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Health based guidelines for wind turbine noise in the Netherlands

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Abstract

Deriving health based guidelines for wind turbine noise is not to be different from those of other noises. That means assessing dose effect relations for relevant health effects, using adequate noise indicators, followed by a cost benefit analysis.

The subsequent choice is what level offers adequate protection. The experience in the Netherlands shows that in making that choice a few non acoustical (and even non scientific) factors may creep in. What a good preparation does however is to limit the playing field. The resulting guidelines are health based, but the exact outcome is down to politics

Introduction

In 2001 a noise complaint was filed by inhabitants of a small village in the North-East of the Netherlands. They said that at certain nights they were disturbed by a low rumbling sound. They pointed to the new wind turbines that were build just across the German border, 0,5 to 2 km away. These complaints were handled formally: the wind turbines (98 meters hub height) satisfied the German noise regulations, and also to the Dutch regulations (even they did not apply). Interventions by the Dutch government were of no avail. The complainers however took their problem to the nearby Science-Shop of Groningen University. The Science Shop took this serious and carried out a series of accurate measurements. The results confirmed that something was going on. The full description of the measurements and the debate with the wind farm branch is reported in a thesis at the Groningen University, and it reads like a detective novel [1]. It turned out that the assessment method in use at that time had had some serious flaws in handling industrial noise.

In the meanwhile because of the discussions in the media the confidence in the current practice of assessing wind turbine noise methods declined to a minimum. This was exploited by active groups opposing wind turbines.

After almost 2 years of heated debate, the Ministry of Environment decided to study the matter. In the next paragraphs the decision process and the data that played role in setting new limits for wind turbine noise are described

Deriving new limits for wind turbines

In a blank situation the general approach for a noise regulation – indeed for many environmental or other types of regulation- would be:

1) assessing the impact on the population
2) evaluation of impact
3) assessing options to avoid or reduce impact considered undesirable.
4) cost-benefit analysis of the options or of mix of options
5) assessment of the preferred option
6) implementation

A general principle which applies to all the steps, is the discussion with stakeholders, the affected as well as the producers.

Assessing population impact

A study by the National Institute for Health and Environment [2] provided the data on the number of wind turbines in the Netherlands, the installed power and hub-heights (fig. 1). By the end of 2008 there were nearly 2000 turbines in operation.

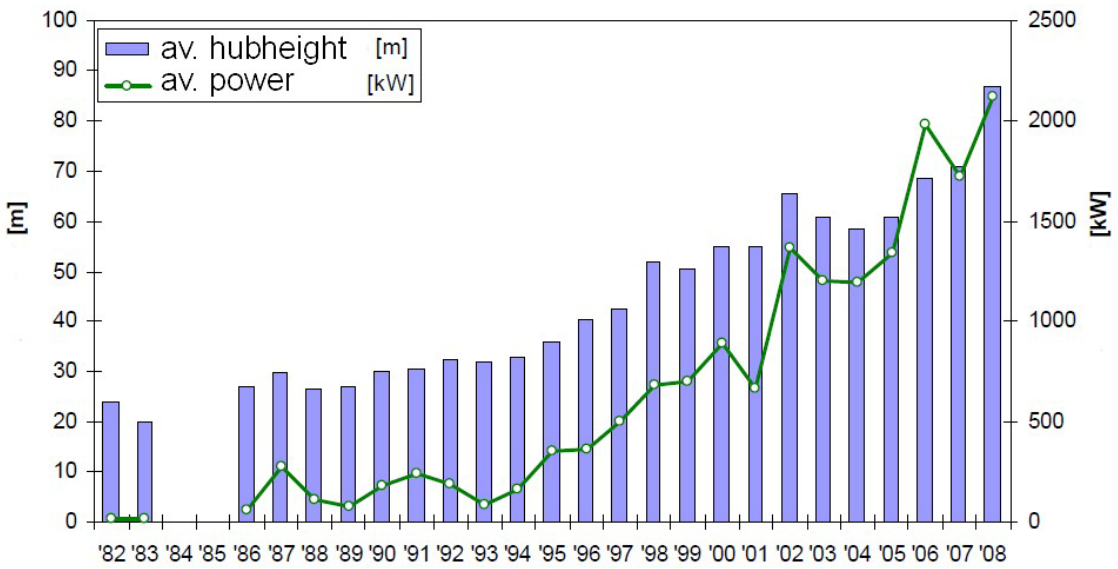

Figure 1: Hub height and power setting wind turbines in the Netherlands [2]

At first the an overview as made of wind turbine noise regulations in various countries.

Table 1, wind turbine regulations in different countries			
Country	Noise Indicator	planning limit	Remarks
Germany	Leq,day/night (at 95% of rated power)	50 /40 45/35	Mixed residential residential
Swiss	Leq,day	50	
	Leq,night	40	
France	Leq?	Maximum +3 or +5 dB above background at 8 m/s	background=L99,99 (quitest 30 min.)
Denmark	Leq, day	45	
Italy	Leq, day	55	
UK	L90, 10 min	43	achtergrond+5
Sweden	Leq, night (at 8 m/s)	40	- 5 dB for cottages
Netherlands	Leq,day	50/53	3 dB WNC correction for < 15 MW turbines
	Leq, night	40/43	Idem
Norway	Lden	45	Proposal
Canada	Leq, 1hr	45	Background (in L90) dependent
New Zealand	Leq?	40 or background+5	background in L95

Although there seems to be some convergence on the levels, there is much variation in the way noise is measured or calculated and in the dependence of the background. Information on the expected effect is at best anecdotic (based on occurring complaints). This was known to be the case for the Dutch regulation as well, so it came as no surprise. After discussions with an expert group it was decided to rely on the EU-indicators Lden and Lnight. That meant that existing data (also dose-response relations) had to be expressed in these indicators.

In the first step of assessing the impact, model calculations were used to derive the noise levels, given in table 1.

Table 1. Exposure to noise from wind turbines in the Netherlands[2]	
Noise levels in Lden(dB)	**Number of dwellings**
> 29 dB	200.000
> 40 dB	6810
> 45 dB	1390
> 47 dB	810
> 50 dB	330

This figures are low when compared to exposures from other sources. Probably 70% of the Dutch population (that is ~5 million houses) is exposed to levels over 50 dB lden, and still 40% over 55 dB Lden.

A study by TNO[3] provided the health impact of wind turbine noise. It turns out that annoyance is the most significant effect in the usual exposure range. In figure 2 it is shown that wind turbine noise is more annoying than most other noises.

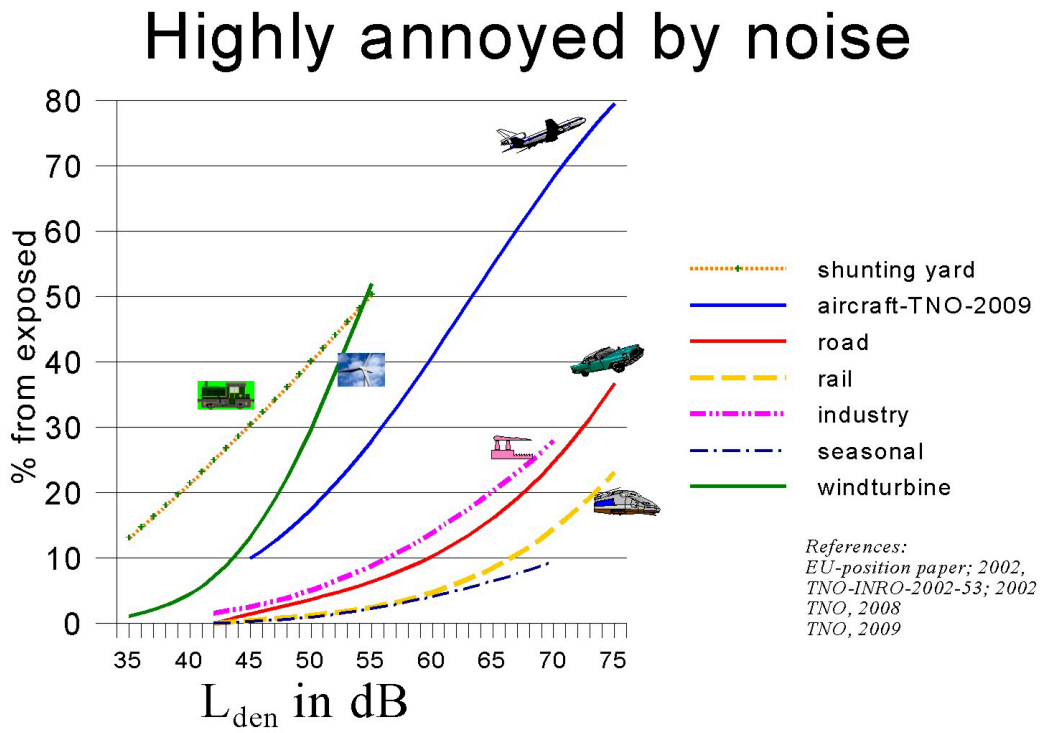

Figure 2: Highly annoyed by noise from various sources[3]

The dose-effect study by TNO could not convincingly demonstrate a relation between night time exposure for wind turbines and an effect. Also no interaction between wind turbine noise (annoyance) and background noise could be proved. This is further discussed in [4], but there is no backing to use this in regulation, in contrast with most other regulations.

Using the relation between Lden and highly annoyed the number of highly annoyed by all wind turbines can be calculated to be around 1500.

Evaluation of impact

The impact of wind turbine noise on public health is very low compared to other sources. The total number of highly annoyed due to noise in the Dutch population is estimated at 5 million people. In the last national survey (2003) wind turbine noise was specifically addressed, but remained below the detection limited (around 10.000). There are no specific data for other power-generating activities, but it is estimated to be equally low.

Also on an individual level the impact is low. Levels higher than 50 Lden are rare as level higher than this occur only at 300 dwellings. On the other hand, these could be extremely annoying situations, with > 50% of the exposed reporting high annoyance. The steepness of the curves shows that the sensitiveness to the exposure is high, so some precaution is sensible. Comparison of maximum allowable levels show that such highly annoying exposures are not often allowed in the Dutch practice. Table 3 shows the percentage highly annoyed for other sources in the Netherlands.

Table 3. Percentages highly annoyed for major sources in the Netherlands

	Motorways	Railways	Industry	Airports
Preferred level	4%	4%	2%	30%
Maximum Allowable	14%	16%	9%	54%

With the exception of airports, citizens are reasonably well protected against noise. If the maximum allowable noise levels for industrial noise are taken as guidance, 9% of highly annoyed would correspond with 47 Lden by wind turbines. Because of the operational mode of wind turbines (mostly at night time) this would limit the night time exposure to 41 Lnight.In the extreme case that the machine would be switched of at day and evening time this would go up to 42 Lnight. In any case comfortably close to the WHO's Lnight recommendation of 40.

Options to reduce impact or avoid new exposure

The Dutch policy for renewable energy (20GW by 2020) leans on a fair contribution from wind energy. In the short term, an additional 2GW on land (doubling the present amount) is foreseen.

It is clear that the stricter the limitations on noise exposure, the less possibilities there are for placing wind turbines. Table 4 shows the relation between maximum allowable noise level and free space for wind energy.

Table 4. Potential free surface for placing wind turbines depending on limit value.				
Limit value in Lden	Potential usable land surface	Potential free surface for noise	Rest free surface (> 1km^2)	Existing dwellings> limit value
37 dB	27%	8%	0.3% (3 GW)	--
40 dB		15%	2% (7 GW)	6810
45 dB		34%	7% (25 GW)	1390
47 dB		43%	10% (34 GW)	810
50 dB		57%	14% (50 GW)	300

Even the lowest limit value leaves seemingly just enough room to place the 2 GW required in the short run. Because of other limitations (like to need to place wind turbines in farms so they can profit from the same infrastructure) this is highly unlikely.

Another factor to consider is the number of existing dwellings above the new limit value. It could be argued that these dwelling would have to meet the limit value in the long run as well, which in the Dutch practice might mean that an improvement program would have to be set up.

Even with the limit values in place, most would mean to increase the number of highly annoyed more or less proportional to the number of wind turbines installed. On the whole of the noise problems in the Netherlands this would hardly be noticeable.

After consultation of the stakeholders (wind branch, communities, environmental groups, wind energy opponents, science representatives and more) finally a draft proposal was submitted to parliament on 31 August 2009.

Assessment of preferred option and political decision making

After considering all the input the proposal as made public was:

- Limit value of 47 Lden
- No provision for background noise.
- New calculation method based on wind speed on hub height
- Every new wind turbine must present an acoustic report to competent authority.
- Measurements only used to control sound power (wind speed dependent)

- Turbine owner must keep record of sound power production

As could be expected the wind branch asked for a – slightly – higher level of 48 Lden, and the wind turbine opposants a much lower level: 40 or 35. Considering the low population impact, an expected maximum of 9% highly annoyed and the need to provide room for at least 2GW, a level of 47 Lden was found to be acceptable. Without societies need for renewable energy a lower level would probably have resulted.

After the official publication of the proposal the opponents started a successful with their MP's which lead to repeated debate in the media and in Parliament. A motion was in the end put to the vote and accepted, in which the Minister was asked to introduce Lnight in order to assure adequate protection for sleep.

The motion was at first rejected with the argument that it was useless as the Lden value of 47 Lden would guarantee a Lnight value of 41 Lnight not to be exceeded. As this value of 41 dB was close to the WHO-guideline of 40 Lnight, it was argued that sleep quality would barely be endangered. Political pressure was such that in the end the Minister had to give in, and so the final regulation including Lnight (be still at the proposed value of 41 dB) came into force on January, 1st, 2011.

Conclusions

The preparation of the Dutch regulation on wind turbine noise shows that even in a difficult political field a rational discussion on noise limits is possible. What is needed is a good understanding of the basic principles and reliable data about exposure and about possible health effects.

References

[1] van den Berg, G.P., The Sounds of High winds , thesis Groningen University, 2006
[2] Verheijen, E, et all. 2009. Evaluatie nieuwe normstelling windturbinegeluid, RIVM, Bilthoven, Netherlands
[3] Janssen, S.A., et all, Hinder door geluid van windturbines, TNO, 2008.

[4] Pedersen, E, vanden Berg, GP. Why is wind turbine noise poorly masked by

Road traffic noise?, Internoise 2010