an impregnable barrier towards successful facility planning. The way in which planners and engineers deal with NIMBY attitudes held by local residents highly influences the viability of resistance and the outcome of planning. Planners should learn from "informative failures" and improve the quality of procedural standards. Procedural fairness, based on a broad risk-communication, is a crucial prerequisite in successfully coping with NIMBY opposition. GIS-based multicriteria analysis methods may help to slow down protest by supporting a transparent, trustful planning process. Providing transparency of information and explicit or implicit normative assumptions is an effective means of communicating about risks of planned facilities. It should be emphasized that quantitative multicriteria decision techniques, following a rational and logical planning credo, on the one hand and forms of local negotiation and consensus building on the other hand are complementary not exclusionary.

6. References

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