Rijksinstituut voor Volksgezondheid en Milieu
Ministerie van Volksgezondheid, Welzijn en Sport

Driemaandelijks overzicht van relevante literatuur over windenergie en gezondheid *Q3-2023*
Periode juli t/m september 2023

Het Expertisepunt Windenergie en Gezondheid houdt voor haar kennisbasis de wetenschappelijke literatuur bij over windenergie en gezondheid. Elke drie maanden wordt een overzicht gemaakt van de nieuwgevonden wetenschappelijke en grijze literatuur.

In dit document vindt u het overzicht van de literatuur gevonden in de hierboven aangegeven periode.

Literatuuropbrengst

Hieronder wordt eerst een overzicht gegeven van de wetenschappelijke artikelen gevonden in diverse literatuurdatabanken. Daarna volgt een (niet-uitputtende) opsomming van overige relevante bronnen, zoals (Nederlandse) onderzoeksrapporten en conferentieverslagen, ook wel grijze literatuur genoemd.

Disclaimer

Deze selectie is tot stand gekomen met behulp van een zoekprofiel (zie bijlage Methode Zoekstrategie) en toepassing van inclusie en exclusiecriteria. Op deze documenten is geen dataextractie toegepast noch is er een algemeen kwaliteitsoordeel aan gegeven.

Literatuur gepubliceerd in wetenschappelijke tijdschriften

Tabel 1 Overzicht van het aantal gevonden studies

Fase	Juli-September 2023
Aantal artikelen gevonden met zoekstrategieën voordat selectie heeft plaatsgevonden	132
Aanvullende referenties gevonden via andere bronnen (dit betreft niet de grijze literatuur)	1
Aantal referenties na verwijdering van duplicaten	109
Verwijderde referenties omdat ze niet relevant zijn (voldoen niet aan inclusie en exclusie criteria)	99
Aantal relevante artikelen geselecteerd door reviewers	11
Aantal artikelen waarover reviewer 1 en reviewer 2 hebben afgestemd (grensgevallen)	6
Totaal aantal relevante artikelen (na afstemmen)	7

Overzicht van de relevante studies

1. Titel: Evaluation of risk perception related with environmental noise among residents living in different vicinities of wind turbines
Samenvatting (gekopieerd uit artikel): This cross-sectional study assessed residents' risk perceptions and associated factors in three rural areas by administering a face-to-face questionnaire to 282 subjects. The association between the perception of risk related to wind turbines and related factors such as noise and annoyance was analysed. Outdoor A-weighted sound pressure levels were measured for all. According to regression analysis, age (B: -0.008, 95% CI: -0.015/-0.002), education (B: 0.415, 95% CI: 0.148/-0.682), noise level day (B: -0.040, 95% CI: -0.068/-0. 013), noise annoyance indoors (B: 0.504, 95% CI: 0.227/0.781) and distance (B: 0.000, 95% CI: 0.000/0.000) had a significant effect on high risk perception ($p < 0.05$). This demonstrates that, in addition to noise, non-acoustic factors also influence risk perception. Ensuring community participation and considering distance before installation could prevent negative risk perceptions and annoyance.

Referentie: Ata, T. & Hassoy, H. (2023). Evaluation of risk perception related with environmental noise among residents living in different vicinities of wind turbines. *International Journal of Environmental Health Research*.
Link naar bron: https://doi.org/10.1080/09603123.2023.2245344

2. Titel: Mapping perceptions of energy transition pathways: Ascribed motives and effectiveness
Samenvatting (gekopieerd uit artikel): This study examines how people perceive possible pathways of a societal transition towards less carbon intensive means of energy production and use. Data were collected with questionnaires among samples of university students in Norway (N = 106) and Germany (N = 142). Participants selected from a set of 15 motives those which they considered to be strongly associated with each of 25 pathways, including examples such as public transportation and nuclear power. Participants also rated the effectiveness of each single pathway, that is, their perceived impact on climate change. Results indicate that the various pathways were associated with specific motives; for example, individual actions such as taking public transportation were closely associated with a self-restraint motive, pathways such as nuclear power and market strategies such as carbon offsets were closely associated with motives supporting free market and progress, and technological solutions such as solar panels and hydro power were associated with the motive for sufficient energy supply. The German and the Norwegian sample did not differ markedly in which pathways were associated with which motives; nor did effectiveness ratings for pathways differ between samples. Solar panels, wind farms, and hydropower were on average regarded as having a mitigating impact on climate change, whereas nuclear power was on average considered to have no mitigating impact. The findings are discussed in the context of public engagement with several of the suggested pathways, noting differences in perceptual patterns across samples. © 2022, The Author(s).

Referentie: Doran, R., Böhm, G., Pfister, H. R. & Hanss, D. (2023). Mapping perceptions of energy transition pathways: Ascribed motives and effectiveness. *Current Psychology, 42*(20), 16661-16673.
Link naar bron: https://doi.org/10.1007/s12144-022-02804-w

3. Titel: Saved by hydrogen? The public acceptance of onshore wind in Norway

Samenvatting (gekopieerd uit artikel): Achieving the green energy transition is not without difficulty. This is also the case for the deployment of renewable energy infrastructures. Among these, onshore wind has often been contested. Taking the case of Norway where opposition to onshore wind has grown, this article evaluates how different production, financial, and end-use schemes can mitigate opposition. One factor stands out: that the wind farm is used not only to produce emission-free hydrogen but that this hydrogen is also sold locally to decarbonize sectors such as transport and industry. In other words, hydrogen on its own will not "save" onshore wind from contestation, but hydrogen with a local purpose will render citizens more supportive of these projects, even when situated in their own municipality. This effect is particularly strong among younger and more educated citizens. However, it transcends the rural-urban divide which often structures attitudes towards onshore wind projects. © 2023 The Authors

Referentie: Jikiun, S. P., Tatham, M. & Oltedal, V. M. (2023). Saved by hydrogen? The public acceptance of onshore wind in Norway. *Journal of Cleaner Production, 408*.
Link naar bron: https://doi.org/10.1016/j.jclepro.2023.136956

4. Titel: Attitudes toward Wind Power in Norway–Solution or Problem in Renewable Energy Development?

Samenvatting (gekopieerd uit artikel): Wind power has become an increasingly important source of renewable energy in Norway. Current demand and production capacity have exceeded expectations stipulated in energy policies a few years back. Wind power affects landscape characteristics, and the rapid development has created considerable public conflict. However, knowledge to date about public attitudes toward wind power development in Norway is limited. We surveyed a representative sample of the Norwegian public to examine relationships between wind power development and place attachment, localization, and policies. We also examined if attitudes toward wind power are linked to broader environmental attitudes and meaning of place. Public attitudes range from strong support to strong opposition. We found limited support for NIMBY effects. Support versus opposition correlates with attitudes toward place attachment, localization of wind power plants and energy policies. We found evidence of a dichotomy between the more fundamental world views of eco-modernism versus de-growth influencing the more specific wind power attitudes. We argue that policy institutions have underestimated the power of attitude diversity in the wind power debate, and that social acceptability of future wind power development will depend on improved understanding of how social values of landscapes are impacted.

Referentie: Kaltenborn, B. P., Keller, R. & Krange, O. (2023). Attitudes toward Wind Power in Norway–Solution or Problem in Renewable Energy Development? *Environmental Management, 72*(5), 922-931.
Link naar bron: https://doi.org/10.1007/s00267-023-01870-5

5. Titel: Why municipalities reject wind power: A study on municipal acceptance and rejection of wind power instalments in Sweden

Samenvatting (gekopieerd uit artikel): This article explores municipal acceptance of wind power in Sweden and draws conclusions on the basis of semi-structured interviews with municipal decision-makers, together with analysis of documents and statistical data. In line with previous research, it demonstrates that wind power opposition is more complex than just a NIMBY effect. The attitudes of local residents influence municipal decision-makers, but may also act to augment and mobilize opposition. Perceptions of distributional injustice, generated by the lack of local economic benefits and the

geographically uneven deployment of wind and hydropower, are also relevant in explaining community and municipal acceptance. Moreover, municipal acceptance depends on national political discourses, economic aspects, institutional settings, regulations and sociopolitical factors. To overcome acceptance barriers, the article argues for the need of some kind of formal compensation schemes, directed to both local communities and the municipality. The authority of the municipality to levy taxes on wind power could potentially rectify perceptions of energy injustice between different geographic regions, stimulate higher approval rates, and motivate municipalities to assume a role as an intermediary, accommodating different, and sometimes conflicting, local, national, and global interests. © 2023 The Author

Referentie: Lindvall, D. (2023). Why municipalities reject wind power: A study on municipal acceptance and rejection of wind power instalments in Sweden. *Energy Policy, 180*.
Link naar bron: https://doi.org/10.1016/j.enpol.2023.113664

6. Titel: How does society assess the impact of renewable energy in rural inland areas? Comparative analysis between the province of Jaén (Spain) and Somogy county (Hungary)

Samenvatting (gekopieerd uit artikel): This article seeks to contribute to the knowledge of energy transitions in Europe by focusing on community perceptions in two European regions belonging to two divergent spatial models of energy transition on the continent. Through a series of questions, it addresses the social assessment of the impact of renewable energies in three main dimensions: environmental, landscape and socio-economic. The article is based on the comparison of two case studies, the province of Jaén (Spain) and the county of Somogy (Hungary). Both are characterised as rural inland regions with a similar level of renewable energy development (not very high) and fairly similar socio-economic characteristics (agrarian economy and ageing). The results show that there are no major differences between the two territories. In general, there is a tendency to assess the impact of renewable energies as negative, especially in the case of wind farms, with the exception of the positive assessment made by respondents when they were asked about local tourism. However, the option "No impact" was mainly selected by respondents when assessing the impact in most questions. Factors such as the lack of knowledge and information, the lack of social consideration in projects or even a lack of interest towards these topics could explain this social stance. © 2023 Universidad de Alicante. All rights reserved.

Referentie: Rodríguez-Segura, F. J. & Frolova, M. (2023). How does society assess the impact of renewable energy in rural inland areas? Comparative analysis between the province of Jaén (Spain) and Somogy county (Hungary). *Cultura de los Cuidados*(80), 193-214.
Link naar bron: https://doi.org/10.14198/INGEO.24444

7. Titel: Development and application of a semantic differential for perception-based optimization of wind turbine and other broadband sounds

Samenvatting (gekopieerd uit artikel): Growing numbers of the population are exposed to wind turbine (WT) and other broadband sound sources from the environment. Acoustically optimizing emissions of environmental noise sources to minimize negative effects on the population therefore becomes increasingly important. The objective of this study was to develop and apply a semantic differential (SD) for multidimensional perception-based assessment of WT and other broadband sounds, to be potentially applied for acoustic optimization. An SD was developed specifically for broadband sounds

and applied in a laboratory listening experiment, using outdoor WT and other broadband sounds covering a wide spectral range, at 40 dBA playback level. Fifty-two participants rated the sounds using the SD. Relevant perceptual dimensions were extracted, and a prediction model for noise annoyance was established on this basis. The experiment revealed that participants could well describe and discriminate the sound characteristics using the affective-evaluative everyday language of the SD. Four perceptual dimensions (or factors) were identified: Evaluation, Timbre, Activity and Randomness, with the latter three describing spectral shape, periodic amplitude modulation and random amplitude modulation, respectively. The factors were strongly linked with annoyance and well suited to establish an annoyance prediction model. The results can be applied in a perception-influenced design to identify how to optimize (perceived) acoustical characteristics and thus minimize annoyance effects on the population. Also, they might potentially be used in field surveys for a multidimensional assessment of broadband sounds to study the long-term annoyance potential of specific perceptual characteristics. This might eventually help to refine exposure–response relationships using predictors beyond basic noise metrics. © 2023 The Author(s)

Referentie: Schäffer, B., Pieren, R., Brink, M. & Schlittmeier, S. J. (2023). Development and application of a semantic differential for perception-based optimization of wind turbine and other broadband sounds. *Applied Acoustics, 211*.
Link naar bron: https://doi.org/10.1016/j.apacoust.2023.109493

Tabel 2 Indeling van de wetenschappelijke literatuur naar type en onderwerp.

	Hinder	**Slaap**	**Gezondheid divers**	**Anders (bijv. co-determinanten)**
Tekstmining (bijv. sentiment analyse van (sociale) media artikelen)				
Case study				
Observationeel (bijv. Cross-sectionele, cohort, of case control studies)			Ata (2023)	Doran (2023); Kaltenborn (2023); Rodríguez-Segura (2023)
Experimenteel	Schäffer (2023)			Schäffer (2023)
Review				
Anders (bijv. theoretisch model, opinie,...)				Lindvall (2023); Jikiun (2023)

Relevante (Nederlandse) onderzoeksrapporten en overige relevante grijze literatuur

Overzicht van relevante grijze literatuur

1. Titel: Beoordeling mogelijke risico's van chemische stoffen en plastic deeltjes van windturbines op zee

Beschrijving (gekopieerd uit rapport):

Windenergie is belangrijk om de overgang van fossiele naar duurzame energie mogelijk te maken. Daarom zullen er in de toekomst onder andere veel meer windturbines op zee komen. Zogeheten epoxy coatings en 'opofferingsmetalen' kunnen worden gebruikt om windturbines te beschermen tegen corrosie. Uit deze materialen kunnen chemische stoffen vrijkomen. Het RIVM heeft uitgezocht of dit schadelijk kan zijn voor mens en milieu. Daarnaast is een inschatting gemaakt hoeveel plastic deeltjes vrijkomen door slijtage van de turbinebladen.

Op dit moment is niet bekend of bij Nederlandse windturbines op zee daadwerkelijk epoxy coatings en opofferingsmetalen worden gebruikt. Het RIVM heeft daarom een denkbeeldig scenario doorgerekend om inzicht te krijgen in mogelijke schadelijke effecten áls ze worden gebruikt. Om deze effecten niet te onderschatten heeft het RIVM gerekend met de ongunstigste aannames over de hoeveelheid stoffen die vrijkomen.

Zeker is dat de uitstoot van zink, indium, lood en cadmium uit opofferingsmetalen bij windturbines op zee niet schadelijk zijn voor mens en milieu. Het gebruik van epoxy coatings kan mogelijk wel schadelijk zijn. Of dit in de praktijk ook echt zo is, hangt sterk af van de gebruikte coating. Het verschilt namelijk per coating hoeveel en welke stoffen er uit kunnen vrijkomen. Het is daarom belangrijk om een beter beeld te krijgen welke coatings bij de huidige windturbines op zee worden gebruikt. Ook beveelt het RIVM aan om bij nieuwe windturbines uit voorzorg coatings te gebruiken waar geen of weinig stoffen uit weglekken.

Er is nog weinig informatie beschikbaar over hoeveel plastic deeltjes door slijtage van turbinebladen in de omgeving terechtkomen. Het RIVM schat dat de hoeveelheid plastic deeltjes die hierdoor in de zee komt kleiner is dan via andere bronnen, zoals de Nederlandse scheepvaart. Er bestaan tegenwoordig technieken om die slijtage zo veel mogelijk tegen te gaan. De precieze hoeveelheid deeltjes hangt onder andere sterk af van de gebruikte techniek.

Dit onderzoek is uitgevoerd in opdracht van het Staatstoezicht op de Mijnen (SodM). Het is een vervolg op een quickscan uit 2022 waarin verschillende aandachtspunten zijn benoemd.

Referentie: Hof, M., Bakker, J. & Spanbroek, N. (2023). *Beoordeling mogelijke risico's van chemische stoffen en plastic deeltjes van windturbines op zee* (RIVM-briefrapport 2022-0241). Rijksinstituut voor Volksgezondheid en Milieu.

Datum van publicatie: 18-7-2023

Link naar bron: https://www.rivm.nl/publicaties/beoordeling-mogelijke-risicos-van-chemische-stoffen-en-plastic-deeltjes-van