Case study: Province Utrecht

Creation and definition of alternatives

The definition of alternatives is restricted by a number of preconditions. The Province made a map with three zones. First, zones where windmills are forbidden. Second, zones where there are no legal objections, however, the location of windmills is unfavourable. Third, zones that are suitable for the location of windmills.
The location of windmills is forbidden (first zone) when:

- Urban dwellings are located within a distance of 350 m.;
- The location is within the provincial main ecological structure;
- The location is within the Bird and Habitatguidline area's;
- The location is within areas of silence (animal and bird protection);
- The location is within national nature protection areas;
- The location affects national or local monuments;
- The location affects – former – defensive works or archaeological valuable areas;
- The location affects water collection areas;
- The location is in the flight path of incoming aeroplanes;
- The location is near main fuel or gas pipe lines;
- The location is within 30 m. from the road, 36.5 m. from a high voltage cable, 50 m. from a canal, or 7.85 m. + half of the diameter of the rotor from a railroad.

Furthermore, the technical specifications of the windmills are important for the definition of alternatives. In particular the height of the windmills and the distance between the windmills should be taken into consideration. Of course, the type of wind turbine has also a large impact on the results of the evaluation, in particular the energy benefits.
In the definition of alternatives a base variant windmill of 1.5MW (height windmill: 85m., diameter 3 bladed rotor: 75 m.) is applied.
Additional two other types of turbines are evaluated:

- variant 1: 2.5MW (95 m. high, 3 bladed rotor of 90 m.);
- variant 2: 4.5MW (124 m. high, 3 bladed rotor of 114 m.).

Several project developers stated that a new type of turbine (3MW, 100 m. high, 3 bladed rotor of 100 m.) might be an additional alternative. However, this variant is not included in the evaluation.
The distance between the windmills should be at least 4 (preferable 5) times the rotor diameter. Thus the distance between two standard 1.5MW turbines should be 300-375m.

The Province prefers locations adjacent to infrastructure and/or industrial sites. However, no suitable locations are found near industrial sites. Furthermore, the windmills should enrich the landscape: the pattern of the windmills should follow the structure of the landscape and the colour of the windmills should be adjusted to the landscape.
In the final selection of favourable sites, four of the planned locations are alongside highways. The fifth location is alongside a canal. The windmills should be preferably located in long lines (location 1 and 2) or otherwise in a series of small rows (location 3, 4, and 5).
The locations are:

1. A2 Highway Vinkeveen – Abcoude: 9 respectively 8 windmills in line
2. Amsterdam-Rhine canal Houten – Wijk bij Duurstede: 2 rows of 9 respectively 2 rows of 8 windmills in line

3. A12 Highway Harmelen and Woerden: near each city 2 rows of 4 respectively 2 rows of 3 and 1 row of 3 combined with a row of 4 windmills on both sides of the highway
4. A1 Highway Baarn and Amersfoort: near each city a row of 5 respectively 1 row of 5 and 1 row of 4 windmills
5. A2 Highway Breukelen: 2 rows of 4 respectively 2 rows of 3 windmills north and south of the city

For all locations there are several options mentioned. This depends on the type of turbine selected. For instance, in the case of the A2 location Vinkeveen – Abcoude, there is enough space for a row of 9 windmills when turbines of 1.5MW (base variant) or 2.5MW (variant 1) are selected. However, when turbines of 4.5MW (variant 2) are selected the location is only large enough for 8 windmills due to the increasing distance between windmills by increasing length of the rotor diameter.
For each location a few alternatives are developed. Most alternatives concern changes in the number of windmills due to changes in the location of the windmills, in particular changes in the distance to the highway or canal.

In Table 1 the planned locations (Plan) and their alternatives (Alt. A and Alt. B) are presented.
Additional alternatives are:
- the zero-alternative in which the Province undertakes no action at all to install windmill capacity. The initiative has to be taken by project developers. Nevertheless, the municipalities and the province have to provide building permits. For those building permits the locations have to fulfil the same requirements considering international, national and local guidelines as is the case when the Province holds the initiative.
- the most environmentally friendly alternative. This is a combination of – parts of - the above mentioned locations that leads to the least environmental damage.

Table 1: The planned locations and their alternatives in the province of Utrecht

	Locations				
	1 A2 Vinkeveen	2 Amsterdam Rhine canal	3 A12 Woerden	4 A1 Baarn	5 A2 Breukelen
Plan	9 resp. 8 windmills 100 m. east of A2	2x9 resp. 2x8 windmills 50 m. of canal	4x4 resp. 3x3 + 1x4 windmills 40 m. north of A12	2x5 resp. 5+4 windmills 40 m. north of A1	2x4 resp. 2x3 windmills 100 m. east of A2
Alt. A	8 resp. 7 windmills 270 m. east of A2	9+8 resp. 8+7 windmills 100 m. resp. 130 m. of canal	4x4 resp 2x3 or 2x4 windmills 2 lines 130-190 m. and 2 lines 40 m. north of A2	2x5 resp. 5+4 windmills 320-420 m. north and 40 m. south of A1	2x4 resp. 3+4 or 2x3 windmills 100 m. east of A2
Alt. B		2x7 resp. 2x6 windmills 120 m. resp. 500 m. of canal	2x4 resp. 2x3 windmills 100 m. north of A2	2x6 windmills 120 and 500 m. from A1	

Source: Province Utrecht (2004)

Given the number of windmills on each location and the capacity of each windmill installed, only a selection of the 5 selected locations need to be realised to arrive at the target of 50MW. However, the Province strives for the development of all locations. If they succeed to realise all 5 windmill parks, the total installed capacity will be minimal 78MW and maximal 239MW (depending on the type of windmills installed).