Independent Noise Working Group

INWG Analysis of WSP Report titled:

A review of noise guidance for onshore wind turbines

WSP report Ref: No. 70081416-001-03-03 PUBLIC
dated October 2022 and released 10 Feb 2023

Analysis of the report prepared by WSP for the UK Government Department for Business, Energy & Industrial Strategy (Now the Department for Energy Security and Net Zero)

INWG analysis dated April 2023

INWG Analysis of WSP Report titled:

‘A review of noise guidance for onshore wind turbines’

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Notes:

Text quoted from the WSP report, website or Linkedin page is shown in blue italics.
Text quoted from other documents is shown in black italics.
INWG comments or statements are shown in red and highlighted in grey

Web links identified by ‘open here’ are provided for convenience to access documents referred to in the text. All documents are in the public domain and we believe that all the websites accessed via these links are safe to use.

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Section 1 - Executive Summary

The report titled; '*A review of noise guidance for onshore wind turbines*' was released by acoustic consultant WSP on their company website on 10 February 2023 with an announcement appearing on their WSP Linkedin social media page, open here. An initial review of the web site report summary, open here raised some serious concerns regarding the integrity, impartiality and accuracy of this report to Government. As a result, the INWG decided to conduct an analysis of the WSP report.

At 400 pages in length, two or three times longer than needed, repetitive and with an excess of jargon it will dissuade all but the most determined reader to properly evaluate the findings. When we analyse the report, its methodology, authors and invited stakeholders it is concluded this review of ETSU-R-97 is biased with conflicts of interest throughout.

For the evidence review workstream at section 3, WSP admit they examined a restricted evidence base and utilised an inferior review methodology that they also admit is subject to a lower level of accuracy and greater risk of bias. There are several important topics that have been dismissed or not properly examined including low frequency noise, uncertainty (tolerances) and alternatives to ETSU-R-97.

The stakeholder engagement survey at section 4 of the report, is arguably the most important workstream within the review. Whereas the engagement objectives would appear to be reasonable, the implementation is judged to be deficient and compromised by bias. The survey composition of the 'by invitation only' stakeholders creates a bias in favour of the wind industry and is particularly imbalanced as it excludes those with direct experience of living near wind turbines and their representatives.

The poor LPA response rate of just 9% for the survey must be questioned as it indicates that something was fundamentally wrong with the way WSP invited LPAs. This 9% rate compares poorly against the 77% rate obtained by the INWG during a similar survey during 2014, open here. However, despite the survey bias and the poor LPA response rate, the findings do provide a useful benchmark for decision makers when considering the future guidance. The top 5 issues by number of respondents from Figure 4-12 and Figure 12-20 are:

- Guidance needs to establish how AM impact should be taken into account
- ETSU-R-97 is outdated and needs to be reviewed: technology and understanding have advanced since publication
- Difficult, costly or time-consuming to robustly establish compliance/non-compliance
- More / updated guidance on cumulative assessments is needed
- The ETSU-R-97 principles underlying the limits need to be reviewed

Despite this overwhelming evidence from the stakeholder survey that ETSU-R-97 has failed, WSP chose to include the written statement from two professional associations (see pages

162 and 163), which recommended to continue with the use ETSU-R-97. The unnamed professional associations in making this statement demonstrate their denial of the facts, the shortcomings of ETSU-R-97 and denigrate the so-called 'objector groups'. This would appear to be an unprofessional attempt to pressure government to retain ETSU-R-97 and to prevent independent scrutiny.

The field survey workstream at section 5 to obtain a snapshot of detectable AM has realised some helpful results. However, other than confirming what is already well known, the WSP field survey does not advance the understanding of AM or wind turbine noise.

Given the strength of the evidence revealed within the WSP report there is a clear and obvious disconnect between this evidence, and the report's conclusions and recommendations. This leads to the belief that the WSP report recommendations were predetermined.

INWG Recommendations

Following this review of the WSP report, the INWG make the following recommendations to Government, expanded below;

ONE	Reject the recommendations made by WSP in their review for ETSU-R-97 to be retained albeit with some revisions.
TWO	Replace ETSU-R-97 with BS4142:2014+A1:2019 as the official guidance for wind turbine noise assessment.
THREE	Reject the WSP suggested proposal for a government position statement on low frequency noise. This proposal is unsupported by the evidence and would conflict with the World Health Organisation (WHO) position.
FOUR	Conduct independent research into the effects on health and well-being of wind turbine noise including impacts from long term exposure, low frequency noise, infrasound, amplitude modulation and tonal noise as recommended by the WHO.
FIVE	Introduce licencing and regulation of wind power generation by a national agency such as the Environment Agency. This to include continuous monitoring and recording of noise and turbine data (SCADA) with the data available for compliance and complaint purposes.

ONE - The recommendation made by WSP for the retention of ETSU-R-97 with a few revisions is not supported by the report findings. The sheer volume and nature of the criticisms of ETSU-R-97 identified in the report, and especially the stakeholder survey

responses point to faults with the fundamental methodology underlying ETSU_R-97. These are faults that cannot be fixed by more revisions or further studies. The evidence from the WSP review plus two decades of criticisms make a clear case for replacement of ETSU-R-97. Retaining ETSU-R-97 and its fundamental methodology around derived noise limits appears to have been pre-determined and were a key objective of WSP when executing this review.

TWO - Arguably the most important omission by WSP in the report is consideration of an alternative to ETSU-R-97 and the continued avoidance of any discussion on the subject.

During 2015 the INWG proposed that ETSU-R-97 be replaced by BS4142. BS4142 applies to all other comparable industrial and commercial noise source assessment. BS4142 has been regularly updated and its suitability as examined at Table 1 must be fully evident to any competent acoustician.

BS4142 has been tested with wind turbine noise data by the INWG. There can be no technical, environmental or ethical reasons why BS4142 could or should not be used. BS4142 would provide the same level of protection to wind farm neighbours as is currently afforded for comparable forms of industrial and commercial noise sources. Also, BS4142 is much better understood by LPAs and its adoption would overcome the identified criticisms of ETSU-R-97 including control of AM, post construction compliance and complaint investigation.

THREE – WSP make the unsupported recommendation to government for a position statement to be made indicating that: "*infrasound from wind turbines at typical exposure levels has no direct adverse effects on health*".

This WSP recommendation concerning low frequency noise is completely at odds with the INWG findings at Work Package 2.1, open here and more recent evidence including the IARO scientific commentary, open here see Section 9 - Appendix. It would also be at odds with the WHO 2018 noise guidelines, open here. Additionally, such a position statement would be dangerous as it would effectively block further progress with understanding low frequency sound and; its health effects and would hinder resolution for affected communities seeking respite from wind turbine noise.

FOUR - The World Health Organisation (WHO) *Environmental Noise Guidelines for the European Region* dated 2018, open here states at section 4.2, page 100; "*Further research into the health impacts from wind turbine noise is needed so that better-quality evidence can inform any future public health recommendations properly."* And at Table 53: "*Exposure to noise at a wide range of levels and frequencies (including low-frequency noise), with information on noise levels measured outdoors and indoors (particularly relevant for effects on sleep) at the residence is needed*."

FIVE - In order to ensure an effective and consistent path for dealing with wind turbine noise nuisance, the INWG propose that industrial wind turbines should be licenced and subject to

oversight by a national agency, such as the Environment Agency. Regulation by a national agency would make it easier to ensure a consistent approach nationally, to maintain appropriate levels of technical competence and would bring wind power in line with other rural located polluting industries.

Net Zero

A theme not so subtly emphasised throughout the WSP report, is the use of the climate emergency as leverage to maintain a commercial advantage for the onshore wind industry. WSP are using this Net Zero threat as justification for being allowed to continue to inflict higher levels of noise than permitted from other comparable industries.

The deployment of wind power does not need to be a binary choice between protecting communities and residential amenity versus fighting climate change and meeting the objectives of Net Zero. It should be possible to generate the renewable power required, and from the most suitable sources, while still protecting host communities, residential amenity and the environment.

A key feature in a democracy such as the UK is that the rights of the minority are protected by the majority. Such protections for communities and the environment are now core values being promoted by the government for the ongoing review of the National Planning Policy Framework. The Levelling up and Regeneration Bill which is currently before parliament puts communities at the heart of the planning system.

Section 2 - Introduction

It is understood that the WSP report was intended to provide a high-level review of the issues surrounding the ETSU-R-97 guidance, and not intended as a platform for in-depth technical discussion. Therefore, this INWG analysis and critique of the WSP report also attempts to minimise detailed technical discussion while aiming to identify the key issues, and provide recommendations for government decision makers. After this introductory section, the INWG analysis generally follows the WSP report workstreams, these being:

- Evidence review
- Stakeholder engagement survey
- Field measurements

This is followed by a general discussion, then the conclusions and recommendations. It is also recognised that the ETSU-R-97 guidance applies to the whole of the UK, not just England.

Why this analysis and critique?

The report titled; '*A review of noise guidance for onshore wind turbines*' was released by WSP on their company website on 10 February 2023 with an announcement appearing on Linkedin social media, open here. INWG were informed of this announcement by a third party shortly after its release. From the WSP Linkedin page it was possible to download the 400-page report via the WSP website, open here.

The report release occurred as INWG were finalising a response to the government Department for Levelling Up, Housing & Communities (DLUHC) consultation to proposed reforms to national planning policy. It was considered that the WSP report was highly relevant to the DLUHC consultation, but the limited time remaining before the 2 March consultation closing date only permitted a preliminary review of the WSP report. As a result, only the summary information provided on the WSP website was reviewed at that time.

This initial review detailed at page 4 of the DLUHC consultation INWG response, open here raised some serious concerns regarding the integrity, impartiality and accuracy of the WSP report.

What was especially alarming is that WSP has recommended retention of ETSU-R-97 after some minor amendments. This recommendation is made despite overwhelming evidence from over two decades that ETSU-R-97 is unfit for purpose. What was most striking about the website summary was what has been excluded from the review. It was therefore decided that INWG would conduct a detailed critique with a view to presenting a report to government ministers.

Background and objectives to the WSP survey

Information provided by WSP on their website indicates that the review of noise guidance for onshore wind turbines was commissioned by the Department for Business, Energy & Industrial Strategy (DBEIS), now the Department for Energy Security and Net Zero.

The government tendering contract information dated April 2021 for the review subsequently awarded to WSP is available at the procurement website, open here. This shows a contract start date of 24 May 2021, an indicative contract value of £50,000 and the scope of the review is shown as;

"*The successful bidder will deliver a research report and recommendation as to whether the current ETSU guidance requires refreshing or if it remains suitable. To inform this research report and recommendation, the contractor will conduct desktop research of existing literature relating to ETSU and wind turbine noise, including AM. They will also conduct stakeholder engagement with those involved in the use of ETSU. The successful bidder will also be expected to conduct field measurements at different onshore wind installations to provide a snapshot of the magnitude of Amplitude Modulation that can be anticipated from the sample of turbines. The results of this work are expected to provide an initial guide as to whether there is any link between different turbine types and the extent of EAM and help identify whether further EAM measurement campaigns are needed and if so how these should be conducted and carried out. The outputs of this work will inform the research report and recommendation at Task 1. We invite bidders to suggest their own methodologies as to how they would undertake this task. Please ensure you review all attached information to ensure a full understanding of this requirement*."

DBEIS would appear to have provided a clear and reasonable scope of supply and objectives.

The understanding by the INWG of the scope and objectives is to determine whether the ETSU-R-97 noise guidance dated from 1997 and the IoA Good Practice Guide (on the use of ETSU-R-97) dated 2013 for onshore wind turbines are fit-for-purpose or should be updated or replaced. Then based on this determination to make recommendations to government.

WSP survey and report timetable

The INWG only became aware that this review of ETSU was taking place quite late in the process and only after being informed by a 3rd party during late August 2021. It was then discovered that the survey and review was being carried out by the acoustic consultant WSP on behalf of DBEIS and that the survey was by invitation only. The INWG had clearly not been invited despite having been active with wind turbine noise issues since 2014. Also, the INWG members are well known to the WSP authors.

A request was immediately made by the INWG to DBEIS to be allowed to participate in the survey and this was agreed by DBEIS on 1 September 2021. INWG subsequently responded to the survey by making a submission to WSP on 24 Sept 2021, open here.

Some 16 months later on 10 February 2023 the report was released by WSP on their own website. This 400-page report is dated October 2022 so would indicate that the report was likely delivered to DBEIS some 4 months previously. The report is also marked 'PUBLIC'.

This raises the question of whether there is another, possibly 'PRIVATE' version of the report in existence that could provide greater transparency of the WSP review process.

WSP report structure and contributors

When reviewing the report, the first aspect of note is that the report is much longer than expected or needed, possibly by a factor of 2 or 3. There is a lot of repetition throughout contributing to this excess. For example, there is a 4 page 'Brief Non-technical Summary' followed by a 23 page 'Executive Summary'. The sheer length of the report at 400 pages plus the use of excessive jargon is intimidating. As such much of the report will be difficult for anyone unfamiliar with acoustics to fully understand and it is considered most unlikely that any government decision maker would read the full report.

The identified WSP report authors, Michael Lotinga and Toby Lewis are well known to the INWG as they have represented wind turbine developers and operators with planning applications and at planning public inquiries. Toby Lewis will also be especially familiar with the noise problems with the Cotton Farm windfarm from his time as EHO at Huntingdon District Council where resident noise complaints are still unresolved. The INWG have provided support to the Cotton Farm residents group over several years. On an earlier version of their website, WSP proudly claimed their experience with onshore wind projects stating, "*We have a long track record supporting wind developers, utilities, funders and investors throughout the project life cycle*."

WSP commissioned Bernard Berry to peer-review sections 3, 6.1, 6.2 and 7 of the report. These sections being, Evidence Review, Discussion sects 6.1 and 6.2, Conclusions & Recommendations, these being the key technical sections. It should be noted that Bernard Berry is one of the original authors of ETSU-R-97 so may have a personal interest and reasons for ETSU-R-97 to endure. He also has had close connections with the wind industry for many years so cannot reasonably be considered as independent. Additionally, the peer review process does not appear to be the rigorous, independent and largely autonomous process normally applied to scientific and academic papers, but a much more informal in-house process.

There is an obvious conflict of interest with WSP undertaking this survey and with Bernard Berry as the peer reviewer.

The report also acknowledges seven others who have contributed; "*Andrea Bauerdorff, Dick Bowdler, Professor Guillaume Dutilleux, Dr Kristy Hansen, Dr Anders Johansson, Dr Yasuaki Okada and Dr Fei Qu in responding to research queries.*". Although these individuals are

associated with the wind industry in the UK and overseas, their contributions would appear to be more limited in scope.

About the Independent Noise Working Group (INWG)

The INWG's mission open here is ensuring that the acoustic impacts from wind turbines are properly controlled in order to protect public health and wellbeing.

The INWG, formed during August 2014, is a multi-discipline team fully independent of the wind industry supply chain and was jointly sponsored by Chris Heaton-Harris MP, Conservative, Daventry open here, and the National Alliance of Wind Action Groups (NAWAG). Most of the founding members of the INWG were associated with NAWAG but after the Written Ministerial Statement in 2015 from Greg Clarke open here that set much stricter controls for further wind turbine developments, the need for NAWAG in England was greatly reduced and it subsequently became dormant.

The main task of the INWG at that time was to conduct an independent and scientific study into wind turbine noise amplitude modulation (AM). This study needed to be able to credibly challenge the methodologies and findings of the Institute of Acoustics (IoA) sponsored AM study. There is great concern with IoA working group member conflicts of interest due to most of them working for the wind industry.

The results of this INWG AM study were presented to Government at Westminster on 13 October 2015 (DECC presentations 1 open here & presentation 2 open here) and at the Institute of Acoustics Conference at Harrogate on 15 October 2015 (open here). The thirteen AM study work packages are available on the INWG website, open here. Although this work dates from 2015, much of the work is still relevant today and is relevant to this latest review of the guidance.

The recommendations made to Government by the INWG during October 2015 included:

- ETSU-R-97 noise guidance to be replaced with a code of practice based on BS4142:2014.
- Independent research is required into the health effects of wind turbine noise including AM and low frequency noise.
- An effective AM planning condition required for every wind turbine planning approval.
- Continuous noise monitoring (with data transparency) should be required for every medium & large wind turbine planning approval.
- Effective remedy required for retrospectively dealing with noise nuisance including AM from existing wind turbines.

Section 3 - Evidence Review

For the WSP report Section 3, Evidence Review (pages 71 to 132), the research methodology at 3.2.1 was focused on the single primary question relating to the adequacy or otherwise of ETSU-R-97; "*Does the evidence indicate that the ETSU-R-97 guidance, when considered alongside the government-endorsed IOA best practice application guidance, requires updating to be consistent with the aims and objectives of current government policy and regulatory frameworks, and if so which aspects of it should be revised?*"

There also being a secondary focus with two secondary questions:

1. What further evidence or information would be needed to support any updating to the current guidance
2. Evidence if there is any on influence of turbine age and design on sound emission.

It is noted that WSP adopted the Quick Scoping Review (QSR) methodology and not the more rigorous Rapid Evidence Assessment (REA) and Systematic Review. Therefore, the selected QSR methodology is anticipated to be less robust, subject to a lower level of accuracy and with a greater risk of bias.

The search strategy at section 3.2.2 states; "*Pilot searches were carried out using a broad range of topics relevant to wind turbine noise assessment guidance, which identified a volume of publications that was not feasible to screen within the project timescales.*"
It is clear that a restricted evidence base was reviewed and the review process would be vulnerable to a lower level of accuracy and risk of bias.

A summary of the key findings in response to the primary and secondary questions are provided at the report section 3.5 (page 128 to 132). The stated findings from the evidence review would appear to reflect many of the earlier findings by the INWG. As a result, the INWG concluded during 2015 that ETSU-R-97 should be replaced, preferably by guidance based on BS4142.

Despite the clear evidence in the report supporting the view that ETSU-R-97 is not fit for purpose, WSP have concluded on page 130 that the guidance (ETSU-R-97) should be retained with some updates. There does not appear to have been any consideration of alternatives to ETSU-R-97 or discussion of the merits of BS4142.

Significantly, WSP have ignored the INWG Work Package 2.1 authored by Richard Cox titled Review of Reference Literature and dated July 2015 open here. This evidence review provides arguably a more balanced and complete review of the issues currently under consideration. Although dated from 2015 most of the findings, conclusions and recommendations are still relevant today.

Section 4 - Stakeholder Engagement

The stakeholder survey, section 4 of the report (pages 134 to 170), is arguably the most important workstream within the ETSU-R-97 review. This section of the INWG critique focuses on chapter 4 of the WSP report with additional material at Appendix C2.

Methodology and stakeholders

The engagement objectives (sect. 4.1.1) and engagement strategy (sect. 4.1.2) would appear to be fair and reasonable. However, participation was by invitation only and the survey was promoted exclusively to government entities (central government and local planning authorities) and industry professional organisations. Table 4-1 identifies all the respondent stakeholders. Community groups and individuals independent from the wind industry were effectively excluded.

The INWG were only by chance informed by a third party that the survey was taking place. Then only after lobbying DBEIS were the INWG allowed to participate in the survey. At Table 4.1 the INWG is shown as the only 'civic organisation' participating, no other independent groups or individuals are identified.

The INWG are aware of at least three survey submissions that were made by others. Since these are not acknowledged in the report, it would appear they were rejected from the survey. By excluding survey participation by individuals, it would have also excluded any industry professionals who may have differing views to their professional association.

For the survey to be effective and meaningful, participation by Local Planning Authorities (LPAs) is critical. However, only 19 LPAs are shown at Table 4-1 as having participated out of the 204 invited (sect 4.1.3). This poor rate of engagement with LPAs and would indicate something fundamentally wrong with the WSP stakeholder engagement strategy.

Five industry professional associations are listed at Table 4.1. These are:

- **RenewableUK** – The UK trade association for the wind industry. WSP is a member.
- **Scottish Renewables** – The Scottish trade association for the wind industry. WSP is a member.
- **Institute of Acoustics (IoA)** – The UK trade association for acousticians. The IoA wind turbine noise working group is made up almost exclusively by IoA member acousticians closely involved in the wind industry supply chain. The WSP report authors are IoA members.
- **Association of Noise Consultants** – Sponsored by the IoA, is the UK trade association for acoustic consultant companies. WSP is a member.
- **BSI PEL/88 Committee** - Responsible for the UK input into the work of IEC/TC88 and CENELEC/TC88 for standards for wind turbine generator systems. These standards will deal with safety, measurement techniques and test procedures.

The first four industry professional associations shown above are closely associated with the same group of acousticians who have controlled the wind turbine noise guidance since the 1990s when ETSU-R-97 was developed.

There must be serious concerns regarding the selective stakeholder identification process, the poor engagement with LPAs, and the exclusion of independent groups and individuals. This has created an unbalanced survey with a clear pro-wind industry bias.

Survey analysis

For this analysis we are dependent upon the information provided at section 4.2 and Appendix C3. The raw data in the form of the original responses have not been made available so limiting transparency.

Figures 4-1 and 4-2 show the stakeholder response rate. This shows 20 LPAs responded to the survey out of 204 invited. The total number of responses being 31. However, Table 4.1 identifies just 19 LPAs indicating a counting error so the response rate is actually 9.3%. The report does not indicate why the response rate is so low and especially so for England. Without transparency of the invitation process, we can only speculate as to why the response rate is so low and as to why WSP did not secure a better response rate.

In response to survey question 1.2, Figure 4-5 shows that 15 out of 31 responses considered that the guidance requires some updating and 13 out of 31 that it is inadequate and requires substantial revision. The two bullet items following after Figure 4.5 indicate that the members of two professional associations have a range of views as to the adequacy of the guidance although individual views have not been included.

Figure 12-7 showing views on the current guidance by respondent type is more informative. It shows that only one respondent, an LPA, considered the guidance adequate. Most of the national government and all of the professional associations considered the guidance mostly adequate. With the LPAs, 11 out of the 19 considered the guidance inadequate, 6 that it was mostly adequate, and one not sure.

A total of 13 out of the 31 stakeholders (LPAs, national government and civic group), 42% consider the guidance to be inadequate. One can only speculate what this percentage would have been had there been a higher response rate by LPAs and that the survey had been an open consultation.

In response to survey question 1.3, Figures 4-6 and 4-7 are also informative showing views on aspects of the guidance that are of concern. At Figure 4-6, of the 10 named topics, 7 are flagged up as being of concern by more than 50% of stakeholders. Figure 4-7 gives another helpful insight separating the views based on mostly adequate and inadequate. The red bars 'Inadequate and requires substantial revision' is considerably greater overall than the green bars 'mostly adequate, but requires some updating or amendment'.

In summary, Figures 4-5, 4-6 and 4-7 provide a clear indication that there are concerns with many aspects of the guidance. The wind industry professional associations consider that these concerns can be overcome with some updating, and that others, mostly the LPAs and the civic group consider that the guidance requires substantial revision.

Additionally, WSP conducted interviews with a few selected respondents that seems to have complicated the analysis and introduced an additional layer of topics. The report does not identify which stakeholders were interviewed or even how many out of the 31 were interviewed. In conducting these interviews to a likely small number of stakeholders in this way, WSP will have created an uneven playing field with either bias or perceived bias favouring the wind industry.

Survey question 1.4 asked; "*Please could you briefly outline the updates you believe need to be made to the current UK wind turbine noise assessment guidance, and identify any publicly accessible evidence you are aware of that would support or inform the updates indicated?*"

This request for comments on each of the topics listed at Q1.3 has resulted in 10 pages (pages 144 to 153) of analysis at Section 4 plus Appendix C3 (pages 362 to 384). A compilation of 125 topics has been produced by the authors at Appendix C3 Figure 12-20/21/22 and Table 12-10, and in truncated format at Section 4, Figure 4-12.

The top 5 issues by number of respondents from Figure 4-12 and Figure 12-20 are:

- Guidance needs to establish how AM impact should be taken into account
- ETSU-R-97 is outdated and needs to be reviewed: technology and understanding have advanced since publication
- Difficult, costly or time-consuming to robustly establish compliance/non-compliance
- More / updated guidance on cumulative assessments is needed
- The ETSU-R-97 principles underlying the limits need to be reviewed

The INWG welcome the results of this stakeholder survey as it has highlighted many of the concerns with ETSU-R-97 that have been raised over the last two decades by numerous organisations and individuals. So, while the INWG agrees with many of these identified themes as being topics of concern, even though insufficiently defined at present, they do provide a useful benchmark for decision makers when considering the future guidance for onshore wind turbine noise assessment.

Unfortunately, a detraction to this part of the survey is the introduction of interviews conducted with selected stakeholders in an opaque manner. When one examines Figures 4-12 it is quite evident that the red bar themes (includes interviewees) significantly outweigh the blue bar themes (non-interviewees only). This again highlights concerns of bias having been applied to the survey results by holding interviews with just a small number of selected stakeholders and the lack of transparency.

In response to question 1.4, the INWG submitted 10 pages of detailed responses on various topics. Unfortunately, much of the detail of these comments have been ignored in the report.

In summary, the WSP analysis to question 1.4 on pages 144 to 153 highlights the sheer number of issues raised by the stakeholder responses with the current guidance confirming the criticism of ETSU-R-97 made over the last two decades and more recently to the Good Practice Guide.

Despite the overwhelming evidence from the stakeholder survey that ETSU-R-97 is unfit for purpose, or possibly because of it, two of the professional associations supplied a written statement that WSP has reproduced on pages 162 and 163.

It is evident from this statement that the unnamed professional associations are in denial of the shortcomings with ETSU-R-97. Additionally, they have denigrated the so called 'objector groups' with the misleading statement; "*The fact that onshore wind development in the UK has attracted little adverse attention from those worried about noise does not mean that such an announcement would not stir up considerable interest from objector groups with no factual or scientific basis for their assertions*."

It should be recognised that this stakeholder survey included 31 respondents of which only one, the INWG might be described as an 'objector group'. Almost all the issues raised by stakeholders to question 1.4 as discussed above came from the other 30 respondents. The statement from these two wind industry professional associations ends with; "*While we do not feel there is a need for new UK wind turbine noise assessment guidance, any further modifications should include a panel of expert acousticians, wind farm, developers, government representatives and the IOA*".

It is therefore of further concern that the suggested panel fails to include audiologists, physicians or representatives of communities negatively impacted by wind turbine noise.

This statement on page 162 and 163 by the wind industry would appear to be an unprofessional attempt to retain ETSU-R-97 as the official noise guidance and to prevent independent scrutiny.

Section 5 - Field Survey Measurements

The field survey workstream, section 5 of the WSP report (pages 172 to 178), with the objective to obtain a snapshot of detectable AM has realised some helpful results. This despite the short measurement duration at each site, two hours at site E and just one hour at each of the other six sites. Even so WSP report that AM was detected for about half the total measurement duration with modulation depths of up to 5dB. The report also confirms that the measurements represent non-TEDCAR-AM (also described as EAM), this being the form of AM not addressed by ETSU-R-97 and responsible for most noise complaints.

What this snapshot measurement survey confirms is that AM is a common and regular occurrence at these sites. Unfortunately, what the survey does not show is whether the AM at these seven anonymous wind farms is affecting any of the local communities.

WSP also confirm that the AM was detected using the IOA Reference Method. During 2015 the INWG tested the RUK method (later to be rebranded as the IOA Reference Method) and other methods as part of the Wind Turbine Amplitude Modulation & Planning Control Study. This was reported in INWG Work Package 5 titled: *Towards a draft AM Planning Condition*, authored by Sarah Large and others, open here. WP5 Table 16 summarises the test results and commenting on the RUK method, Large concluded; "***There are significant flaws with this method, it does not control EAM and as such it is recommended that this control mechanism is discarded as not fit for purpose***".

BS4142 was also tested and Large concluded; "***The use of BS4142 has been shown to work with wind farm noise data. Concerns raised previously with low background sound levels and influence of meteorological conditions, namely wind speed, have been addressed in revisions along with advancement of the science and quashed. The advantage of BS4142 over separate EAM assessment methods is the ability of BS4142 to assess noise level along with different noise character, including intermittency and tonality. BS4142 can also be used in conjunction with an assessment of wind farm noise level. It is recommended that for a holistic assessment of wind farm impact that BS4142 is the preferred method. This is consistent with industrial noise assessment in general including other energy producing systems with which wind energy competes***".

It is quite remarkable that this WSP survey has actually taken place when less than 10 years ago acousticians acting for wind farm developers at planning inquiries were stating that either AM did not exist or if it did exist, it occurred so infrequently that it should not be subject to a planning condition.

Had WSP really wanted to demonstrate evidence of and characteristics of AM they could have referred to INWG Work Package 2.2 titled: *AM Evidence Review* dated August 2015 by Sarah Large, open here. This provides a much more robust evidence review of AM.

Section 6 - Discussion

Methodology and Process

The scope and objectives of the stakeholder survey and review of ETSU-R-97 provided by DBEIS dated April 2021 when tendering for the review would appear to be clear and reasonable. However, the INWG only discovered by chance and quite late in the process during August 2021 that the review was taking place and that participation was by invitation only. The closed nature of the stakeholder survey was an immediate cause for concern for risk of bias. Fortunately, the INWG were permitted by DBEIS to provide a last-minute response during September 2021.

There was no subsequent feedback until the report dated October 2022 was finally released on the WSP website, but not until 10 February 2023. No reason is given for the apparent delay of over 3 months between report completion and its release. When reading the report, the first impressions are that it is far too long at 400 pages, very repetitive and will be very difficult for the non-technical reader. This repetition contributes to the report being probably two or three times longer than needed. These factors almost guarantee that government decision makers will not read the full detail of the report, relying on the final recommendations only.

When we delve into the report and identify the authors and stakeholders we see that central government, local government and the wind industry including their acousticians are the only participants other than the INWG. Even the appointed 'peer reviewer' is one of the original authors of the ETSU-R-97 guidance and has been closely associated with the wind industry for over two decades. There being no other independent stakeholders identified and the INWG is aware of several unsolicited survey responses have not been acknowledged or included in the review.

It is concluded this review of ETSU-R-97 by WSP is biased throughout in its methodology and execution.

Evidence review

The objectives shown for this workstream are reasonable however, the scoping and screening methodology would appear to have been inadequate. The author admits that the Quick Scoping Review (QSR) methodology employed is a less robust option, subject to a lower level of accuracy and a greater risk of bias. This becomes more apparent when we analyse the restricted evidence base that was reviewed.

The summary at section 3.5 does however include many of the concerns previously identified by the INWG and others over many years. Unfortunately, there are several areas that have not been properly examined or simply dismissed. These are discussed below and

include low frequency noise, uncertainty and the use of BS4142 as an alternative to the ETSU-R-97 based guidance currently in use.

When one considers the number and nature of the issues identified with ETSU-R-97, any independent review is likely to conclude that there is a need to replace the current guidance.

In conducting their evidence review, WSP have ignored the INWG Work Package 2.1 authored by Richard Cox titled; '*Review of Reference Literature*' dated July 2015 open here . This provides a more balanced and comprehensive review of the issues currently under consideration and although dated from 2015 is still relevant. WP 2.1 reviews over 160 documents where every document was individually reviewed and a short assessment produced. This time-consuming review methodology may not be an attractive option for a commercial organisation such as WSP, but does allow for a more comprehensive and rounded assessment to be made.

WSP have taken great care to effectively dismiss wind turbine low frequency noise as being of any significance based on some clearly selective evidence reviews and a claimed lack of evidence. WSP discuss this on pages 101, 114, 115, 116 and 117and fail to consider the ever increasing turbine sizes that could increase LF sound to harmful levels. They offer no recent Epidemiological field studies involving large turbines to prove their claims.

At page 116, WSP claim: "*Overall, the findings from the existing evidence base indicate that infrasound from wind turbines at typical exposure levels has no direct adverse effects on physical or mental health, and reported symptoms of ill-health are more likely to be psychogenic in origin*".

On what basis should medically unqualified acousticians, (as are the WSP authors) opinions on the health and wellbeing of adversely affected residents, become accepted as a statement of fact, on which large scale planning decisions are made and on which government policy is determined?

Then at page 232, WSP are mischievously recommending that government make a position statement indicating that; "*infrasound from wind turbines at typical exposure levels has no direct adverse effects on health*". These conclusions and recommendation are completely at odds with the evidence review findings by the INWG at Work Package 2.1, open here and more recent evidence, bringing to mind the age old saying; "*The absence of evidence is not evidence of absence*".

The INWG findings from 2015 are summarised in the WP 2.1 Executive Review at para 5; "*The evidence regarding low frequency noise (LFN), a significant component of WTN including AM, is compelling. Despite the wind industry's continual denial of the significance of LFN, the available evidence demonstrates conclusively that:*

- *LFN including infrasound is an integral component of WTN;*
- *Complaints regarding WTN currently classified as AM or EAM or OAM by the wind industry is an obfuscation of the true nature of the problem;*
- *Conditions giving rise to noise complaints are often characterised by 'sensation' as being the major form of disturbance. In some cases, the 'noise' may not even be audible;*
- *Noise measurement using the A weighting may be unsuitable for WTN where low frequency components are present;*
- *Noise measurements should be made inside homes when investigating noise complaints;*
- *Noise measurements where LFN is present should be made using suitable instrumentation. IEC 61672 compliant 'Class 1', instrumentation may be unsuitable for LFN measurement or where background noise levels are low as in typical rural areas*."

The World Health Organisation (WHO) released its updated *Environmental Noise Guidelines for the European Region* during 2018, open here. Sections 3.4 and 4.2 cover wind turbine noise.

At section 3.4, page 85 the WHO state; "*Wind turbines can generate infrasound or lower frequencies of sound than traffic sources. However, few studies relating exposure to such noise from wind turbines to health effects are available. It is also unknown whether lower frequencies of sound generated outdoors are audible indoors, particularly when windows are closed*".

At section 4.2, page 100 the WHO state; "*Further research into the health impacts from wind turbine noise is needed so that better-quality evidence can inform any future public health recommendations properly. For the assessment of health effects from wind turbines, the evidence was either unavailable or rated low/very low quality*."

Table 53 provides further detail including for "*Exposure of interest*" the statement; "*Exposure to noise at a wide range of levels and frequencies (including low-frequency noise), with information on noise levels measured outdoors and indoors (particularly relevant for effects on sleep) at the residence is needed*."

With these statements by the WHO, the government should seriously question the recommendation made by WSP and specifically the requested position statement identified above. Such a statement would be dangerous, would effectively block further progress with understanding wind turbine low frequency noise and its health effects and would hinder affected communities seeking respite from wind turbine noise.

The current denial of problems with low frequency noise by the wind industry follows a close parallel with the argument from around a decade ago when the wind industry was in

denial regarding amplitude modulation. Acousticians defending wind power developers were prepared to state at planning inquiries that amplitude modulation either did not exist or if it did exist it occurred so infrequently to be irrelevant for consideration in the planning balance. Only when the evidence was overwhelming in identifying the extent of occurrence and the characteristics of AM were the wind industry forced to acknowledge its existence.

At section 3.3.3, WSP give minimal mention on the subject of uncertainty or its significance. Uncertainty being the errors that can accumulate within the assessment process. ETSU-R-97 fails to allow for uncertainty so may be the only area of science that works with zero error. Uncertainty will occur with each of the measurement and calculation stages including microphone windshields, statistical methods used to derive limits and sound propagation calculations. These errors can be cumulative and the INWG has previously estimated the overall error or uncertainty for a wind farm noise assessment could be as high as +/-10dB. Considering that many noise assessments accompanying wind turbine planning applications have shown the headroom between predicted noise levels and the derived limits can be as low as 1dB, the level of uncertainty can be highly significant.

Stakeholder engagement

The stakeholder survey at section 4 of the report (pages 134 to 170), is arguably the most important workstream within this ETSU-R-97 review. Whereas the engagement objectives would appear to be reasonable, the implementation is judged to be deficient and biased.

Survey participation has been limited to central government departments, local planning authorities and industry professional associations. Community groups and individuals external to the wind industry were excluded. This composition creates a bias in favour of the wind industry and is particularly imbalanced as it excludes those with direct experience of living near wind turbines or their representatives.

In addition to the government responses there were five responses from professional associations. Of these, RenewableUK, Scottish Renewables, Institute of Acoustics and Association of Noise Consultants constitute the UK wind industry voice on wind turbine noise issues. It should be noted that either WSP or the WSP report authors are members of these four professional associations.

What is particularly disappointing is the survey response rate from the LPAs. Out of 204 LPAs invited by WSP only 19 participated. This 9% response rate compares poorly with the response rate of 77% obtained by INWG during a similar survey during 2014. This survey is documented in INWG Work Package 3.1 open here, authored by Trevor Sherman titled; '*Study of Noise and Amplitude Modulation Complaints Received by Local Planning Authorities in England*' dated February 2015. For this survey, INWG contacted 265 LPAs and received responses from 205, a response rate of 77%.

The poor LPA response rate for the WSP survey must be questioned as it indicates that something was fundamentally wrong with the way WSP invited LPAs.

Despite the survey bias, the results presented at Figure 4-12 and Figure 12-20 highlight many of the concerns with ETSU-R-97 that have been raised by the INWG and others over the last two decades. These findings do therefore provide a useful benchmark for decision makers when considering the future guidance.

The top 5 issues by number of respondents from Figure 4-12 and Figure 12-20 are:

- Guidance needs to establish how AM impact should be taken into account
- ETSU-R-97 is outdated and needs to be reviewed: technology and understanding have advanced since publication
- Difficult, costly or time-consuming to robustly establish compliance/non-compliance
- More / updated guidance on cumulative assessments is needed
- The ETSU-R-97 principles underlying the limits need to be reviewed

The WSP analysis to question 1.4 on pages 144 to 153, even with the survey shortcomings, highlight the sheer number of issues with the current guidance raised by the stakeholder responses.

These complaints go to the heart of ETSU-R-97 and its fundamental assessment methodology involving derived noise limit curves. This critique should remove any remaining consideration that ETSU-R-97 could be safely retained, even with the peripheral changes being suggested by WSP.

Unfortunately, WSP created an additional complication and 'unlevel playing field' for the survey by conducting interviews with some selected stakeholders but not others. Unfortunately, this results in further lack of confidence in the impartiality of the report. Due to the lack of transparency, no details of who was contacted or even how many stakeholders were contacted are provided.

With overwhelming evidence from the stakeholder survey that ETSU-R-97 is 'unfit for purpose', or possibly because of it, two of the professional associations supplied a written statement that WSP has chosen to reproduce on pages 162 and 163. These unnamed professional associations demonstrate their denial of the shortcomings with ETSU-R-97 and denigrate the so-called objector groups.

This statement on page 162 and 163 by the wind industry would appear to be an unprofessional attempt to pressure government to retain ETSU-R-97 as the official noise guidance and to prevent independent scrutiny.

Field survey measurements

The field survey workstream, section 5 of the WSP report (pages 172 to 178), with the objective to obtain a snapshot of detectable AM has realised some helpful results. Despite the very short measurement durations at the five wind farms, WSP report that AM was detected for about half the total measurement duration with modulation depths of up to 5dB. The report also confirms that the measurements represent non-TEDCAR-AM (also described as EAM), this being the form of AM not addressed by ETSU-R-97 and responsible for most noise complaints.

Unfortunately, this field survey has been presented in a way that leads the reader to assume that AM is a more benign characteristic of wind turbine noise than it really is and plays down its impact. Other than confirming what is already well known, the WSP field survey does not advance the understanding of AM or wind turbine noise.

Had WSP really wanted to demonstrate evidence of or the characteristics of AM they could have referred to the INWG Work Package 2.2 dated August 2015 by Sarah Large, titled; "*AM Evidence Review*", open here. Despite its 2015 date, this provides a much more robust evidence review of AM than the WSP survey.

Large concludes at WP2.2 with; "***The data described below is conclusive that AM exists and it shows AM is being generated by the majority of wind energy developments. It also shows that AM can be generated by all turbines regardless of size, model or type. AM is not rare but is prevalent and whilst meteorology may not be the sole determinant, under certain meteorological conditions adverse AM can occur for long periods of time***".

The argument for BS4142

On completion of the amplitude modulation study during 2015, the INWG made an evidence-based recommendation to government that ETSU-R-97 should be replaced by the use of BS4142. The current version at that time being BS4142:2014, but has now been superseded by BS4142:2014+A1:2019.

Whereas BS4142 has been recommended as a replacement for ETSU-R-97, wind industry acousticians have avoided any discussion on the subject. Instead, they have continued to argue for ETSU-R-97 to be retained with a few minor revisions. BS4142 does get mentioned in the WSP report but only with regard to secondary technical issues and not in the context of its use as a replacement for ETSU-R-97 or whether it could overcome the many faults identified.

Examination of BS4142 shows that it is suitable for wind turbine noise assessment and is used on comparable industrial noise sources that could be located in rural areas. Additionally, the WSP authors should be fully aware of the suitability of BS4142, especially as

Toby Lewis, one of the WSP authors is a member of the Association of Noise Consultants Good Practice Working Group for BS4142:2014+A1:2019, open here.

Testing of BS4142 was carried out by Sarah Large and reported in INWG Work Package 5 titled: '*Towards a draft AM condition*' dated November 2015, open here. These arguments are still relevant today and chapter 8 provides a detailed assessment of the application of BS4142 for wind turbine noise.

ETSU-R-97 was designed firstly to assess the noise impact during the planning process but also to assess noise complaints. When ETSU-R-97 is instead used loosely for post-construction compliance testing, the averaging and vagaries in the derivation and application of the noise levels and limit curves means exceedances are less likely to be found than when adhering to the complaints processing as prescribed by ETSU-R-97. Then, on the basis of the post-construction compliance testing, the operator claims that the wind farm is compliant; subsequently the noise complaint remains unresolved.

The current system of reliance on the LPA for enforcement is subject to differing interpretations of the rules across the country, LPA budgets and a general lack of the acoustic expertise needed when challenging wind turbine operators and their acoustic consultants. As a result, it is apparent LPAs are reluctant to act against wind power operators.

As we have seen in the WSP report at Figure 4-12 and Figure 12-20, LPA complaints of inadequate government guidance on dealing with wind turbine noise complaints, feature as the No 3 complaint. The ETSU-R-97 noise guidance is clearly very attractive to the onshore wind industry and they are avoiding any discussion on changing to an alternative guidance.

At the planning stage the developer's acoustics consultant always has the option to produce a noise assessment exploiting the averaging, vagaries and derived limits claiming the proposed wind farm will be compliant with ETSU-R-97. To date the INWG are only aware of a few planning applications having been refused with noise as a main reason. These refusals were due to interventions by Dr J Yelland, despite the LPA's initial acceptance of the developer's NIA authored by an IoA qualified acoustician and declared as compliant.

Once a wind farm becomes operational, the operator's acoustics consultant will again claim that the wind farm is compliant with ETSU-R-97, by exploiting the averaging and vagaries of the process. At this point the LPA will in the face of expensive litigation costs give up, leaving the complainant with Statutory Nuisance proceedings through the courts as the only option.

Experience to date shows that pursuing a noise complaint using Statutory Nuisance laws presents an unacceptable burden on a private citizen and is destined to fail. This is discussed in the INWG consultation response dated 27 Feb 2023 to the reforms to national planning policy, open here. To date the INWG are not aware of any wind turbine noise complaints that have been resolved satisfactorily in England.

Only a relatively small number of wind farms have been subject to persistent noise complaints, but where there are complaints often involving lack of sleep and health impacts it has in some instances, required people to abandon their homes to gain respite. These local residents are effectively abandoned and helpless in obtaining a resolution so they have no option other than to suffer in silence. This is not an acceptable situation in a democracy.

The recognised method to control wind turbine noise is to curtail operation, either by reducing output or stopping the turbine during the conditions when nuisance occurs, typically at night-time. The attraction to the wind industry of retaining ETSU-R-97 is that it removes commercial risk of operational curtailment due to noise complaints.

Hence the lengths the wind industry is going to in maintaining the status quo.

Adopting BS4142 as the official guidance would provide a viable and more straightforward route for the unquantified number of residents impacted by noise nuisance to obtain speedy redress. Wind farm operators would be forced to adopt a more responsible attitude while the impact on renewable generation nationally would likely be minimal.

Below at Table 1 we compare key facts and features of ETSU-R-97 with BS4142.

Table 1 : BS4142 v ETSU-R-97 Comparaisons

Feature / Question	BS4142	ETSU-R-97
What is it?	Titled: Methods for rating and assessing industrial and commercial sound, open here and, open here.	Titled: The assessment and rating of noise from wind farms, open here.
What is it used for?	It is the British Standard For rating and assessing sound of an industrial and/or commercial nature.	For noise assessment of wind turbines only.
Where is it used?	Used for investigating complaints, assessing sound from proposed, new, modified or additional sources of sound of an industrial or commercial nature. For virtually all industrial and commercial applications, except wind turbines. It uses "*outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident*."	For wind turbine sound assessment only. Primarily designed for noise assessments for wind turbine planning applications. Has been adapted for use when investigating complaints and is usually included as a planning condition Not designed for post construction compliance testing but has been adapted for such assessments.
What is their history?	Originally based on the Wilson Report of 1963, first published in 1967, amended in 1975, 1980 and 1982. Revised in 1990. Revised again in 1997 and 2014. Amended 2019 with the current version designated; BS4142:2014+A1:2019 (BS4142:2019)	Dated September 1996 and produced by a wind industry noise working group facilitated by the government department of trade (DTI). ETSU-R-97 has not been revised since although the Institute of Acoustics issued a Good Practice Guide in 2013, open here.

Why was the Good Practice Guide (GPG) produced during 2013 and has it improved the situation?		Was instigated in response to many years of criticism of ETSU-R-97. The GPG clarified several areas of the assessment process but still left critical faults inherent with the basic ETSU-R-97 methodology. The method for deriving noise limits and wind speeds is still the root cause of most of the noise complaints. Does not adequately account for wind shear and allows undue latitude with the setting of noise limit curves. Also fails to control AM.
Why was ETSU-R-97 created?		The emerging wind industry considered BS4142:1990 to be too restrictive and unsuitable for several reasons for wind turbine application. ETSU-R-97 is described as; *"...a framework for the measurement of wind farm noise and gives indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development or adding unduly to the costs and administrative burdens on wind farm developers or local authorities*."
If BS4142:1990 was unsuitable, why is the current version of BS4142:104+A1:2019 now suitable?	Summarised by S. Large @ WP5 page 160 11.5: "*The use of BS4142 has been shown to work with wind farm noise data. Concerns raised previously with low background sound levels and influence of meteorological conditions, namely wind speed, have been addressed in revisions along with advancement of the science and quashed*."	

Is BS4142 in its latest revision ready for use with wind turbine noise assessment	Yes It is recommended though that some additional user guidance be produced specifically for use with wind turbine noise	
What are the main concepts or differences between ETSU-R-97 and BS4142	Utilises the 'Rating' method of assessment. Compares the noise impact at a specific location by assessing noise loudness and character (Rating) compared with the actual background noise level.	Utilises a 'derived limit' method of assessment. Compares either predicted or measured noise with noise limits derived from data from a background noise and wind speed survey data. Relies on the masking effect of wind induced noise to mask the turbine noise.
How does it work?	The basic process being; Make measurements of all noise at the assessment location, including the "problem" noise, in terms of LAeq - termed the "ambient" noise level, then; A measurement is then made of all the noise excluding the "problem" noise in terms of both LAeq and LA90; these measurements are termed the "residual" and "background" noise levels respectively, then; The "residual" LAeq measurement is then subtracted (logarithmically) from the "ambient" LAeq measurement to produce the noise level produced by the "problem" noise alone - termed the "specific" noise Level, then; If the "problem" noise is tonal [containing a noticeable hiss, whine or hum] or if it is impulsive [contains bangs clatters, clicks or thumps] or if it is irregular enough to attract attention, a correction is added to	The basic process being; Conduct a background measurement survey of the wind farm site either before the turbines are built or when not operating. Sound measurement in $LA90_{10}$min, also metrological data including wind speed. Sound measurement at receptor locations where the noise will be experienced, then; Derive noise limits for day and night from the background sound levels plus 5dB except for the lower limit over a range of derived wind speeds, then; Predict turbine noise levels over a range of wind speeds, then; Compare predicted noise levels with the ETSU-R-97 derived limits. If predicted noise exceeds the limit, the result is a fail. If the predicted noise is below the limit the result is a pass. Noise limits are subject to separate regimes for day and

	the "specific" level to produce the "Rating level ", then; The "background" LA90 measurement is then compared against the "rating" level, then; If the "rating" level exceeds the "background" by around 10 dBA or more this "indicates a significant adverse impact". A difference of around 5 dBA 'indicates an adverse impact'; at a difference below 5 dBA, the lower the adverse impact and below 0dBA – Low adverse impact likely – 'All dependant on the context'.	night. For daytime, the minimum is 35 – 40 dB $LA90_{10}$min increasing with increasing wind speed. For night time the minimum is 43dB $LA90_{10}$min increasing with increasing wind speed. For financially involved receptors the minimum limit day and night is 45dB $LA90_{10}$min. Not designed for compliance testing.
What was the purpose of the Good Practice Guide (GPG) for ETSU-R-97?		Defined in the GPG para 1.2.1 by; "*This guide presents current good practice in the application of the ETSU-R-97 assessment methodology for all wind turbine developments above 50 kW, reflecting the original principles within ETSU-R-97, and the results of research carried out and experience gained since ETSU-R-97 was published. The noise limits in ETSU-R-97 have not been examined as these are a matter for Government*." The GPG has been criticised as the fundamental defects with ETSU remain and as witnessed by the WSP stakeholder survey.
Does the guidance control for tonal, impulse and amplitude modulation, and if so, how?	Yes Applies graduated corrections for both tonal and impulsive character including AM. Tonal correction of up to 6dB, impulse correction of up to 9dB. Corrections are cumulative.	Tonal only. Does not control impulsive character or AM. The IOA have proposed a separate control method for AM but when tested by the INWG it was found to underestimate AM and declared not fit for purpose, see above.

Is low frequency noise controlled	No	No
ETSU-R-97 is criticised for using the $LA90_{10}$min index whereas BS4142 uses the LAeq measurement index. What are the implications?	Uses the LAeq measurement index that effectively averages all the sound energy over the measurement period. A separate frequency analysis using fast time data is used to identify tonal and for impulsive calculations.	Uses the $LA90_{10}$min measurement index effectively recording a sound level exceeded for 90% of the time and averaged over a 10-minute period. As such it fails to identify impulsive or modulating sound including AM.
Does the guidance allow for uncertainty in the process, also known as measurement error or tolerance	Yes - The latest version now allows for uncertainty.	No - Has been criticised as being possibly the only application of science where uncertainty has not been recognised. This assumes zero error in the measurements and calculations. The INWG has estimated that the cumulative uncertainty in a typical noise assessment with noise prediction could be as high as plus/minus 10dB. The guidance should allow for the aggregation of errors representing a reasonable worst case
The ETSU-R-97 derived noise limits have been a topic for criticism for many years. What are the issues?	Does not use fixed limits or require derived noise limit curves.	Heavily criticised for improper statistical modelling of the background noise data when determining the noise limit curves. Many noise assessments found to have poorly fitted curves unsupported by physics and determined mostly by the analytic method employed. They almost always favour the developer with higher noise limits than warranted.

There has been criticism of the fixed noise limits, what are the issues?	There are no fixed noise limits. The Rating assessment method compares the impact of the noise at the receptor location. This eliminates the ambiguity of derived wind speeds, derived noise limits and the effects of wind shear.	Limits are derived via a complex and opaque process to create limit curves based on background noise level, wind speed and minimum limits. This can result in significant adverse noise impact, typically during evenings and night and for extended periods while still remaining 'compliant' with ETSU-R-97. Failing to account correctly for high wind shear conditions, typically occurring during the night is a fundamental fault with ETSU-R-97. Compared to other jurisdictions, ETSU-R-97 has some of the highest minimum noise limits for wind turbines. Is also unique in having night rates higher than day rates.
Is the guidance designed for post construction compliance testing	Yes	No Ambiguity on this allows the operator considerable latitude in the assessment process such that it becomes inevitable that the wind farm is declared 'compliant'. The LPA is therefore unlikely to challenge this finding by the operator's consultants.
Is the guidance designed for post construction complaint resolution	Yes	Yes However, ambiguity on this allows the operator considerable latitude in the assessment process such that it becomes inevitable that the wind farm is declared 'compliant' with ETSU-R-97. The LPA is then most unlikely to proceed with Statutory Nuisance proceedings leaving the complaint unresolved.

Section 7 – Conclusions

The recommendation made by WSP for the retention of ETSU-R-97 with just a few revisions is not supported by the report findings. The sheer volume and nature of the criticisms of ETSU-R-97 identified in the report, and especially the stakeholder survey responses, point to faults with the fundamental methodology supporting ETSU-R-97. These are faults that cannot be fixed by more revisions or further studies. The evidence from the WSP review plus two decades of criticisms make a clear case for replacement of ETSU-R-97.

Given the strength of the evidence revealed within the WSP report there is a clear and obvious disconnect with the report's recommendations. This leads to the conclusion that the WSP report's recommendations were predetermined. The report itself appears to have been designed with obfuscation as an objective. At 400 pages, highly repetitive and full of jargon it will dissuade all but the most determined reader to properly evaluate the findings. With this level of obfuscation there is a risk that decision makers could rely on the WSP conclusions and recommendations without examining the supporting evidence.

Arguably the most important omission by WSP is the consideration of an alternative to ETSU-R-97 and the continued avoidance of any discussion on the subject. Retaining ETSU-R-97 and its fundamental methodology around derived noise limits would appear to have been an overriding objective for WSP when executing this review of ETSU-R-97.

The INWG proposed during 2015 that ETSU-R-97 be replaced by BS4142. While BS4142 applies to virtually all other comparable industrial and commercial noise source assessment, its suitability for wind turbine noise as examined at Table 1 must be fully evident to any competent acoustician.

BS4142 has been tested with wind turbine noise data by the INWG. There is no technical reason why BS4142 could not be used. The use of BS4142 would provide the same level of protection to wind farm neighbours as is currently afforded for all other forms of industrial and commercial noise sources. Also, BS4142 is much better understood by LPAs and its adoption would overcome virtually all the identified criticisms of ETSU-R-97 including control of AM, post construction compliance and complaint investigation. It is recognised that some additional user guidance specifically for wind turbine noise assessment with BS4142+104+A1:2019 may be required to ensure a consistent approach to its use and to prevent any of the undesirable features from ETSU-R-97 being applied.

In order to ensure an effective and consistent pathway for dealing with wind turbine noise nuisance, the INWG propose that industrial wind turbines should be licenced and subject to oversight by a national agency, such as the Environment Agency. Regulation by a national agency would make it easier to ensure a consistent approach nationally, to maintain appropriate levels of technical competence. This would bring wind power in line with other rural located polluting industries.

ETSU-R-97 has served the wind industry well by providing a much more permissive noise guidance than for any other industry. It does appear quite remarkable that such an exception could persist for so long in support of a single industry, testament to the lobbying power of the wind industry. Very few planning applications have ever been refused for noise assessment reasons and very few noise complaints have ever been resolved. As a result, most complainants eventually give up and continue to suffer in silence. Pursuing noise complaints through the courts using Statutory Nuisance has been shown to be unworkable.

The WSP review claims insufficient evidence of any health effects from wind turbine noise including low frequency sound. However, the absence of participation by suitably qualified health professionals must give little weight to this claim.

On page 232, WSP make the unsupported and unevidenced recommendation to government for a position statement to be made indicating that: "*infrasound from wind turbines at typical exposure levels has no direct adverse effects on health*".

This WSP conclusion and recommendation concerning low frequency noise is completely at odds with the INWG findings at Work Package 2.1, open here and more recent evidence including the IARO scientific commentary, open here at Section 8, Appendix . Especially section H; '*Exclusion of Infrasound & Low Frequency Noise'*, and section K; '*What you can't hear can't hurt You'*.

Such a government position statement would also be at odds with the WHO 2018, open here noise guidelines where they recommend;

At section 3.4, page 85; "*Wind turbines can generate infrasound or lower frequencies of sound than traffic sources. However, few studies relating exposure to such noise from wind turbines to health effects are available. It is also unknown whether lower frequencies of sound generated outdoors are audible indoors, particularly when windows are closed*".

And at section 4.2, page 100; "*Further research into the health impacts from wind turbine noise is needed so that better-quality evidence can inform any future public health recommendations properly. For the assessment of health effects from wind turbines, the evidence was either unavailable or rated low/very low quality*."

Such a position statement as proposed by WSP would be dangerous as it would effectively block further progress with understanding low frequency sound and; its health effects and would hinder affected communities seeking respite from wind turbine noise.

There can be no pretence that the WSP review is impartial. Throughout the review from the methodology, restricted stakeholder invitations, through to the analysis and recommendations there is a strong bias towards meeting the needs of the wind industry. Unsolicited survey responses have been rejected or ignored and the INWG response was

only included as DBEIS agreed to INWG participation. There being no other independent voice allowed.

A most significant failure with the stakeholder survey is the poor response rate by LPAs at just 9%. This compares poorly against a response rate of 77% realised during a similar survey of LPAs conducted by the INWG during 2014. One can only question the effectiveness of the WSP process in inviting LPAs and whether this poor response rate was intentional or due to incompetence.

The written statement submitted by two of the professional associations that WSP has chosen to reproduce on pages 162 and 163 demonstrate arrogance and denial of the failures of ETSU-R-97. This toxic culture within the wind industry leads local communities to have little trust in the way wind power has been deployed in their neighbourhoods or is likely to be deployed in future. Communities hosting wind power development are simply considered as 'collateral damage', and an inconvenience if they dare complain.

This lack of trust with an arrogant wind industry will present an additional barrier to any future deployment of onshore wind power.

A theme not so subtly emphasised throughout the report, is the use of the climate emergency as leverage to maintain a commercial advantage for the onshore wind industry. WSP are using this Net Zero threat as justification for being allowed to inflict higher levels of noise than permitted from other comparable industries.

The significance of the planning balance between the protection of residential amenity and the deployment of wind power is eloquently summed up by Justice Richards in the landmark Bald Hills judgement (***Uren v Bald Hills Wind Farm Pty Ltd [2021]***) Victoria, Australia) open here where she quotes at Para 243: "***The generation of renewable energy by the wind farm is a socially valuable activity, and it is in the public interest for it to continue"***

And at Para 244: "***The evidence did not suggest, however, that there is a binary choice to be made between the generation of clean energy by the wind farm, and a good night's sleep for its neighbours. It should be possible to achieve both***"

A key feature in a democracy such as the UK is that the rights of the minority are protected by the majority. Such protections for communities and the environment are now core values being promoted by the government for the ongoing review of the National Planning Policy Framework. The Levelling up and Regeneration Bill which is currently before parliament puts communities at the heart of the planning system.

Section 8 – Recommendations

Following this review of the WSP report, the INWG make the following recommendations to government;

1. Reject the recommendations made by WSP in their review for ETSU-R-97 to be retained albeit with some minor revisions.

2. Replace ETSU-R-97 with BS4142:2014+A1:2019 as the official guidance for wind turbine noise assessment.

3. Reject the WSP proposal for a government position statement on low frequency noise. This would set a dangerous precedent, is unsupported by the evidence and would conflict with the WHO position.

4. Conduct independent research into the effects on health and well-being of wind turbine noise including impacts from long term exposure, low frequency noise, infrasound, amplitude modulation and tonal noise as recommended by the WHO.

5. Introduce regulation of wind power generation by a national agency such as the Environment Agency. This to include continuous monitoring and recording of noise and turbine (SCADA) with the data to be made available for compliance and noise complaint purposes.

Section 9 – Appendix

IARO Scientific Commentary

Scientific Commentary on the UK Government's Department of Business, Energy and Industrial Strategy (DBEIS) "Scoping review of current onshore wind turbine noise assessment guidance"

The International Acoustic Research Organisation (IARO) submitted an unsolicited response to the DBEIS survey during 2021 but this response was rejected by WSP so is not included in the WSP review. Details of the IARO response with an additional scientific commentary is available on their website, open here. The IARO document provides a highly critical appraisal of ETSU-R-97 and provides an insight into recent developments into wind turbine low frequency noise.

The IARO findings support the INWG recommendations ONE, THREE and FOUR at Section 1, Executive Summary and Section 8, Recommendations.

The IARO scientific commentary section H; EXCLUSION OF INFRASOUND & LOW FREQUENCY NOISE (paras 42 to 62) present compelling new evidence relating to wind turbine low frequency sound, its characteristics and effects. The following IARO scientific commentary statements are especially relevant:

Para 9 – "*Medical expertise is conspicuously absent from the list of the Members of the Working Group responsible for ETSU-R-97, and yet, ETSU-R-97 is touted as appropriate for the protection of Public Health against wind turbine noise*".

Para 11 – "*Unsurprisingly, given the absence of representatives of the medical community, noise limits suggested by ETSU-R-97 do not prioritize, or even conscientiously consider, the health and well-being of UK citizens*."

Para 67 – "*It is shocking that a policy-decision document which has served as the core document for wind turbine noise assessments, with direct implications on Public Health, and where scientific evidence is of critical importance, is absent of any accountability or responsibility.*"

Para 78 - "*If the medical community was not represented in the preparation and publication of ETSU-R-97, how can the UK Government allow ETSU-R-97 be used to establish public policy with direct implications on Public Health?*"

Scientific Commentary on the UK Government's Department of Business, Energy and Industrial Strategy (DBEIS)

"Scoping review of current onshore wind turbine noise assessment guidance."

Document number IARO21-6

December 2021

International Acoustics Research Organization

IARO Is an international group of researchers with a mission to investigate acoustical environments, especially with respect to features that affect humans and animals, and to publish the results. IARO holds the ethics approval for the CSI-ACHE, the Citizen Science Initiative into Acoustical Characterisation of Human Environments, the results of which are publicly disseminated.

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A. EXECUTIVE SUMMARY

1. This Scientific Commentary was prepared by Scientists concerned with the health of human communities living in the vicinity of wind power stations.

2. This Scientific Commentary seeks to inform policy decision-makers of the challenges that wind energy has brought to human communities

3. This Scientific Commentary deconstructs the complex technical issues that frequently obfuscate the matter of wind turbine noise.

4. This Scientific Commentary was prompted by the call for a Scoping Review on the current Onshore Wind Turbine Noise Assessment Guidance, on behalf of the Department of Business, Energy and Industrial Strategy (DBEIS).

5. The DBEIS Scoping Review on Onshore Wind Turbines specifically excludes any discussion on infrasound and low frequency noise, thus contradicting its stated objective.

6. The document known as ETSU-R-97 (*The assessment and rating of noise from wind farms),* published in 1996, is the core guideline of the wind turbine noise assessment guidance currently in practice in the UK, and on which DBEIS bases its public policy.

7. The UK Government, through DBEIS, relies on ETSU-R-97 in spite of the dubious and questionable nature of the "veracity or accuracy of any facts or statements"[1] contained in ETSU-R-97, as is self-acknowledged by the signatory authors in their initial disclaimer.

8. ETSU-R-97 chooses to ignore the infrasound and low frequency noise emissions from onshore and offshore wind turbines.

9. Medical expertise is conspicuously absent from the list of the Members of the Working Group responsible for ETSU-R-97, and yet, ETSU-R-97 is touted as appropriate for the protection of Public Health against wind turbine noise.

10. The noise limits suggested by ETSU-R-97 are based on:

    "Existing standards and guidance relating to noise emissions

[1] ETSU-R-97, page 0

- *the need of society for renewable energy sources to reduce the emission of pollutants in pursuance of Government energy policy*
- *the ability of manufacturers and developers to meet these noise limits*
- *the researches of the Noise Working Group in the UK, Denmark, Holland and Germany*
- *the professional experience of members of the Working Group in regulating noise emissions from wind turbines and other noise sources*
- *the discussion of the issues at meetings of the Noise Working Group and with others with appropriate experience."*[2]

11. Unsurprisingly, given the absence of representatives of the medical community, noise limits suggested by ETSU-R-97 do not prioritize, or even conscientiously consider, the health and well-being of UK citizens.

12. The ultimate purpose of the DBEIS Scoping Review is, as yet, unclear.

[2] ETSU-R-97, Executive Summary, page iii

B. BACKGROUND

1. It has come to our attention that the Government of the United Kingdom, through its Department of Business, Energy and Industrial Strategy (DBEIS), has commissioned a Scoping Review on the current assessment guidance regarding onshore wind turbine noise.

2. IARO scientists welcomed and applauded this initiative taken by DBEIS.

3. Particularly since, in 2021 alone, IARO scientists were involved in the following Public Inquiries held in Ayrshire, Scotland:

   a. **Rigghill Wind Power Plant** (ongoing)

      ITPE Energies Acoustics Consulting, for the wind developer

   b. **Arecleoch Wind Power Plant Extension** (WIN-370-2), 7 March

      Hoare Lea Acoustics Consulting, for the wind developer

   c. **Clauchrie Wind Power Plant** (WIN-370-3), 10 May

      Hayes McKenzie Acoustics Consulting, for the wind developer

   d. **Rigghill Wind Power Plant Appeal** (Ref: PPA-310-2034), 27 August

      ITPE Energies Acoustics Consulting, for the wind developer

4. Upon closer inspection of the requirements and limitations imposed by DBEIS on their Scoping Review, it became clear that incongruities existed between its stated objective and the information that would actually be gathered, i.e., the conditions DBEIS imposed on its Scoping Review contradict the stated objectives.

5. Very specifically, where wind turbine 'noise' is concerned, the Scoping Review limits the topics to:

   a. Amplitude Modulation (AM), and

   b. Tonality.

6. *Question:* Why is the topic "Infrasound and Low Frequency Noise" not included?

7. DBEIS has also limited their Scoping Review to invited organisations only.

8. *Questions:* Why?

   In addition to the Wind Industry-related enterprises and professional acoustic consulting firms, what other organizations have been invited to participate in this Scoping Review?

   The populational groups most directly affected by the current wind turbine noise assessment guidance (i.e., human communities who now have wind power plants as neighbours) appear to have been summarily excluded from this Scoping Review. Why?

C. GOALS

9. Policy-making authorities are oftentimes unfamiliar with the issue of acoustics and/or acoustics and health.

10. The primary goal of IARO's Scientific Commentary to the DBEIS Scoping Review is to deconstruct the technical complexities associated with the matter at hand, and that contribute to the (wilful?) obfuscation of this issue.

11. It is the goal of this Scientific Commentary to facilitate the understanding of the competent decision-making authorities regarding the contradictions and incongruities self-imposed by DBEIS on its own Scoping Review.

12. In doing so, some aspects of the core document currently regulating wind turbine noise in the UK (ETSU-R-97) will be discussed.

D. DISCLAIMER

13.

   a. The authors of this Scientific Commentary are not party to anti-technology sentiments.

b. Wind turbines are considered by the authors as welcome additions to modern technological societies.

c. The Scientific Commentary provided herein has one, and only one, agenda—that of pure scientific inquiry.

d. In no way can, or should, this Scientific Commentary be construed as a document arguing for or against the implementation of wind turbines, or any other industrial complexes.

e. There are no commercial, financial, or professional agreements (contractual or otherwise) between the authors of this report and any persons or parties involved in the wind turbine sector or persons or parties who stand against the implementation of wind turbines.

f. This Scientific Commentary was provided *pro bono*.

E. CONTEXTUALIZATION

14. It may be surprising to those reading this report that, all over the world, including the UK:

a. Citizens living in the vicinity of onshore wind power stations have been complaining of adverse health effects, also observed in pets and livestock;

b. Citizens living in the vicinity of onshore and offshore wind power stations have formed small, grass-roots groups in order to challenge the 'wind industry';

c. Numerous ongoing legal proceedings are opposing private citizens, or groups of private citizens, to the 'wind industry';

d. Many of the ongoing and concluded legal proceedings are subjected to non-disclosure agreements, or gag orders.

15. In the UK, the current situation that sees residential communities opposed to existing and planned wind power stations has been ongoing for three decades, since the operation of the first wind turbines in 1991 at Delabole in Cornwall—hub height: 32m, blade length: 17 m. In 2021, the Arecleoch wind turbines in Scotland have a hub height of 83 m, and a blade length of 69 m. Figure 1 is reproduced from industry literature.

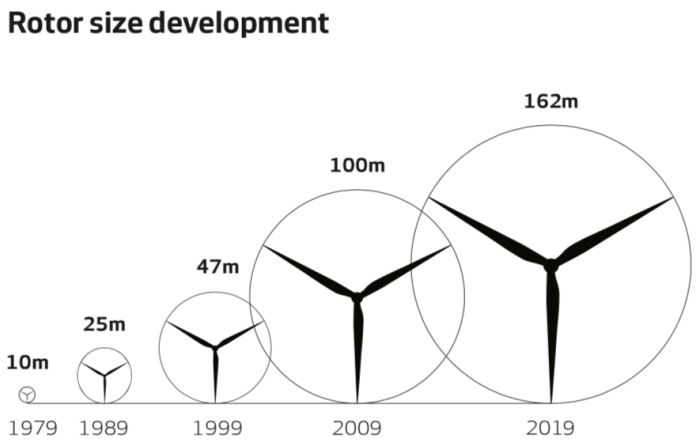


Figure 1. Evolution of the size of wind turbine rotor blades[3].

16. In addition to the stroboscopic effect (which, in the sole case of wind turbines, is termed 'shadow flicker') and the decreased visual amenity, wind turbines also produce 'noise.'

17. A part of the 'noise' produced by wind turbines is of a unique type, that is not properly contemplated in current assessment guidance: pulsed infrasound and low frequency noise.

18. The immediate and long-term effects of this unique type of 'noise' on human health are, for the most part, not investigated.

19. It would therefore seem appropriate and natural that the UK governmental agency responsible for "Energy and Industrial Strategy" would take a strong interest in this matter, particularly given their "Energy White Paper: Powering our net zero future."[4]

20. On the other hand, it would seem equally appropriate that the UK governmental agency responsible for the protection of Public Health should also take a strong interest in this matter.

[3] Vestas Wind Systems A/S, 2019. "EnVentus Platform" Brochure. https://www.vestas.com/en/products/enventus-platform/enventus-platform

[4] https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future

F. DBEIS SCOPING REVIEW

21. It is worthwhile to review the wording used by DBEIS in the Introduction section of the Scoping Review on wind turbine noise assessment guidance[5].

> *"The purpose of the review is to determine whether the guidance adequately ensures that wind farm turbine noise is managed effectively and consistently in line with current Government policies on noise (…), accounts for contemporary technological and acoustical developments, and (if not), what updates may be necessary to achieve this."*

22. The first part of this statement is unequivocal—the purpose of this Scoping Review is to ensure that the current assessment guidance is "in line" with current Government policies on noise. Presumably, this means, in line with ETSU-R-97[6].

23. The second part is more surprising because it acknowledges the possibility that contemporary technological and acoustical developments *might not* be accounted for in the current assessment guidance.

24. Lastly, the purpose of this Scoping Review seems to be the gathering of information on what type of updates could be introduced into the existing assessment guideline to account for the hypothetical technological and acoustical developments.

25. The recognition of the need to gather information is further corroborated by item 3) in the excerpt below:

> *"This survey is divided into three main parts:*
>
> *1) questions about topics addressed in the current UK wind turbine noise guidance,*
>
> *2) questions about wind turbine technology and wind farm design, and*
>
> *3) a request for any other evidence or suggestions that may be relevant to the intentions of this scoping review."*

[5] https://www.smartsurvey.co.uk/s/ZJ1E81?fbclid=IwAR1MCDZDxYF5AndTiM5AgT3f6rUj

[6] ETSU-R-97: The assessment and rating of noise from wind farms. The Working Group on Noise from Wind Turbines, Final Report September 1996.

26. The purpose of this information gathering exercise is explained as follows:

> *"[T]he current review will inform a decision on whether any future guidance development is required (…)."*

27. It is further added that:

> *"[N]o guidance development is being undertaken (…); but any potential subsequent development of guidance is likely to be accompanied by a consultation stage (…) However, please ensure you raise any* ***key issues*** *that you feel should be considered at this stage" [bold in the original text].*

28. In the meantime, as would be expected:

> *"This review and engagement does not affect any material considerations of the current UK onshore wind turbine noise assessment guidance within ongoing planning applications and decisions, which remain as referenced in the relevant authority policies."*

29. Offshore wind turbines are excluded from this Scoping Review.

30. Lastly, the Introduction informs:

> *"Your responses to this engagement will be an important part of ensuring that the wind turbine noise assessment guidance in the UK is consistent with Government policies, and remains suitable."*

31. In Paragraph 21 above, a small portion of the statement of purpose of the Scoping Review was truncated, and is now reproduced below:

> *"The purpose of the review is to determine whether the guidance adequately ensures that wind farm turbine noise is managed effectively and consistently in line with current Government policies on noise* ***and achieving 'Net Zero'[1] greenhouse gas emissions by 2050****, accounts for contemporary technological and acoustical developments (…)" [our bold].*
>
> *[1] Achieving the Government's ambitious 2050 Net Zero target will require significant increases in renewable electricity generation, and we will need to increase deployment across a range of technologies, including onshore wind. Our recent Energy White Paper: Powering our net zero future stated that we will need sustained growth in the capacity of onshore wind over the next decade, alongside solar PV and offshore wind."*

32. A brief review of the above-mentioned 2050 Net Zero White Paper reveals a preponderance of discussion on *offshore* wind power stations, with only 2 entries for "onshore wind." Offshore wind power is excluded from the DBEIS Scoping Review.

G. DBEIS SURVEY QUESTIONS

33. Having laid out the stated purpose of this Scoping Review in Section E, it is now of interest to see what types of questions were included in this survey.

34. This survey can be taken online,[7] by invited organizations only.

35. Figure 2 shows the Definitions used in the survey.

36. "Amplitude Modulation" and "Tonality" are two features associated with 'noise' emitted by wind turbines—both exclusively imply the existence of *audible* disturbances.

37. Notably, there is no entry for "Infrasound" nor for "Low Frequency Noise," although the item associated with "Amplitude Modulation" may cover some aspects of the audible, low frequency noise emissions.

[7] https://www.smartsurvey.co.uk/s/ZJ1E81?fbclid=IwAR1MCDZDxYF5AndTiM5AgT3f6rUj

PLEASE READ THIS PAGE CAREFULLY BEFORE CONTINUING WITH THE SURVEY

Term	Meaning
Current UK wind turbine noise assessment guidance	*ETSU-R-97 The Assessment and Rating of Noise from Wind Farms (1996), the Institute of Acoustics Good Practice Guide to the Application of ETSU-R-97 (2013) and its six Supplementary Guidance Notes (2014)* It is acknowledged that further individual devolved UK administration noise guidance is also in place, both wind turbine specific and non-specific. It is also acknowledged that the SGNs to the IOA GPG do not officially form part of the guidance endorsed by all devolved administrations, due to the publication dates (specifically, the Northern Ireland Assembly and Scottish Government endorsements preceded the SGN publications). However, it is believed that the IOA GPG SGNs are widely viewed as representing best practice guidance around the UK.
Government policies on noise and Net Zero	*The UK devolved administration governmental policies on noise and achieving net zero targets for greenhouse gas emissions relevant in any UK nation to which your professional experience is applicable* If your experience encompasses more than one UK nation, please provide details of any divergence in your responses as they concern the context of the policies of each devolved administration, as appropriate.
Amplitude modulation	*A sound characteristic associated with the regular rotation of the wind turbine blades, sometimes described as 'swishing', 'whooshing', 'whoomphing', or 'thumping'*
Tonality	*A sound characteristic sometimes described as 'droning', 'humming', 'ringing', or 'whistling'*

Figure 2. Screen shot of the survey webpage-Definitions[2].

38. Following the questions related to identification of the participant in the survey, the pivotal question appears: see Figure 3.

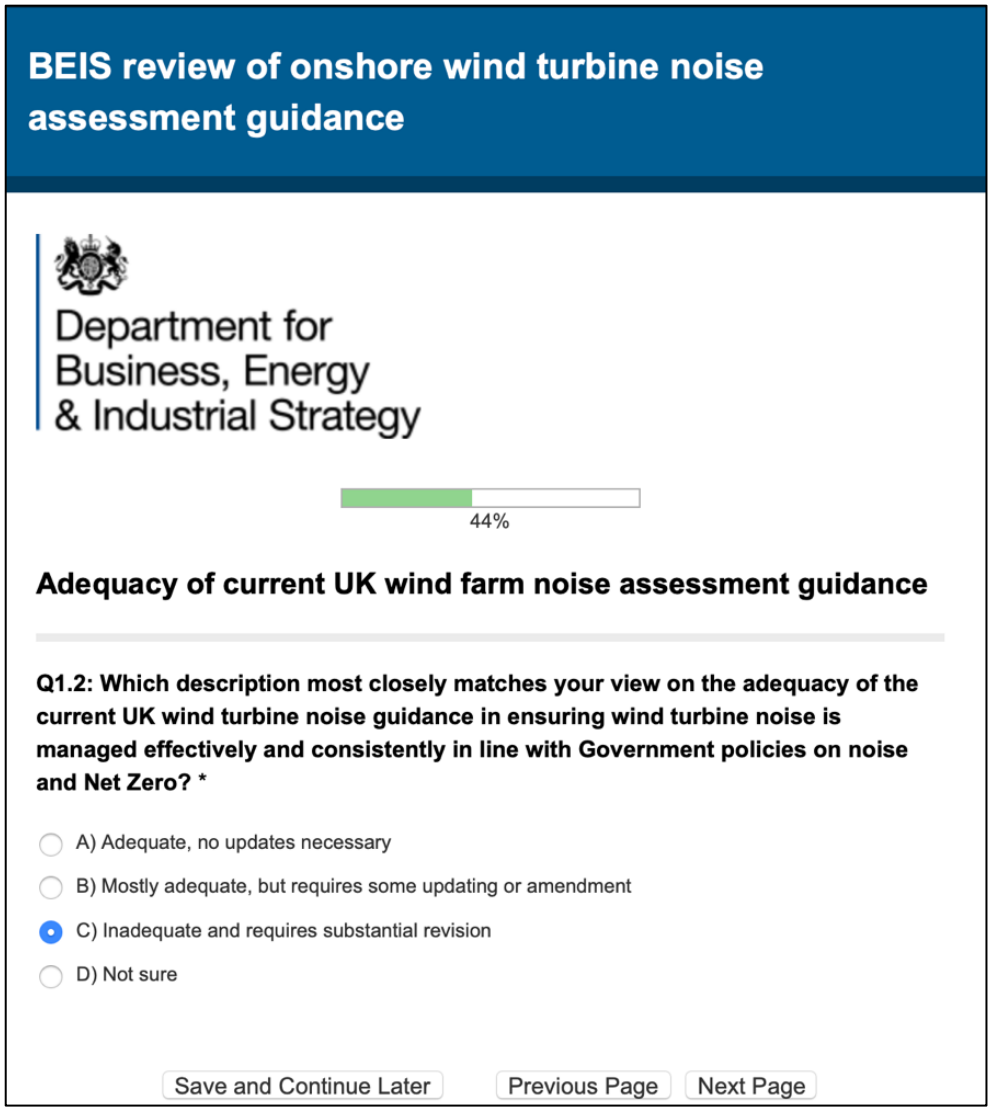


Figure 3. Screen shot of the survey webpage—Pivotal Question[2].

39. Figure 4 shows the next screen of the survey in which the participant is asked to choose from a list of topics associated with wind turbine noise assessment, indicating which topic would require updating.

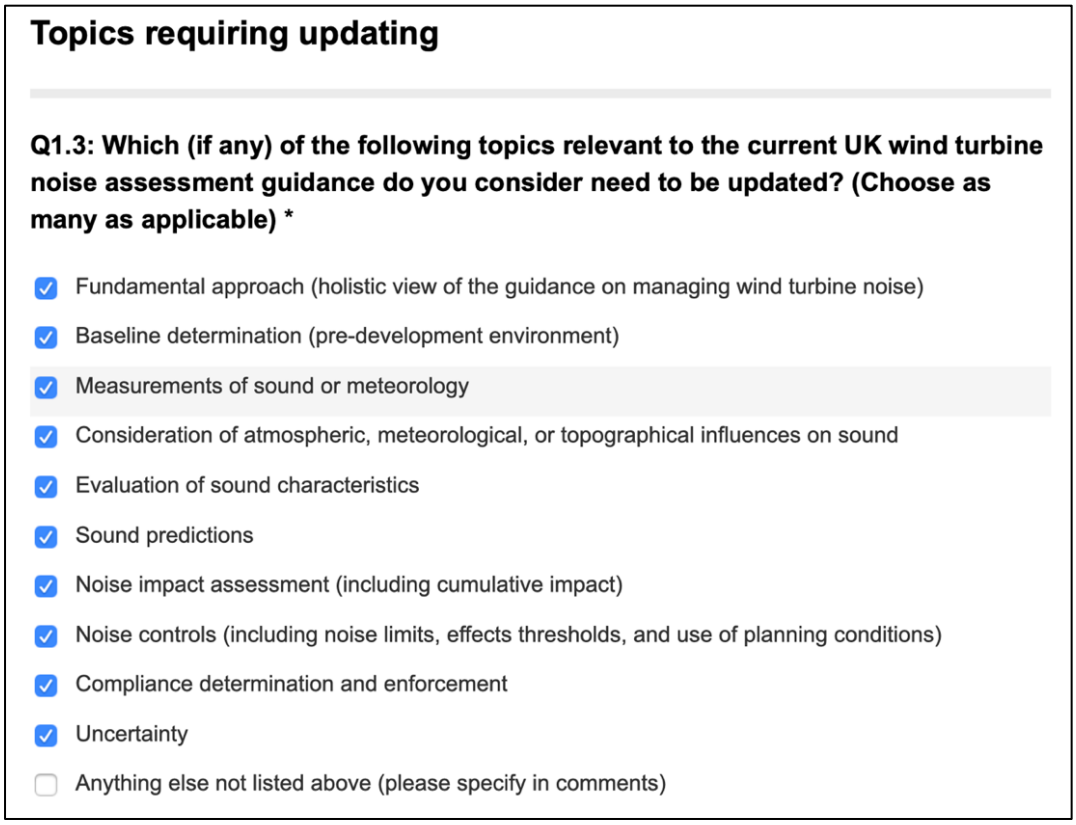


Figure 4. Screen shot of the survey webpage—Topics Requiring Updating[2].

40. The following screen in the survey lists these same topics and invites the participant to outline the updates believed to be required.

> **Q1.4: Please could you briefly outline the updates you believe need to be made to the current UK wind turbine noise assessment guidance, and identify any publicly accessible evidence you are aware of that would support or inform the updates indicated? (Please enter your responses under headings from the topics listed below that are most closely applicable to your suggestion)**

41. Lastly, specific questions are posed, as shown below:

> **Q2.1: Do you have any specific experience or research knowledge of the potential influence of wind farm or wind turbine design or age on sound emissions? ***

> **Q3.1: Please could you identify any publicly accessible evidence you are aware of that could be relevant to the development of any future UK wind turbine noise assessment guidance and is not already mentioned in your previous responses?**

Q3.2: Please could you briefly outline any suggestions you have for how any future UK wind turbine noise assessment guidance could be developed and maintained to provide a stable platform for development planning and assessment, while ensuring that it is kept up to date with robust scientific evidence?

H. EXCLUSION OF INFRASOUND & LOW FREQUENCY NOISE

42. IARO represents a group of scientists who, collectively, hold over 100 years of scientific experience in the field of infrasound and low frequency noise, and its effects of human health. Since 2016, our researchers have been recording and analysing acoustical data in and near homes located in the vicinity of onshore wind power stations, in the following countries (alphabetical): Australia, Canada, Denmark, England, France, Germany, Ireland, New Zealand, Northern Ireland, Portugal, Scotland, Slovenia, and The Netherlands. Prior to 2016, all IARO scientists were already working either in acoustics alone or in acoustics and health.

43. All research conducted by IARO is part of the Citizen Science Initiative for Acoustic Characterization of Human Environments (CSI-ACHE), the research protocols for which have been approved by the New Zealand Ethics Committee (application number NZEC19_12).

44. In a nutshell, IARO provides citizens with continuous (weeks), high-resolution infrasound and low frequency noise recordings, during which time citizens log their symptoms in a diary.

45. Diaries are then time-matched with the recorded acoustic environment.

46. This methodology has been allowing IARO scientists to pin-point what type of acoustical disturbances are present when citizens claim to be most impacted by wind turbine 'noise.'

47. The ultimate goal of IARO Scientists is to contribute to the establishment of dose-response relationships for infrasound and low frequency noise exposures, in both environmental and occupational settings.

48. The high-resolution methodology for recording acoustic environments as employed by IARO scientists is not prescribed by any guideline or legislative document.

49. IARO's methodology is, however, in compliance with the axioms of The Scientific Method and Evidence-based Medicine.

50. And now, some of those technical complexities arise.

Table 1 compares three major noise assessment parameters that clearly distinguish the methodology prescribed by ETSU-R-97 and the scientific methodology used by IARO Scientists.

Table 1: Comparison of noise assessment parameters used by ETSU-R-97 and IARO

Parameter	ETSU-R-97	IARO
Temporal resolution	*10-minute averages*	*1-second*
Frequency resolution	*1/3rd of an octave*	*1/36th of an octave*
Frequency weighting	*A-weighting*	*Unweighted*

51. Table 1 reflects a progression that is analogous to going from the hand-held magnifying glass to the table-top microscope.

Features that were previously unseen are now revealed and can be quantified.

52. IARO scientists have always found that images can greatly aid in the understanding of more complex technical issues. Figures 5, 6 and 7 provide a visual comprehension of the complexity of acoustics. A composite image with this data is provided at the end of this Commentary.

53. Figure 5A and 5B are not visually different.

In terms of ETSU-R-97 requirements (red bars), no significant difference exists between these environments. Moreover, in both, noise levels are below 30 dBA.

And yet, on July 22 (Fig 5A) the couple slept peacefully, while on July 29 (Fig 5B), they were unable to sleep, and were compelled to take medication.

Are they hallucinating? Are they suffering from some psychosomatic pathology? Is this evidence for the existence of a nocebo effect?[8]

[8] A psychosomatic disorder in which the patient believes s/he has contracted some illness, but no organic basis for illness exists; the opposite of the "placebo effect."

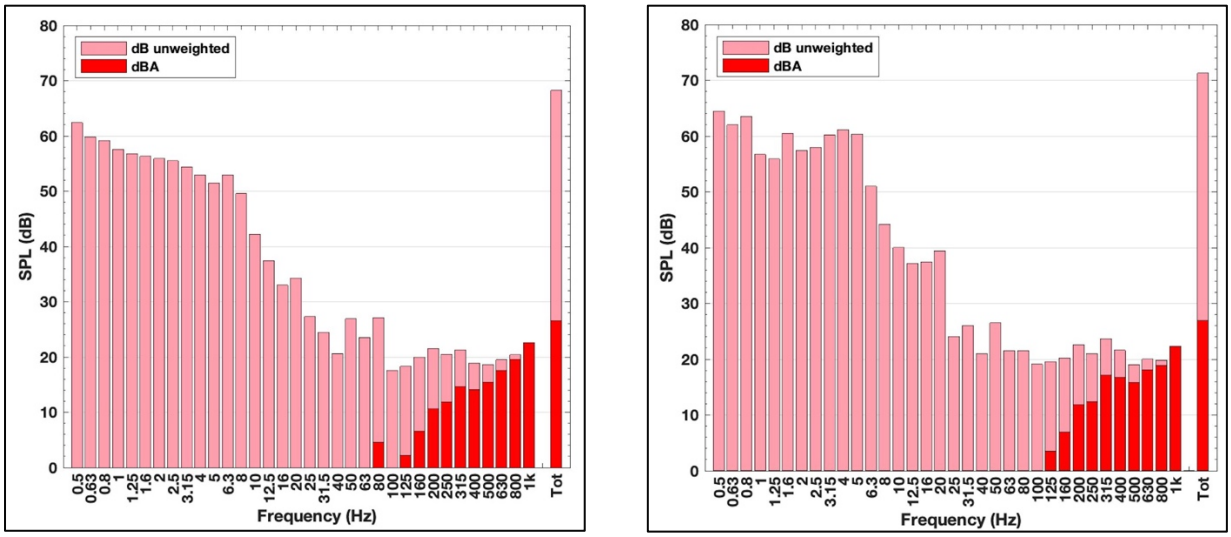


Figure 5. 1/3 octave band analyses of the acoustic environment within a bedroom of a home located near a wind power station. **A:** 22 July at 04:00, couple slept peacefully. **B:** 29 July at 03:20, couple required medication.

These images are analyses performed with a frequency resolution of 1/3rd of an octave (1/3rd octave band analysis), within the frequency range of 0.5—1000 Hz. Additionally, data is analysed over segments of 10-minute time averages.

The **red bars** reflect the 'noise' levels that are **measured under ETSU-R-97 constraints**, with the application of the A-frequency weighting filter, yielding the dBA (decibel-A) metric.

The **pink bars** reflect the 'noise' levels that are **actually present** in the bedroom, measured in unweighted (or linear) decibel units.

54. By observing the acoustic environment with methodologies that are free of the ETSU-R-97 constraints, a much different picture is obtained—one that exonerates citizens of suspicion of having developed psychosomatic disorders.

55. Figure 6 shows the exact same data as that presented in Figure 5, but with a higher resolution analysis.

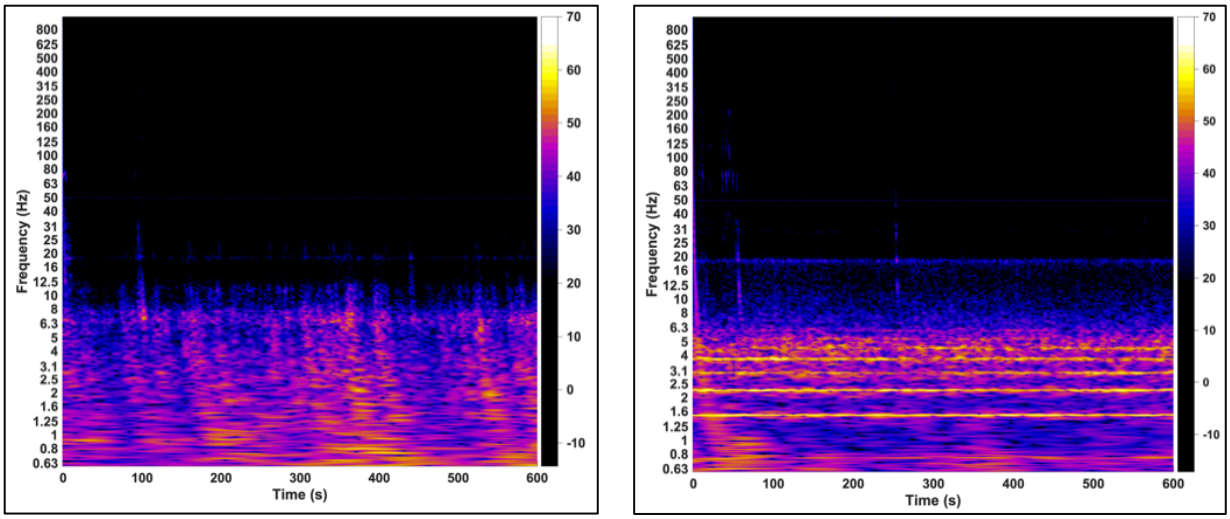


Figure 6. 1/36 octave band analyses of the acoustic environment within a bedroom of a home located near a wind power station. **A:** 22 July at 04:00, couple slept peacefully. **B:** 29 July at 03:20, couple required medication.

These images are analyses performed with a **frequency resolution of 1/36th of an octave** (instead of a 1/3rd octave band resolution), within the frequency range of 0.5—1000 Hz. The images reflect the same 10-minute segment as is shown in Figure 4, but instead of the 10-minute time average, they show a **second by second (600 seconds)** breakdown of the environment.

The colour-bar reflects the unweighted noise levels, at each 1/36th octave and at each second.

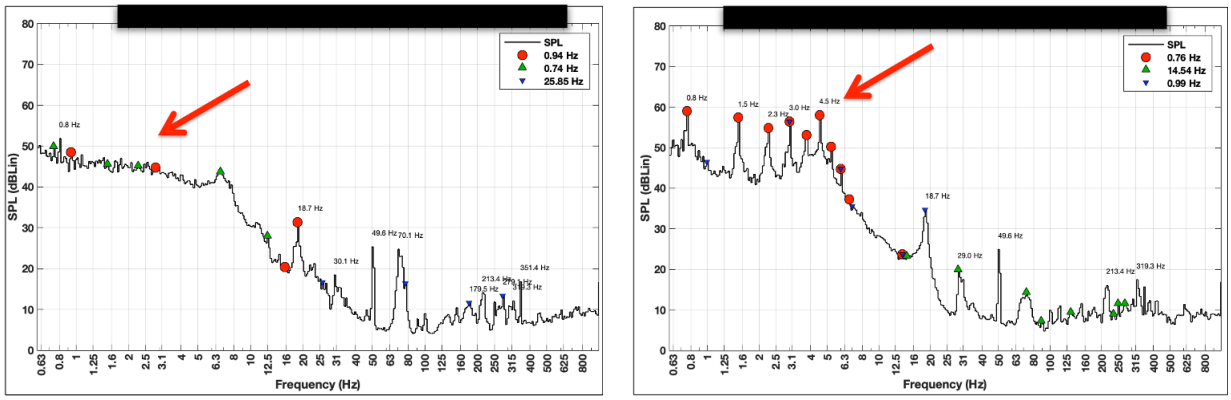
56. Figure 6B clearly exhibits straight horizontal lines, stretching throughout the 600-second interval, with levels reaching up to 60 dB, and all occurring at frequencies below 5 Hz. This was on the sleepless morning of July 29th, when medication was required.

    These acoustic phenomena are not present in Figure 6A, which was the morning of July 22nd, when couple slept peacefully.

57. These horizontal lines correspond to the acoustic output of wind turbines. They can be mathematically matched to the technical specifications of each wind turbine make and model. They are called *wind turbine acoustic signatures*.

58. Another view of the same data might be helpful. Figure 7 shows the same numerical data as that used to construct the images presented in Figures 5 and 6. These images reflect the absence of elevated peaks of acoustic energy on the morning

when the couple slept peacefully, and their presence on the sleepless morning when medication was required.



A B

Figure 7. Periodograms over a 10-minute average of the acoustic environment within a bedroom of a home located near a wind power station. **A:** 22 July at 04:00, couple slept peacefully. **B:** 29 July at 03:20, couple required medication. Arrows point to the absence (A) and presence (B) of the wind turbine acoustic signature.

59. Features that are not distinguishable with the "magnifying glass" (i.e., ETSU-R-97) become visible when using the "table-top microscope" (IARO scientific methodology).

60. By now, it should be clear to the readers of this report why IARO scientists welcomed and applauded the DBEIS initiative to consider reviewing the wind turbine noise assessment guidance.

61. Despite being outright precluded from the DBEIS Survey topics (see Fig. 2) "infrasound and low frequency noise" are inextricably associated with the acoustic output of wind turbines.

I. ETSU-R-97: A DISCLAIMER THAT VITIATES THE ENTIRE DOCUMENT

62. The 175-page document titled "The assessment & rating of noise from wind farms," known as ETSU-R-97, has an opening statement which is fully transcribed below:

> *"This report was drawn up under the direction of the Noise Working Group. While the information contained in this report is given in good faith, it is issued strictly on the basis that any person or entity relying on it does so entirely at their own risk, and without the benefit of any warranty or commitment whatsoever on the part of the individuals or organisations involved in the report as to the veracity or accuracy of any facts or statements contained in this report. The views and judgements expressed in this report are those of the authors and do not necessarily reflect those of ETSU, the Department of Trade and Industry or any of the other participating organisations."*[9]

63. It is acknowledged that a certain level of protection against liability suits may be required for a document of this nature, and hence the following statement is understandable:

> *"…it is issued strictly on the basis that any person or entity relying on it does so entirely at their own risk…"*

64. As Scientists, however, the second part of the ETSU-R-97 opening statement is astonishing:

> *"While the information contained in this report is given in good faith, it is issued strictly (…)* ***without the benefit of any warranty or commitment whatsoever*** *(…)* ***as to the veracity or accuracy of any facts or statements contained in this report*** *" (our bold).*

65. What an extraordinary statement! It is very difficult for Scientists to read this statement and simply proceed with validating the remainder of the report.

66. Lest the readers of this Commentary be misguided into thinking that this type of wording is some sort of standard practice, IARO scientists would like to make the following very clear:

[9] ETSU-R-97, Page 0

To the best of their knowledge to date, the IARO scientists that are signatories to this Scientific Commentary, stand behind the veracity and accuracy of all statements contained in this document.

67. It is shocking that a policy-decision document which has served as the core document for wind turbine noise assessments, with direct implications on Public Health, and where scientific evidence is of critical importance, is absent of any accountability or responsibility.

J. ETSU-R-97 IS UNRELATED TO PUBLIC HEALTH PROTECTION

68. It might now be interesting to list the people and entities who knowingly co-signed a document of (self-acknowledged) questionable veracity and dubious accuracy[10]:

Members of the Noise Working Group:

Mr R Meir, Chairman	DTI
Dr M L Legerton, Secretary	ETSU
Dr M B Anderson	Renewable Energy Systems
Mr B Berry	National Physical Laboratory
Dr A Bullmore	Hoare Lea and Partners
Mr M Hayes	The Hayes McKenzie Partnership
Mr M Jiggins	Carrick District Council
Mr E Leeming	The Natural Power Company Ltd
Dr P Musgrove	National Wind Power Ltd
Mr D J Spode	North Cornwall District Council
Mr H A Thomas	Isle of Anglesey County Council
Ms E Tomalin	EcoGen Ltd
Mr M Trinick	Bond Pearce Solicitors
Dr J Warren	National Wind Power Ltd

[10] Two of the commercial enterprises represented in this Working Group are still closely involved in current wind turbine planning procedures (see Paragraph 3b and 3c).

69. *Questions*: Who represented the medical community?

If no medical expertise was relied upon, how is it that ETSU-R-97 has become the forefront document presumably contributing to the protection of Public Health, as far as wind turbine noise is concerned?

70. The answers to these questions become obvious in the first paragraph of the Executive Statement, transcribed below (our bold and italics):

> *"This document describes a framework for the measurement of wind farm noise and gives indicative noise levels thought* ***to offer a reasonable degree of protection*** *to wind farm neighbours,* ***without placing unreasonable restrictions on wind farm development or adding unduly to the costs and administrative burdens on wind farm developers*** *or local authorities. The suggested noise limits and their reasonableness have been* ***evaluated with regard to regulating the development of wind energy in the public interest.*** *They have been presented in a manner that* ***makes them a suitable basis for noise-related planning conditions or covenants within an agreement between a developer of a wind farm and the local authority****" (Executive Summary, page iii).*

71. ETSU-R-97 seems to be (yet another) example where an industrial sector is directly involved in the preparation of governmental 'guidelines' that shape policy-decisions and that minimize or outright ignore potentially harmful emissions generated by that particular industrial sector.

K. "WHAT YOU CAN'T HEAR CAN'T HURT YOU"

72. This is the outdated notion on which ETSU-R-97 is based: "what you can't hear can't hurt you."

73. It is this same outdated notion that explains why infrasound and low frequency noise is conspicuously excluded from the DBEIS Scoping Review.

74. Since infrasound is inaudible at the levels generated by wind turbines, it is considered by some to be irrelevant to human health.

75. In fact, those who 'complain about wind turbine noise' when levels are below the ETSU-R-97 mandated levels, are often ridiculed and labelled as suffering from the 'nocebo effect.' [8]

76. This outdated notion justifies the use of the A-frequency-weighting (yielding the dBA unit) (See Table 1).

77. It is also used to justify the claim that wind turbine acoustic signatures have no effect on health as they occur below the human hearing threshold.

L. CLOSING PERPLEXITIES

78. If the medical community was not represented in the preparation and publication of ETSU-R-97, how can the UK Government allow ETSU-R-97 be used to establish public policy with direct implications on Public Health?

79. What was the purpose of the DBEIS Scoping Survey, considering that a critical part of the problem was specifically excluded from discussion, namely, infrasound and low frequency noise?

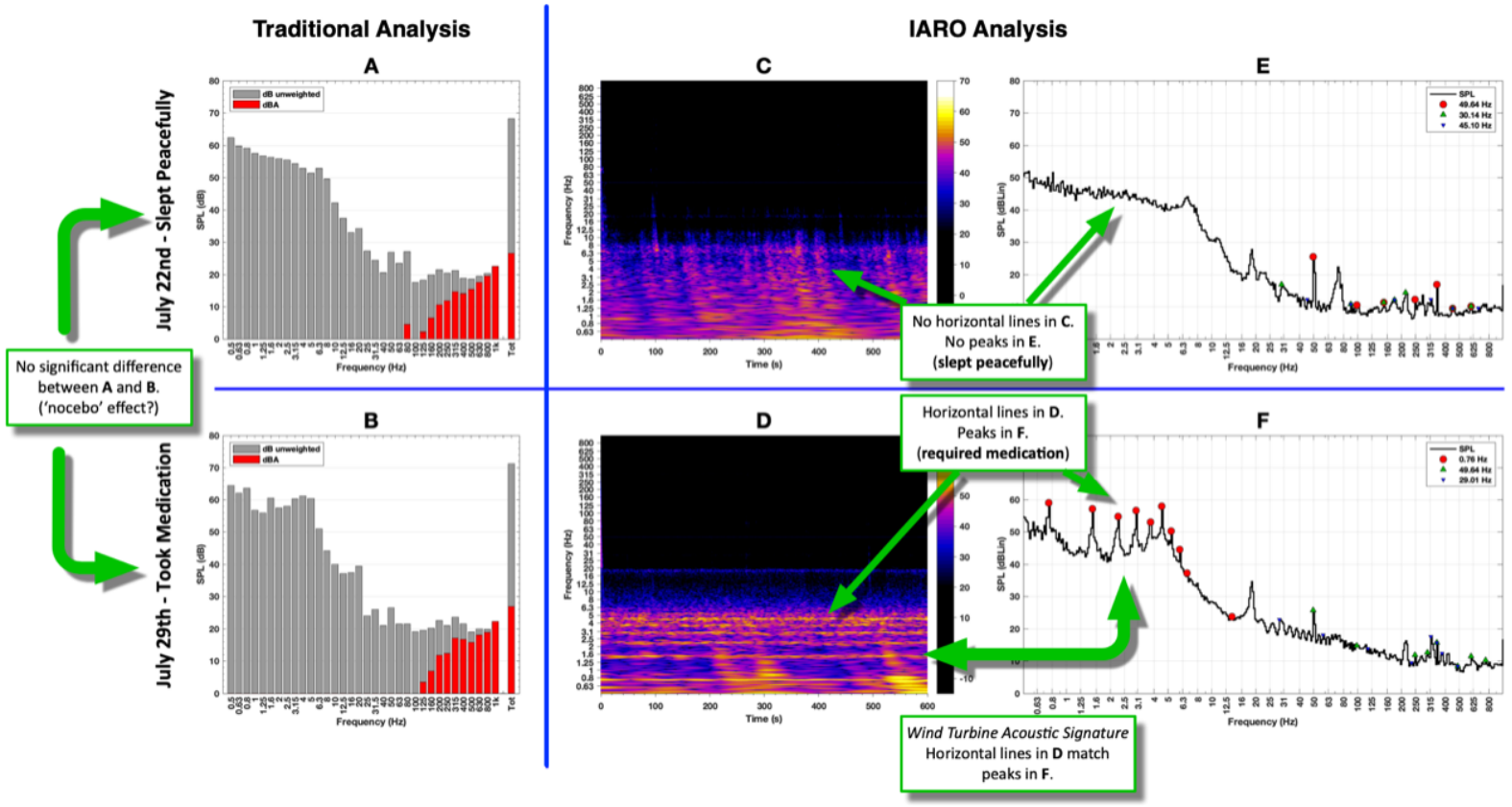
80. If offshore wind power plants are the focus (almost exclusively) of the currently imposed "2050 Net Zero target," why is the "2050 Net Zero target" being used by DBEIS to justify onshore wind turbine development?

81. If the "2050 Net Zero target" is of such paramount importance, why were offshore wind power plants specifically not included in the DBEIS survey? Both onshore and offshore wind turbines have the same type of acoustic signatures.

82. If the veracity and accuracy of *any* statement contained in ETSU-R-97 is questionable, as is self-acknowledged, how can it conscientiously be used to establish public policy?

83. Why does the UK Government, through DBEIS, rely on ETSU-R-97 for protecting the UK population against wind turbine noise?

84. These and several other critical issues, relevant for the well-being of the UK population, could have been opened for discussion with the DBEIS Scoping Survey. Regrettably, they were not.



Composite Figure—Please see full legend on next page

Legend for the Composite Figure:

Comparison between the acoustic environments (10-minute recordings) in a bedroom of a home located close to wind power plants. On 22 July (at 04:00), the couple slept peacefully (A, C, E). On 29 July (at 03:20), medication was taken at 04:00 to 'deal with the noise' (B, D, F).

A and B

- Acoustic analysis using a 1/3rd octave resolution.
- Red bars indicate sound pressure levels in dBA, as required by ETSU-R-97.
- Overall noise levels are below 30 dBA and therefore, well within the ETSU-R-97 guideline.
- Grey bars indicate the sound pressure levels actually existent in the environment.
- No visual difference between A and B.

C and D

- Acoustic analysis using a 1/36th octave resolution.
- Straight horizontal lines are present in D—29 July, sleepless night
- No horizontal lines in C—22 July, slept peacefully
- Evident visual difference between C and D.

E and F

- Periodograms showing peak level.
- No peaks on July 22—slept peacefully.
- Prominent peaks on July 29—sleepless night requiring medication.

Takeaway message:

ETSU-R-97 requirements are insufficient to predict human health effects and are irrelevant for protecting Public Health against wind turbine noise immissions.

December 2021